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Modern office design in the "information age"

Garrett Guess, DDS[a,b,*]

[a]*Private Practice, 8929 University Center Lane, Suite 209, San Diego, CA 92122, USA*
[b]*Department of Endodontics, University of Pennsylvania School of Dental Medicine, 240 South 40th Street, Philadelphia, PA 19104-6030, USA*

The modern dental office in the "information age" of today bears little resemblance to the offices built 20 or even 10 years ago. The focus of providing superior and effective patient care remains the same, but the method of delivery and presentation has changed thanks to improvements in technology on many fronts. Most influential in this change has been the widespread use of computers and computerized peripherals in providing dental treatment and educating patients about the treatment they are to receive. The information age, which represents the use of computers to share and maintain information, has had many influences in the field of dentistry, especially in endodontics. These influences have begun to change the daily practice of dentistry by affecting the standard of care and, most apparent, the overall design of the modern dental office to allow the use of and to take advantage of these technologic changes. Like putting the pieces of a complex puzzle together, this article reviews the process of reaching the goal of modernizing a new or existing endodontic office.

Most of the advancements in the modern endodontic office revolve around the use of computers that act as "hub" between the various components. It is not rare to find a modern endodontic practice using computers to capture digital video and still images of treatment, to take and store digital radiographic images, and to chart the patient's treatment information. Computers in the dental practice are not a new occurrence. For many years, computers have been used to schedule patients, store patient information, do billing, and in more advanced cases, perform comprehensive charting. By using a computer system to manage the information used by the practice, greater efficiency is achieved on many levels. The most important advances in

* Private Practice, 8929 University Center Lane, Suite 209, San Diego, CA 92122.
E-mail address: guessendo@mac.com

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the dental office come with the software that manages all of the vital information used in the practice. Computer programs that maintain patient information, digital radiographs, and scheduling information are forms of databases. Databases allow the storage of all types of digital information that can be retrieved and stored with minimal cost and maximal efficiency. Instead of using wall space in an office to store paper charts, a computer system uses hard drive space in a computer to digitally store a patient's information. Given this design, a computer system allows instantaneous access of information, whether it is looking up when a patient is scheduled or retrieving their chart and associated radiographs. The gain in efficiency easily can be seen on many levels. Eventually, the days of searching through reams of patient charts will be gone because the computer programs allow searching the office database with instantaneous and accurate results.

The key to a modern endodontic practice's organization and efficient operation revolves around the stability of the computers that run practice management software programs and other peripherals. The computer hardware available today has the speed, flexibility, and capability to perform just about any needed task in the dental office. Whether it ranges from creating documents, storing patient data in a practice management program, or manipulating digital video and images, the hardware available to the private practice endodontist or dentist is affordable and capable. Therefore, choosing the appropriate hardware comes down to esthetics, cost, performance, and compatibility with peripherals and practice management software. Some computer systems use more intuitive operating system software and have greater stability (eg, the Apple Macintosh systems), which translates to less cost of maintenance and less downtime. If one's knowledge is minimal regarding computers and their related systems, seeking the advice from a computer consultant is invaluable. A consultant can plan the requirements within a certain budget to get the job done. The choice of hardware is an important one: it can mean the difference between a transition full of ease/success and a constant headache. The specific hardware requirements will be dictated by the practice management software program, the digital radiographic system, and the peripheral video equipment used. Because the software program ties in all of these technologies, it is one of the best places to start looking when deciding what is needed to upgrade to a modern office (Fig. 1).

Choosing a software program to manage the office could be one of the most important decisions to make when considering the transition to a computerized office. So many functions of the practice hinge on this choice and there are a lot of offerings available. Considering how important the tasks are that the program manages, it is clear why this decision has to be made wisely. In an office where everything is stored in the computer, the entire office is dependent on the computer program, the hardware on which it runs, and the network that connects it all together. If the program is inefficient or incapable, then the dentistry practice will likewise be inefficient

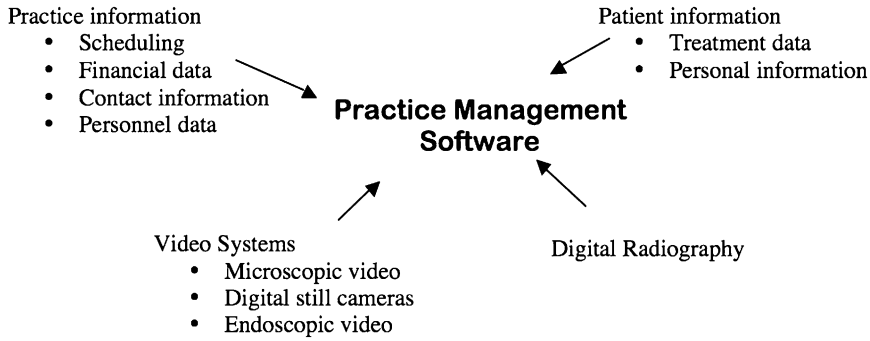

Fig. 1. Practice management software is the hub connecting and managing all other technologies utilized in the endodontic practice.

or incapable. Therefore, the choice of stable hardware on which to run the software is important, as is the setup of the system to ensure that it is trouble-free. The various practice management software packages available perform the same overall function, but different programs do it in very different fashions. Some systems are designed by practicing dentists, whereas others are made by consultants and computer programmers; certain programs are designed for specialty practices, whereas others are made for a dental office in general; and some systems have severe limitations when it comes to expansion or upgrading—all of these factors are important to consider. As an endodontist, a program designed specifically for the endodontist often will be a wiser choice over one for dentists in general. The flow of treatment planning, referral management, and other issues will be better suited to the daily routines and management of a specialty practice. There are dozens of computing solutions to manage the dental practice, and all may work well for an endodontic office. There are currently four "endodontics-only" software packages: three are available for Windows-based computer systems and one for Macintosh-based computer systems. The Windows solutions are PBS Endo (PBS, Texas), EndoVision (Discus Dental, Inc., Culver City, California), and TDO (DogBreath Software, San Diego, California). The Macintosh system is called EndoTrak (Digital Database Systems, San Diego, California) and was developed by the author. These systems all focus on the specific needs of the endodontist in their own ways and have specific pluses and minuses that need to be evaluated by the prospective dentist when choosing between them. Each of these systems provides comprehensive charting, referral, and practice management, which are important in an endodontic practice.

Because the financial and time investment is large when purchasing programs and training personnel to use them, the longevity of the system is important. Considerations with regard to expansion and compatibility are also crucial. The abilities of a software program to efficiently incorporate different peripherals such as video input from a microscope or a digital still

camera and to link with a digital radiography program are essential. The only way to get accurate information to make an informed decision is to talk to users of different software programs, listen to their experiences, and visit their offices. It is even more helpful to test the programs using a demonstration copy because often it is difficult to get the full sense of a program when a salesman is present. Time is needed to get a feel for the "thought process" that a particular computer program uses. This thought process is the manner in which information is entered, changed, searched for, and stored. Some programs can be intuitive and simple, whereas others may be very complex and do not interact in a predictable or commonsense manner. These important attributes of a computer program can only be noticed when enough time is spent using and understanding the system through either a demonstration or training session. In this way, a clear decision can be made as to the best system for the specific application. All dental practices are different; an office may not want to start immediately with digital charting but want that capability in the future. The software will need to be able to support this upgrade, so thinking ahead when reviewing the current and planned features is important.

Because the computer program ties together the pieces of technology in the office, the choice of the software program should follow exactly the technology goal of the practice. If digital charting is desired, then the program will have to have the capability to be networked to allow access to patient information from different locations in the office. For example, the front desk will work with and maintain the patient information while the back office will work with that patient's chart for the day. The front desk needs to know the treatment performed to properly collect the fees. Having the infrastructure present to support these capabilities is a prerequisite. The infrastructure includes the wires, power outlets, and other equipment needed to perform certain functions. To have computers in the operatories linked to share patient information, a computer network has to be present. Today, there are different types of networks available: wired and wireless. A wired network is the preferred method (which involves wires to be run to each location where a computer is present) because it is the most robust method of interconnecting computers. Wireless systems have tremendous flexibility in environments where wires cannot be placed due to feasibility or economics. The current wireless systems do not have the speed capabilities of the standard wires and are susceptible to interference issues, which make them unacceptable in most dental practice settings. Therefore, planning is required and a contractor needs to be employed run the wires to all needed locations throughout the office. It always is smart to plan ahead for expansion by running extra wires that may be used in the future.

Computers have changed the landscape of digital imaging and its ease of use in many environments including dentistry. Endodontics is one field that has taken advantage of this technology—the ability to document treatment with digital still and video imaging. Endodontists often will want to take

pictures with the operating microscope, and this capability should be considered as part of the requirements of the imaging system. The majority of microscope manufacturers have the ability to output a video signal from an optional camera mounted within the microscope. Capturing images can easily be done using computers that can import digital video through a capture card or similar device that converts the analog video signal from the scope into a digital signal that the computer can use. Recording and presenting this media to patients and referrals is an impressive method of education and relaying information about treatment plans and outcomes. It allows a patient or referral to see exactly what is being treated. To perform this function, the proper wiring that links the microscope and the computer needs to be present. This connectivity allows a computer program to import and store video and still images that are seen through the operating microscope camera. These images can be added to a patient's chart or put in a report to share with referrals. Documentation using images is invaluable with respect to certain liability and consent issues.

When viewing video images and patient charting in the operatories, it is beneficial to have several displays that show the output from the computer. Especially with digital radiography systems, having a display behind the patient allows for the viewing of radiographic images in the manner similar to viewing conventional film with respect to the tooth location (Fig. 2).

Also, a monitor for the assistant to view during treatment is helpful to allow data entry into the chart as treatment is occurring. For example, one computer screen with which the assistant can interact can show the chart for data entry during treatment and is placed at the 12 o'clock position in the operatory, whereas another screen can display the working radiographs for the doctor to reference on the doctor's side of the operatory (Fig. 3). The exact placement of the multiple monitors is determined by each dentist's preference. Flat-paneled monitors take up little wall space and are simple to wall-mount, so it is possible to place these screens in different locations with ease. The infrastructure requirements of this capability will not only require the power and video cables to be present in the walls but the computer hardware and software also must support the function of multiple displays or video mirroring. It is clear that as more functions are added, demand for a more complex infrastructure arises. Planning the current and future wiring needs should be closely evaluated before construction or remodeling begins to account for all possible configurations that may be tried now and in the future.

Computer systems have evolved tremendously over the last 5 years. The evolution has been spurred by the changes and new technologies incorporated in the computer systems themselves. With tighter integration of many software components, computers have been able to tackle just about every task presented in a tight-knit fashion. Where Hi-8 8-mm video tape decks were used to record surgical procedures, a computer can now record the video with digital quality that can be edited into educational and informative media with many uses. Still imaging is handled by computers in the same way.

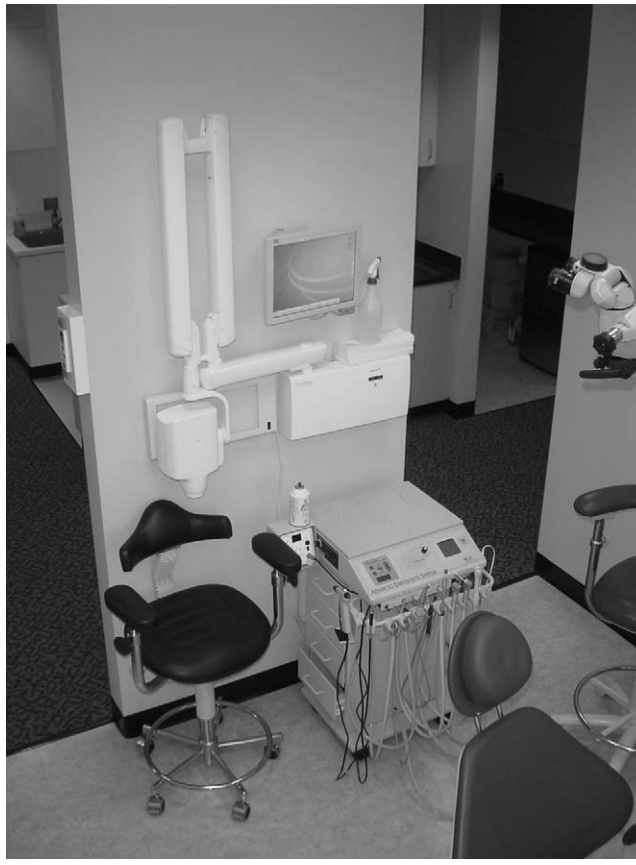

Fig. 2. Computer monitor placement on the wall behind the patient for flexible computer viewing and input by the staff and/or doctor.

Instead of a photographic film-based camera system, digital images can be stored and sorted for each patient with little turnaround. These images can be transferred to a digital chart of the patient and stored for later viewing or sent to referrals or benefit providers.

As the complexity of the technologies and their related systems increases in the dental office, so does the requirement of an increased knowledge base for those who use the equipment. The doctor and staff must understand and be fully capable of using the new technologies to their fullest extent to make the transition worthwhile and less disruptive. The best and most capable software program linked to a high-quality video recording system is a waste of time and money if it is not used efficiently. Unfortunately, learning new technologies can be very difficult, especially for those who are unaccustomed to computers and their usage. Usually, the largest hurdle to overcome is learning the software program that manages the office. Some of these

Fig. 3. Doctor and staff working shown with an operating microscope and integrated video camera, displaying the video through a chairside computer station.

programs have such a large number of features that it is a challenge to master them all. The other equipment such as the setup of the servers and the network can be left to contracted consultants. Most companies offer training manuals, videos, and training sessions to familiarize the office with their programs. When hiring personnel in the modern dental office, it is important to research the training and experience of potential employees because training is a difficult and long process when starting at ground zero.

One of the most substantial changes in a modern dental office is the ''movement'' of computers from the front office to the operatory where patients are treated. With the addition of computer workstations in the office, a networking infrastructure is used to share information among the computers in the office (Fig. 4). Taken one step further, computer systems in separate office locations can be linked for a reasonable cost by means of the Internet. Dental offices have approached enterprise-level complexity in the use of computer systems and the networks that link them together. This complexity can be achieved thanks to significant advances in the hardware and software that allow these capabilities. Such complexity would have required a full-time staff of trained network experts just 10 or 15 years ago, but not today. A networked dental office can share all parts of patient information between the front office and operatories and remotely between separate offices in different locations. No longer is information in an irretrievable, inefficient storage state—the written patient chart. Computer software systems that manage the dental practice allow the archiving and storing of countless numbers of patients. All information stored within these records can be sorted and sifted through instantaneously. The efficiency of this arrangement over an older written patient chart is incredible. With

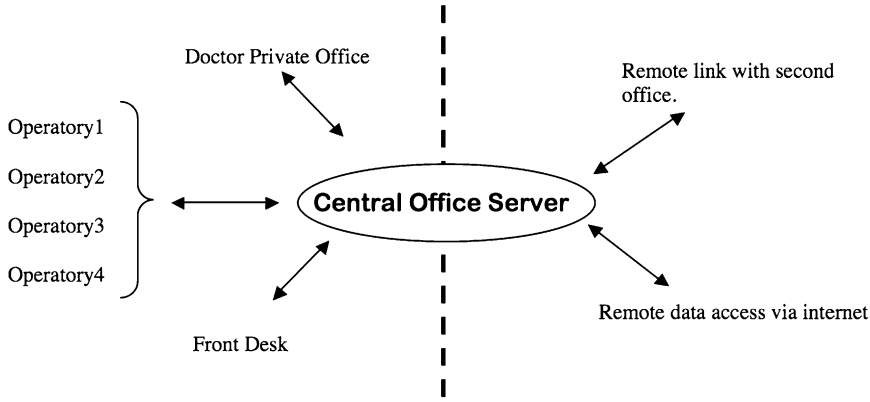

Fig. 4. Network connections between computers in the same office, and between offices to permit the sharing of patient and practice data.

increased power and capability of computer hardware, networking, and software systems, this efficiency continues to increase. A complex network of computers managing a dental practice has been facilitated by the increased capabilities and utility of today's computer and software systems.

Of the technical aspects of the modern office, one of the greater advancements of the information age is the increased networking ability of computer systems today. A computer network is no longer something limited to large businesses with large technology budgets. It is common now to come across a dental office with a computer network as advanced as any large business or enterprise, which is possible through advancements in technology in the hardware and software of today's systems that makes having a network a simple process. In addition, the workforce has a greater number of consultants familiar with networking, so the cost of installation and maintenance has decreased significantly over the past 10 years. The Internet has made communication among colleagues a facilitated process, especially with regard to sharing digital media about patient treatment (eg, radiographs, images, and videos). This facilitated sharing allows colleagues to confer and share their ideas and experiences in great detail, irrespective of their office proximity. This permits general practitioners and specialists to work together in a much more efficient and exacting manner. In endodontics, the postoperative reports and radiographic images of patients can be electronically mailed to referrals directly using many of the computer programs available today, thus allowing for more efficient follow up turnaround. Even patient insurance benefit inquiries and claims submissions can be quickly and accurately handled by communicating over the Internet. The increased ability to share information is making communication among colleagues faster and more effective by providing better information in the form of images and even video of treatment performed.

A new type of practice management software system is designed to take advantage of the networking capabilities of the Internet. Instead of the usual in-office computer server, the server with all of the office's information is located off-site and managed by an outside company. Therefore, to access treatment information for the patients in the office, the server is accessed over the Internet using a Web browser instead of proprietary software like most practice management software programs. This system has the advantages of data portability and security because data are on a secured server that is frequently backed up in case a problem occurs. Through this kind of setup, patient charts and information can be accessed anywhere that access to the Internet is available. This method is less popular but likely to be the "wave of the future" as Internet reliability and security increases.

Clinical research capabilities have been strengthened by the use of computerized charting systems in dentistry. Storage of clinical treatment information in a digital form allows practice management software programs to perform searches that allow a clinician to track success and failure with regard to many different variables. This type of information allows a private practice clinician to have an evidence-based practice using data from his or her own practicing techniques. This information is invaluable because some procedures work well in some doctor's hands, whereas others do not, and with an efficient method to track and study this information, significant findings can be obtained. With the lack of published clinical research data from private practice practitioners, this powerful feature of increased technology has exciting potential.

A computer system in the treatment operatory allows many aspects of treatment presentation, documentation, and education to be changed. Digital radiography has become a diagnostic tool that many dental offices are taking advantage of for many different reasons. The ability to expose a sensor to radiation and have the image appear in less than 10 seconds on a computer screen is a proven utility (Fig. 5). It is clearly more efficient than chemical processing, does not require a significant time lag in the development process, and does not require maintenance of the processing equipment. Direct digital x-ray sensors are most helpful in endodontics by providing the ability to expose the sensor multiple times without removing it entirely from the mouth. This allows subtle repositioning of the x-ray cone to get various angled images with greater accuracy and less retakes. For example, if a midoperative working radiograph is taken and one root is superimposed on another, then the x-ray cone can be moved slightly in one lateral direction and the sensor re-exposed. With a standard film, when an incorrect angle results, another film needs to be taken and there is a chance that the same image may be taken again or another improper angle may result because the entire film assembly is removed and then replaced. By not having to move the sensor in the patient's mouth, more accurate changes in angulation can be performed. This feature enhances the midoperative diagnostic accuracy of the practitioner, especially in multirooted teeth

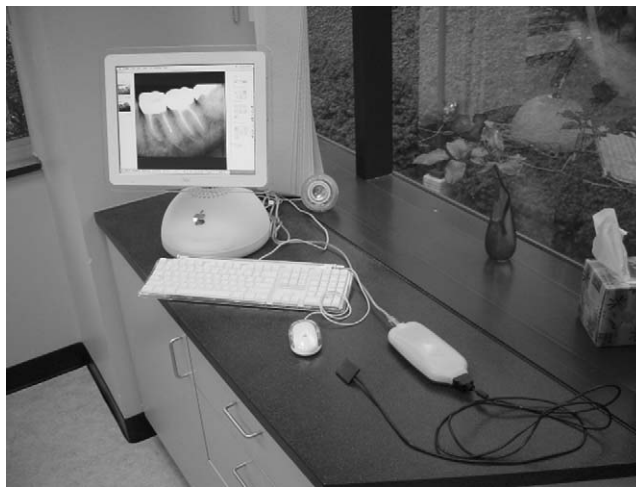

Fig. 5. Digital xray system: wired sensor connected to a USB interface with the computer. The exposed sensor produces an image on the computer display for viewing and manipulation.

because each root end can then be visualized over a series of angled digital radiographic images before progressing. From a waste and materials-usage standpoint, there are no chemicals to maintain or change, so digital radiography has no "per-use" cost other than the storage space on the computer that the digital image file requires. Also, with most systems using newer image compression routines, the file sizes are extremely small relative to the storage available. Digital radiography also has several staff, doctor, and patient health benefits because the radiation dose exposure is significantly decreased. Compared with the fastest E-speed film that may require a 20-millisecond exposure at 70kVp, the same quality image can be obtained with a digital radiographic system using just 3 milliseconds of exposure time with the same 70kVp, which is close to a seven-times decrease in radiation exposure to the patient. Digital radiography allows the doctor to more easily view the image and greatly facilitates educating the patient because it allows a large screen-sized image to be viewed on the monitor. The resolution of the current digital radiographic systems is very good, greater than most computer screens can display. The image quality is mostly determined, therefore, by the type of monitor or flat panel that is used because all systems have similar high-quality sensors and resolution capability. For this reason, high-quality computer displays are an important investment when considering the purchase of computer equipment for the modern dental office.

The benefits of digital radiographic systems are clear, but it is the high cost of the system that keeps most offices from making the change. In addition, digital radiography must be used with a computer that controls the radiographic system, so a computer is required in each operatory. To get

around the expense of equipping an entire office with a network and computers in the operatories, some practices use a laptop that is carried between operatories or a computer that is on a wheeled cart that can move from one operatory to another. There are many ways to do this, all of which still incur significant cost. Systems today range in price from $6,000 to $14,000 per operatory, which does not include the computers that run the software and manage the sensors. As mentioned earlier, the resolution of all systems is comparable, but the differences in software, sensor size, service, warranty, and especially price are what distinguish systems from each other. Choosing a digital radiographic system is similar to picking practice management software; it is advisable to try different systems to see which one works for the particular tastes of the office. To aid in the decision, some digital radiographic systems work best or even exclusively with certain practice management programs. There are approximately 20 digital radiographic sensor systems available today, with most of them being Windows-based and 4 being available for the Macintosh-based computer systems. When choosing a digital radiographic system to use on its own, practitioners should get one that has the potential to work with the practice management solution they are most likely to purchase. If a Macintosh-based practice management software system is preferential, then a Macintosh-based digital radiographic system is necessary so that new computers will not be needed when the transition is made. The best way to sample all systems at once is usually at dental trade shows where one can go from booth to booth to see each system and have the competition freshly in mind. As always, it is advisable to ask colleagues in the field about what works well for them; these unbiased opinions are the most valuable ones obtainable.

The need is clear to incorporate computer-based technologies in the office, and getting there requires significant planning. The best way to plan any endeavor is to map out a technology goal. A technology goal consists of looking at the current state of the practice at three levels: budget, knowledge base, and infrastructure. A sound budget is important because the incorporation of technology costs significant time and money. Time is needed to train staff on new systems that are introduced and time is required for the days that the office is not open when the infrastructure is being constructed. It takes significant amounts of money to purchase the expensive equipment required: computer hardware, software, and peripherals. All of this combined can be one of the largest purchases made by a dental practice during its construction. Current computer systems cost about $1200 for each unit, whereas a server computer to host the computer program can cost four times that amount. Peripherals such as digital radiography incur a large expense, but this technology is well worth the money, especially in endodontics for the reasons mentioned earlier. Almost all microscope companies provide the option of an integrated video camera, which is invaluable when explaining treatment to patients. This option adds a significant cost (in the range of several thousand dollars) to the

already-expensive operating microscope. Digital still cameras also can be mounted to the operating microscope to take high-quality still images. The cost of the adapters and camera is similar to an integrated video camera system, and is often more bulky and less aesthetic that the integrated unit. The added weight of the still camera and attachments on the scope head is another drawback to this type of digital imaging solution, sometimes making the scope less maneuverable. When images are obtained—producing printed media for the digital radiographs, postoperative reports, or images—there are many economical printing solutions that can be used. There are many high-quality, inexpensive ink-jet printers available that provide excellent output that can be given to patients or sent to referrals or insurance providers.

For better or for worse, the technologies driven by computers and their capabilities are a necessity in the successful and efficient dental practice. Can a practice thrive without the use of computers and their related peripherals? It certainly can, as thousands of successful dentists have proved over time. Times are definitely changing, however. Patients are more aware than ever before of the technologies that are available to dentists. They are learning more and are becoming more accustomed to seeing technology in all parts of their own lives and are expecting dental offices to follow suit. In fact, competition among dentists and especially specialists has become increasingly greater in many urban and suburban locations, making the acquisition of technology not only a benefit from a patient treatment standpoint but also an effective and necessary marketing tool. It makes a greater impact on a patient to see a video of a procedure as seen through a microscope or to see the digital radiograph of their tooth on the computer screen than it does to be told information that they may not understand. Through "high-impact" patient education using the tools available today and in the future, patients can be impressed and educated by the treatment they receive. It makes a much greater impact on a patient to be able to see their own tooth and the conditions it may have versus a drawing or generic photograph. In addition, patients are increasingly using the Internet to research the treatment they are about to obtain and the biographical information of the dentist doing the treatment; this is where Web sites play a large role in marketing the dental practice. A Web site can set the tone of a practice and ease tensions by giving patients pictures so that they know what to expect. Many patients like to "put a face to their doctor" before coming to the office, and Web sites enable them to do this. All offices should take advantage of a Web site because it is a relatively inexpensive marketing tool that can be used effectively for introducing the practice to anxious patients.

The defining feature of a modern dental office is not the equipment alone, but its use. Greater technology and complexity requires greater education and, often, changes in the way procedures are being performed. Time is needed to research, purchase, and then learn new equipment, new software

programs, and most difficult, keep up with the changes. What is advanced today will quickly and inevitably be improved on in the near future. By making the right decisions in software type and video and radiographic systems, planning for the future is possible. By building a foundation that is prepared to handle changes in computer demands, it is hoped that the networking, wiring, and power infrastructure of the office will not require any changes for a long time. Computer hardware itself will need to be upgraded over time as the demands of software and other systems always seem to increase. The hardware needs to be able to efficiently handle more features as they are added. Fortunately, hardware development and updates tend to be far ahead of the needs of current dental software and peripheral demands.

Making the transition to the modern dental practice is expensive and time-consuming but also profitable and exciting. There is so much to learn in this process and so much to keep up with because the technology changes rapidly. Soon, all dental offices will be using digital radiographic systems, video systems, and patient charting programs that use no paper documentation. These features make up the modern dental office of today and of tomorrow. Going 100% paperless is not the best solution for all practices, but the time is getting closer where this is increasingly becoming a reality and an expectation of patients. As computer familiarity and the staff knowledge base increases with the growing use of computers in society overall, finding the office personnel able to harness the efficiency and power of the technology in the dental office will be easier, making this transition a smooth one. Through careful planning and formation of a reasonable technology goal, updating an old office or creating a new modern endodontic practice with the technologies of today can be an enjoyable reality from which practitioners and their patients can benefit.