An Assessment of Computer Integration in Private Practice Compared with Postdoctoral Orthodontic Programs

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To my teachers and mentors in dentistry and orthodontics. Thank you for giving me this wonderful career. JS

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1. Introduction

The introduction of problem based learning, computer simulation, and information technology have been important topics in dental school curricula across the world. Simulations in gross anatomy, physiology, histology, and clinical dentistry have been widely studied and explored. Many schools have integrated these simulations into their curricula due to their positive impact on learning. Information technology (IT) coursework has not been traditionally included in dental education at either the pre- or post-doctoral level. Additionally, few schools have integrated information technology training or programs into their curricula.

This study compares the use and integration of computer technology in clinical private practice orthodontics to postdoctoral orthodontic programs. An assessment of the attitudes, understanding, competency, and needs of the practicing orthodontist will be quantified and compared with current orthodontic programs' inclusion of computers in their curricula. This study will also assess how individuals obtain and develop their computer skills, training, and continuing education, as well as the perceived need to use computers in the delivery of clinical orthodontics.

2. Literature Review

A. The Use Of Computers In Private Healthcare Practices

Clinicians in both medical and dental fields have been slow to understand and accept the integration of information technology.[1] In an article titled "The costs of being first," Bergeron discusses the implications of this lack of understanding and training.[2] He asserts that healthcare workers often are at the mercy of what Bergeron calls "a well orchestrated ad campaign" by commercial interests. He speaks of physicians as a persistent group of problem solvers who recognize and resolve questions every day. He questions the affect these personality traits have on an area such as computer technology, which is outside their field. In other words, if doctors are, by nature problem solvers, Bergeron postulates that they may get wrapped up in solving technology problems which they are not properly trained to resolve, and that this may take away from what they do best—treat patients.

The Bergeron article provides advice to physicians on several matters related to technology. He states that the doctor should only be the first to try a product when absolutely necessary. The physician should ignore pressure from peers or sales people on early product releases. One way to effect this is to establish multiple "go and no-go" decision points and relate them to a timeline. Additionally, all product selections should be business transactions, not emotional ones. Bergeron stresses that the health care

provider place the responsibility of making the product work on the vendor. Bergeron also states that the health care provider should make it a priority to select a backup system for office records. [3]

Orthodontists may have personality traits similar to the physicians described above, which might put them in situations where they feel the need to solve information technology problems without proper educational support or background. Further, orthodontists may be at the "mercy" of technology sales people and therefore more likely to make product selections based on biased information. In fact, the issue in orthodontics may be even more problematic due to the small total number of practitioners throughout the country. Unlike other areas of software, there are only a few well supported choices for orthodontists. Orthodontists therefore must face questions regarding the long term product support and survivability of their computer technology. This may force them to choose between the best product, the product most likely to survive in the marketplace, or the product that remains compatible with an existing investment. While bigger is not always better, there are advantages to larger software companies in that they have more manpower to offer customer support; however, as larger software companies acquire smaller ones, they often discontinue the less popular product lines by dropping support and upgrades.

B. Attitudes Regarding Computer Use Among Doctors And Patients

1. Attitudes Among Heathcare Providers And The Possibility Of The Paperless Office

There is a strong correlation between age of the user and attitude toward computer use and integration.[4] Today, children are learning to utilize computers at a very young age. There is a continuum across the ages whereby young individuals have a higher degree of acceptance, understanding, and usage of computers when compared to their elders. This gradation of computer acceptance with age has a significant impact on the use of computers in healthcare. There are obviously exceptions to the rule, but the trend is that younger providers are more comfortable with the integration of information technology in the delivery of care. Likewise, younger patients may be more accepting of the technology. This trend cuts across the fields of nursing, medicine, and dentistry.

Healthcare providers who are interested in information technology and the possible utilization of computer records in their office have toyed with the idea of the paperless office for some time now. A paper by Appleby addresses the issue of paper versus paperless as it relates to physicians.[5] The concept he discusses is that of an internet based system for storing patient records. The idea is that navigation around patient records would be as simple as moving around a web page. While this technology currently exists, he notes that the physicians may not be ready to make the change. He states that "physicians like to have a paper copy of the chart[s], and [that] when information is in other formats than they're already used to using—it's hard to get

people to change." Appleby sites the common perception that computer use decreases individual productivity. Despite these concerns, he believes that remote access to records will be internet based and that the internet will become the "central artery" for doctors who want clinical information while at home or another remote location.

Another opinion on the paperless office is offered by Arvary.[6] The emphasis of his article is on the use of the digitizing pen, referred to as "digital ink", to input information into the computer. Like the encounter form, the "digital ink" limits the time the healthcare worker is "face to monitor" and keeps the doctor-patient encounter more traditional. In keeping with the theme of many of the articles cited in this paper, Avary notes the difficulty physicians have making change. The significance of the digital ink concept deals with the idea that health care providers are less likely to embrace a change if it is perceived to be more difficult than existing methodology. If doctors are used to writing with a pen and paper, perhaps some of them will feel that a stylus and PDA feels more like what they're used to and will be more likely to embrace the change. In addition to perceived difficulty of use, some providers feel that the computer can make the doctor-patient encounter less personal. This issue too can be a roadblock to digital record usage. Computers can sometimes be perceived as cold or impersonal if not properly integrated and utilized.[7]

"The pain of going paperless" is the self-evident title of a brief article in a 1998 hospital journal which outlines some very real growing pains of the loss of paper records in

medicine. [8] A physician from one of the first hospitals in a major northwest hospital chain stated that, "the biggest mistake we made was trying to get rid of all the paperwork." The employees experienced "culture shock" as they were thrust into the new system without training. They noted that the time needed to utilize the new system was problematic, stating that "The no-paperwork rule would not work in the ER and ICU" because of the time required to key in the necessary data. Interestingly, as the hospital perfected the systems and the implementation process, they converted a second and a third facility. By the end of the rollout, the company offered four two-hour training sessions and made workstations available for practice. This allowed the staff to transition to the new system. The training also significantly altered the learning curve. The lesson learned is that the best system in the world is not sufficient if the human resource is unwilling or unable to adapt to its requirements.

2. Validity of Computerized Information

The validity of the information contained in a computer is only as good as the data entered. The term "GIGO" (garbage in garbage out) is dated back almost as long ago as the very existence of computers. There are limitless fonts, colors, sounds, and pictures that can be used to embellish computer data; however, even impressive presentations require good data. In orthodontics, we have seen the Rocky Mountain Growth Study evolve into today's VTO (treatment/growth predictions). Is this ornate animation without substantiated data? It should be clearly understood that computers are not able to take bad or irrelevant data and assemble valid predictions or thoughts.

Thus, while the point here is that computers can make things look and sound great, it is important to separate the appearance of the presentation from the validity of the message. This may be particularly important for laypersons attempting to make informed decisions about their treatment options when they do not possess the scientific background to distinguish between computer adornment and fact.

3. Patient Acceptance of Computer Technology

One study discusses the use of computers to facilitate patient education and improve the patient's overall office experience. McRoy et al. developed a program called LEAF[9] (Layman Education and Activation Form) to assist the patients' understanding of treatment and care while completing their medical forms. This internet-based interactive method for taking medical histories allows patients to answer questions during an on-line interview. The LEAF system is interactive with the computer asking questions based on patient answers in a dynamic fashion. In so doing, the patient is not asked to answer irrelevant questions, thus resulting in a tailored and personal interaction for that patient's specific needs. The information provided by the patients also triggers the system to provide specific questions the patient might want to ask their physician at their scheduled visit. Additionally, the LEAF explains terms that patients may be confused about or just may not understand.

This project is most significant given the increasing role patients are playing in their health care and today's emphasis on informed consent. Simply put, the use of

computers in McRoy's model helps educate patients at home before they come to their appointment, making treatment options more fully understood.

C. Current Information Technology Usage In Dental And Medical Curricula

Medical and dental curricula are generally split into two main camps—didactic and practical (clinical). The use of computers in these two areas is about as different as the areas themselves. In the didactic years, computers are used to simulate dissections, clinical encounters, pharmacology topics, and physiology concepts to name a few. In the clinical years, there is a great variability among dental schools regarding computer usage. If current commercial software packages provide improved options for healthcare informatics, but are not embraced because of provider unwillingness for change, perhaps a reexamination of formal medical and dental informatics education is in order. If physicians and dentists are formally educated in areas of information technology, learn to interact with patients using electronic records, and are trained to be discriminating customers of computer vendors, it could result in a greater acceptance and understanding of technology options in their practices. Attitudes could change!

Eisner talks about a different justification for the complete integration of computers in the delivery of clinical care in dental education.[10] He asserts that if dental students'

activities are completely integrated with computer technology, so too would accreditation standards. Put another way, if dental schools were utilizing totally computerized data management, these banks of data would become an automatic source of survey data about the schools. In Eisner's model, dental schools would be branches of the home office (The ADA) in Chicago.

A study by Saranto and Leino-Kilpi provides a roadmap for determining which IT skills to add to an educational curriculum. [11] The authors began with a simple evaluation of the skills needed by practicing nurses. Next, they identified skills possessed by technologically savvy nurses. A detailed review was utilized to establish a foundation for determining which technology coursework should be added to existing nursing curricula. To gather their data, the authors assembled a panel of experts to identify the basic computer and technology skills that should be possessed by nurses and included in their curriculum. They also used a combination of focus groups and surveys to answer similar questions. According to their report, information technology should constitute about 80 hours of formal instruction, twice that which is commonly included. They also concluded that these skills should be taught by a nurse skilled in medical informatics.

1. General Information Technology Training

The literature regarding the use of computers as an adjunct to academic dentistry is extensive. Student exposure to computer technology by its use in dental curricula is

important, but should not be confused with information technology coursework. If students are interacting with computer technology as a regular part of their curriculum, they may become somewhat familiar with computer basics, but not necessarily if it is not a requirement for matriculation. Providers of healthcare may need formal credit-hours of instruction in basic computer skills. In a comment by Niamtu to the editor of the Journal of Oral and Maxillofacial Surgery, he stated, "the directors of the American Association of Plastic and Reconstructive Surgeons passed down a dictum that as of the year 2000, only computerized lectures can be presented at their official meetings." He also cites the Journal of Orthodontics and Dentofacial Orthopedics as pushing ahead by dedicating a section to technology (TechnoBytes).[12] Where do doctors learn how to make electronic presentations? Those who embrace this technology possess basic IT skills such as word processing, electronic mail, downloading remote files, searching the web and other library databases.[13] Healthcare providers must be able to access and evaluate electronic information. This in turn necessitates that doctors obtain proficiency in the selection of computer systems, peripheral devices and software.

2. Simulations

There is a great deal of information, study, and publication on the subject of computer simulation in dental education. Bachman writes about **C**omputer **A**ided **L**earning or **I**nstruction, also abbreviated CAL, CAI, and CBI. These terms all mean the same thing. Bachman asserts that CAL has been shown to be at least as effective as traditional teaching methods.[14] He notes a relative similarity in the test scores of students

learning in the traditional classroom compared with the virtual one. He states that there are several issues of convenience and accessibility afforded by the virtual experience.

The *reality* of the virtual world ties in well with the highly discussed topic of problem based learning. According to Botelho, PBL is a relatively recent educational strategy that uses simulated complex, real-world problems or situations. Small groups of students discuss and investigate the scenarios to create possible solutions or hypotheses in response to the presented data. [15] The components of PBL are listed below:

- Small group learning
- Problem based
- Student centered activity
- Self directed learning
- Tutor facilitated

Simulation and information technology tie into this new model of dental education nicely because it allows for self direction. Computer simulations based on large bases of data allow students to direct their studies and explore areas of dentistry as in-depth as necessary to ensure they master particular concepts.

At the University of Connecticut, students had the option to learn endodontic diagnosis using a computer based simulation.[16] An experiment was designed comparing a control group of students, a group of students who used the computer simulation, and a group

of students attending a seminar. With strong statistical significance, the computer simulation group showed the best improvement from their pre-test to their post-test scores.

According to Issenberg et al., simulation training avoids using patients for skills practice, which gives students an improved level of proficiency before they reach live patients.[17] The simulator experience could, therefore, potentially reduce the number of diagnostic tests required. Issenberg also discusses the expense of simulation technology, the time it demands, and its impact on live teachers. He states that the use of a simulator can increase what previously required patient and instructor time, allowing students to learn during off hours or scheduled self guided learning periods. This means more teaching with less human resource and/or more student-material interaction per semester hour. The key to success according to the authors is to ensure that simulators are completely integrated throughout the curriculum so that it is possible to acquire enough practice to obtain expertise.

Henderson describes a computer simulation of clinical work at an HIV clinic. In this paper, several traditional educational models are discussed and a new information technology based model is developed.[18] The new model of learning, the "Virtual Practicum," is based on CD-ROM technology, dealing with the primary care of HIV patients. This software is designed to simulate the emotional component of patient care at a time in the curriculum where student doctors are not ready to treat live

patients. The process of treating a virtual patient starts the clinical decision making process earlier and theoretically gives students a stronger background for entering practice. As an aside to the clinical skills gained in this model, students are also becoming more familiar with the use of information technology in healthcare. Better simulations, particularly those that help students understand a difficult concept or provide a valued skill are more likely to result in general acceptance by practitioners; nevertheless, there is still a significant gap between simulations in the didactic portion of doctoral curricula and complete incorporation of IT in clinical practice.

The Dental Interactive Simulations Corporation (DISC) is a non-profit organization dedicated to the development of patient simulations for dental and dental hygiene education as well as continuing education. The aim of the DISC simulations is the development of cognitive and decision making skills in dentistry. This technology may eventually be useful for testing by the Joint Commission on National Dental Examination, the ADA's National Dental Board authority. The development plan for the new simulation system will be done in six parts.[19] The initial phase involves developing an extensive database which will become a modern test file, feeding interactive simulations and allowing for multiple combinations and variations of patient problems and treatment options. The future focus of DISC will be a voice recognition protocol that will allow students and dentists to interact with the database in a more realistic fashion. In addition to voice recognition, the use of three-dimensional views of patient images is planned. According to the DISC article, it may also be possible to incorporate

tactile or haptic technologies that would provide a realistic "feel" to the actions performed by the user.

3. Distance Learning

The utilization of information technology in healthcare curricula facilitates creative new methods of teaching. The Virtual Classroom in Periodontology is a distance learning project designed to provide quality learning in Periodontology to an international group of undergraduate students.[20] The concept is based on HTML and CD-ROM technology combined with the internet as the means for communication. The images are stored locally on a CD-ROM to ensure adequate speed for operation. The CD alone would not have been meaningful without the internet combination. In short, the system allowed students in several different countries to access quality video and still images of diagnostic quality. This concept would also lend itself well to continuing education and study club activities. Yip states, "The use of distance education and telecommunications to support classroom-based instruction changes the dynamic between students and teachers and the nature and location of the classroom. The use of these technologies is simple, once the basic skills have been learned. The proliferation of electronic venues for the exchange of scholarly ideas and research in dental education is challenging the traditional protocols of publication and review."[21]

D. Perceptions Of Administrators, Faculty And Residents Regarding Information Technology In Curricula

Schleyer notes that the success of computer system implementation is based in part on the faculty who must embrace and successfully utilize the technology. [22] Not only must the faculty receive the new computer equipment, but they must receive adequate training and support. He feels that successful integration does not come from localized initiatives or without strong administrative support. However, the expense associated with a school-wide project is often a roadblock. The article stresses that without all three elements of equipment training and support, an implementation is less likely to succeed. Lastly, Schleyer notes that academic computing must be part of the school's mission, and provide value to faculty and students alike. He feels that while it is easy to measure issues like institutional culture and support, educational outcomes may be more difficult to ascertain.

In several schools, oral radiology has successfully integrated IT with traditional dental curriculum. Ludlow found no significant difference in the transfer of knowledge using traditional tape and slide format versus the web page format in one radiology department; however, students found the web format much more convenient.[23] Students were able to navigate and direct the flow of information at their own pace. Ludlow's project was a ten year look at attitudes toward computer aided learning (CAL). They feel that the web lends itself well to pictures with short narratives and that longer narratives are better suited for written media.

Yip et. al. offer an interesting point about IT in dental curricula. They state that despite advances in technology, the teacher remains the most significant factor in the educational experience. The point they stress is that teachers must still convey knowledge and that IT should be used as a supportive adjunct, not a replacement. Specifically, they assert that the question is not which medium is better, but what attributes of available media might combine with learner traits under given task conditions to produce different and optimal kinds of learning.[24] Computer technology is really only as good as the people responsible for its design and use and cannot replace excellent educators. Several studies do support the idea that students believe the use of computers for learning is both challenging and motivating[25]

The Diversity of educational backgrounds in the entering classes of today's health professions makes it is difficult to accurately predict the level of computer expertise among entering students. However, the trend seems to be that with each passing year, understanding and usage increases. This diversity and rapid rate of computer evolution makes curricular planning quite challenging. [26]

E. Limitations of Computer and Information Technology

Posner lists the potential disadvantages of computerization as follows: [27]

- Need for structured, coded data
- Temptation to "stamp collect"
- Layouts not intuitive
- Temptation to embellish data
- Loss of design control and flexibility
- Cost
- Adverse response from patients
- Reliance on hardware
- Reliance on software

Computer based treatment notes do not easily adapt to free text. While this can be incorporated into systems, the predominant way in which systems are designed to be quick enough for real time use is with coded information—a pre-determined system of shorthand. This may mean learning a number of codes for specific procedures etc. The temptation to "stamp collect" addresses the idea that a paper record has some limits. Once a piece of paper is full, there is no more room to add information. The limits on a computer-based system are more vague. In fact, it would be easy to add and search a very wide range of information. Likewise, a paper system has a logical flow and order where blank areas are easily seen. Layouts on computer screens are not always as intuitive. This can lead to a disorientation on the part of users as they attempt to locate information. Lastly, the reliance on the machine and its software is a serious issue. Not only can breakdowns or system failures cause serious problems, but the rate at which computer technology is changing makes the investment a continual one. [28]

F. Privacy Concerns Raised By The Useage Of Information Technology In The Healthcare Setting

As we move into the electronic age where information can be shared and accessed over computer networks, the issue of privacy becomes increasingly important. In a brief interview, Berger[29]addresses several questions regarding privacy and computers in medicine. When asked, "What do people fear most about computers being used for healthcare?" The answer is, "Infringements of privacy and the breach of the integrity of

data." The authors of this article feel the fear is a valid one, and state that security must be incorporated into the basic design of the system, not an added afterthought.

Concerns regarding patient confidentiality tend to be increased with electronic records; however, with the use of unique passwords for each member of the staff, data can be viewed in a very controlled way, not available with paper charts. In England, proposed methods of protecting privacy include legislation making it a crime to use medical information if unauthorized to do so, audit trails allowing access to be traced to a specific user, and computer encryption.[30]

G. Change v. Progress

There are several areas outside healthcare which have embraced the use of IT and are farther along the learning curve. In an article by Tuttle[31] there are eight comparisons to the implementation of IT in non-medical fields compared to implementations in healthcare. One of the more interesting areas he discusses is the creation of the internet. Such comments as, "yes we can build it, but who would use it" (Bell Labs), or "we don't want e-mail in academia," caused what he termed "benign neglect" in the early years of the internet. In other words, why did it take so long for the internet to be embraced and used following its creation? And what can we learn from this in healthcare? An interesting quote from Sandy Lerner of Cisco Systems (co-founder), "the internet is the best thing the United States bought since the Louisiana Purchase." If this technology is so great, why is there so much literature supporting the concept

that healthcare providers are not embracing it? The tone of the article suggests that it will only be a matter of time before patient records are internet based and stored out of the office.

H. The Use Of Information Technology In Orthodontic Curricula

Aside from the standpoint that computers are simply becoming a part of everyday life, why should academic orthodontics embrace and integrate computers into their technology? In an article by Powsner, Wyatt, and Wright, the authors outlined some key points about the rationale for digital records.[32]

- Simultaneous, remote access
- Data incorporation
- Legibility
- Continuous data processing
- Data safety
- Assisted search
- Confidentiality
- Greater range of output methods
- Flexible layout
- Tailored output
- Integration with other information systems

Data incorporation deals with the ability to integrate a digital x-ray machine, digital cameras, and perhaps other previously unknown methods of data collection and directly input them into a patient file. Continuous data processing deals with the ability to instantly check the validity of data as it is entered, addressing accuracy and integrity of the data. With good crosschecks, a computer system can eliminate double entries, erroneous information, or other errors. The area of assisted search is quite interesting and somewhat undervalued. The use of a standard protocol of record taking and

storage such that cases could be catalogued and collected from multiple office locations and university programs could provide an extremely valuable source of information about treatment modalities. From the standpoint of academic orthodontics, this system could provide an excellent teaching tool for residents. Lastly, the use of digital photographs might serve as an excellent motivator for patient compliance. Instant retrieval of patient progress photographs could serve as a good way to help patients understand the importance of appliance wear or hygiene—concepts that are often difficult for patients. [33]

A computer system can also assist in gathering and charting patient information. But what justification is there for such a costly replacement for the tried and true method of pen and paper charting? A retrospective study by Shiffman et.al. compared medical records gathered by two different groups of residents and evaluated them for thoroughness of documentation and user satisfaction.[34] One group of residents used the traditional contemporaneously created unstructured record taking method, while the other group used a structured encounter form. Overall, residents in the structured form input group documented more data elements per visit than did those in the unstructured records group.

One could apply this study to clinical orthodontics and pose the same question. Would encounters with the orthodontist be better documented if a standard computerized form entry system were used? With the use of the computer chairside, the orthodontist

and staff alike may be better reminded to check progress and cooperation in areas such as hygiene, elastic wear, breakage and the like. Additionally, the computerized encounter may facilitate the initial examination process by reducing missing pieces of exam findings or patient history. Another key point in the Shiffman paper is the importance of how the information is taken from the clinical setting and input into the computer. In their case, the scanned forms were used, which saves the cost of having a computer at every point of clinical encounter in the office. Whether prompted by a paper report or a computer screen, the point that data collection is more standardized and complete is well taken from their work and is certainly a rationale for computerizing chart entry.

Barnard discusses several philosophical aspects of IT integration into the practice of nursing. [35] He makes the distinction between progress and the human measures of spirituality, ethics, art literature and human experience. He says, "progress is associated commonly with science and technology and appears at first to be unassailable." This article reminds us that the core human values must not be forgotten when we integrate technology. We must balance too much technology and progress with too little human contact. In a study by Dharamsi et. al., they focused on the social experience of curricular change.[36] The article focuses on the introduction of problem based learning into a traditional curriculum. This parallels the IT articles in that they both discuss the "legitimacy of change." Dharamsi states that ideas of legitimacy are based upon a history of academic experiences. Simply put, it is difficult

to change! This article deals with the reality of the impact of change on faculty. In many cases, he feels faculty are the limiting or pace setting factor in the integration of curricular change.

The present study may identify the type of IT training that should be included in modern orthodontic curricula. The following list summarizes the concepts found in this literature review that are important in healthcare and may be applicable to orthodontics:

- Formal instruction by health informatics experts on accessing, searching, and retrieving computer data.
- Formal instruction by a digital photographer on image capture, manipulation, scanning, archiving, printing, and sharing electronically.
- Formal instruction by practicing office managers on the selection of commercially available management software packages.
- Formal instruction by IT experts on selection, usage, and minor repairs of computer hardware, digital cameras, printers, and scanners.
- Formal instruction by IT/Informatics experts on implementation of a new computer system.
- Formal instruction by practicing orthodontists on the cost versus benefit of various degrees of computerization.

3. Research Objectives

The research objective of this paper is to assess the level of computer use in orthodontic programs and in private orthodontic practices and draw comparisons. The topic of computer usage is rather broad, and therefore has been broken down into several categories for better comparison. These categories include the following:

- Self assessment of the degree of computer usage
- Computer training
- Computer system selection
- Frequency of computer usage
- Identification of key users of computers in orthodontics
- Identification of specific computerized procedures
- Assessment of nine basic computer skills essential to healthcare
- Assessment of the importance of computer usage to orthodontists and their general attitude toward computer usage

Responses from the private practitioners will be compared with their gender and age.

4. Materials and Methods

To assess and compare the use of information technology in postdoctoral orthodontics and private practice, two types of surveys were prepared and mailed. The completed surveys were scored and analyzed using a statistics software package. Chi^2, frequency counts, and crosstabulations were performed on the data set.

A. Instrument Design

The survey instrument was designed in cooperation with the department of public health dentistry at OHSU, and pilot tested by current orthodontic residents and faculty. The final surveys sent to the private practitioners and the residency programs were very similar with changes in language to make them fitting for their respective audiences. Private practitioners were asked to indicate their age, gender, and year of graduation

from residency. Residencies were asked to indicate how long their computers have been in place and how they were selected. The instrument was designed with several formats of questions ranging from informational and descriptive to specific and usage oriented. The balance of the survey used five point Likert scale questions to assess attitude and skills. In the Likert style questions, participants answered using ratings including strongly agree, agree, neither agree nor disagree, disagree, and disagree strongly to appraise the importance of computers in their delivery of care.[37]

B. Instrument Construction and Scoring

Surveys were created on IBM compatible computers using TeleForms® by Cardiff software, San Marcos, Ca. TeleForms in conjunction with a Panasonic high-speed duplex scanner scored and assembled the survey data, exporting the findings to Microsoft Excel® and SPSS. In an effort to conserve paper, a two sided printer was used, keeping each mailing to three pieces of paper including the cover letter. Participants were asked to fill in circles on the surveys using number 2 pencils and instructed specifically to answer only one choice or multiple choices as indicated. The software was set-up to eliminate answers which were incorrectly completed. The process of machine reading the surveys was not entirely automatic. In fact, the author had the discretion to establish the degree of automation of the process. The more automated the process becomes, the more erroneous it can be. Accordingly, the Principle Investigator (PI) designed the form so that every survey was visually inspected before reporting to the data set. This commitment more than doubled the time

required to score the surveys, but greatly increased confidence in the data set. Any case of multiple answers for single-answer-only questions forced the system to notify the PI and eliminate that individual item. Any answer choices left blank were not scored, even if there was an unchecked "none or never" choice. No assumptions were made and no interpretations of hard to read choices were presumed or counted in the final data set. This resulted in dual reporting in the final analysis by the software, termed "valid percent responses" and "percent response." In all calculations the valid responses were used.

C. Survey Recipients

Surveys were prepared and mailed to the directors of each postdoctoral orthodontic program in the United States. Each of the 47 program directors received one survey. Similar surveys were prepared and mailed to a random subset of 1000 active and associate private practitioners in the Pacific Coast Society of Orthodontists in the continental United States and Hawaii. Each envelope contained a cover letter and a return envelope. Bulk mail pre-sorted/pre-printed envelopes were used in conjunction with pre-printed no-postage-necessary return envelopes. All returned envelopes were opened by the departmental administrative assistant, who stacked the incoming surveys for scanning.

D. Handling the Returned Surveys

All surveys were visually inspected and edited as follows: Respondents who did not follow the instructions were aided by having their check or "X" marks completely darkened to facilitate the computerized scanning process. In no case was the clear intent of the respondent guessed or altered, rather changes were made to reduce computer scoring delays and mistakes in the manual verification phase of data collection. Completed surveys were matched against the outgoing mailing list so that a follow-up mailing could be completed. The option for follow-up was not exercised. The match-up did facilitate gathering specific state by state representation which is reported in the results.

The following pages contain the surveys and will serve as a reference to the tables in the results section.

The following survey is designed to gather information about the use of computers in orthodontic practices. This anonymous survey will be machine read, **please use a number 2 pencil** and fill in the corresponding circles completely. Please do not make any stray marks and erase errors completely. Your support will help orthodontic programs address the computer training needs of graduating orthodontists. Thank you in advance for your assistance.

Section I

The first two questions apply to offices that do NOT use computers. If you DO use computers in your office, please skip this section and go to section II.

1. If you do not use a computer in your office, please indicate why. (fill in all that apply)

○ I don't need them.

○ They are too expensive.

○ I'm too close to retirement or sale of my practice.

○ My staff doesn't need or want computers.

○ I have worked with a computer, but it is too much trouble for use in my office.

2. Do you plan on computerizing your office within the next two years?

○ Yes

○ No

Please go to Section III

Section II

For offices that DO use a computer, please answer the following questions. Note that some questions may have multiple answers. Unless indicated as a single answer, please fill in all that apply.

3. Rate the overall level of computer usage in your office. (one answer only)

○ Extensive ○ About right ○ Too little

4. How did you select the computer system in your office? (fill in all that apply)

○ Staff reviewed the systems and selected one.

○ A recommendation from a peer.

○ I saw the system at a convention .

○ Exposure during continuing education.

○ Exposure during residency.

○ The system was already in the office.

○ I researched the systems myself.

5. Who is the key person that understands/troubleshoots the computers in your office? (one answer only)

○ Orthodontist. (you)

○ Another orthodontist. (partner/associate)

○ Treatment coordinator or office manager.

○ Receptionist.

○ Clinical assistant.

○ Outside source.

CONTINUE ON BACK OF THIS PAGE

6. In the table below there are several procedures listed in the first column. Please fill in the appropriate circles indicating how often the staff and/or the orthodontist perform these functions if ever. If the procedure is not computerized, please fill in the circle marked "Not computerized" in the far right column.

Procedure	Staff	Orthodontist	We don't do this with a computer
Accounts receivable or payable	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Electronic filing of insurance claims	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Scheduling	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Storage of patient demographics	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Correspondence/word processing	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Remote access to patient records from home or second office	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Access the internet	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Use a flatbed scanner	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Use a digital camera	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Use a color printer	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Digitize cephalometric radiographs	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	
Digitize panoramic or FMX radiographs	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	
Store and view digital patient photographs	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	
Use digitized study models	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	

CONTINUE ON NEXT PAGE

Rank your **ability** to do the following by filling in the circle that completes the statement; I can do this_____. (one answer only)

7. Organize computer information (name files, set up directories, move files, rename files).

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

8. Word process.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

9. Use a spreadsheet program.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

10. Search a database.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

11. Find relevent sites on the web.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

12. Download files from the internet.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

13. Make minor repairs to the computers in my office.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

14. Send and receive e-mail.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

15. Troubleshoot software problems in your office.

O Very well O Fairly well O Somewhat O Not well O I can not do this at all

Indicate how strongly you agree or disagree with the following statements. (one answer only)

16. Computers are a necessary part of clinical orthodontics in my practice.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

17. Digital records are an integral part of my practice.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

18. My patients expect to see computer generated reports and pictures.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

19. I feel my peers are more computerized than me.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

20. I would feel comfortable evaluating and selecting a computer system for use in my office.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

21. I am adequately trained to use the computer system in my office.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

22. I feel I could treatment plan my cases with entirely digital records.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

CONTINUE ON BACK OF THIS PAGE

23. Have you obtained training in computer technology? (one answer only)

O Yes

O No

24. If you answered YES above, where did you get your computer training? (fill in all that apply)

O Community or local college.

O Local computer store.

O During college.

O During residency.

O In continuing education classes.

O From the software manufacturer of my office system.

25. Do you provide computer training for your staff? (one answer only)

O Yes

O No

26. What platform does your office use? (one answer only)

O IBM compatible only O Macintosh only O Both IBM compatible AND Macintosh

O Both, but primarily IBM compatible O Both, but primarily Macintosh

Please write in the name of the imaging software you use. (please print ALL CAPS)

Please write in the name of the office management software you use. (please print ALL CAPS)

please answer the remaining questions in section III

Section III

27. Gender

O Male

O Female

Please write in answers to questions 28 and 29 in the squares **and** fill in the corresponding circles.

28. Age

0 1 2 3 4 5 6 7 8 9

29. What year did you graduate from your orthodontic residency?

0 1 2 3 4 5 6 7 8 9

END OF SURVEY

The following survey is designed to gather information about the use of computers in orthodontic programs. This anonymous survey will be machine read, **please use a number 2 pencil** and fill in the corresponding circles completely. Please do not make any stray marks and erase errors completely. Your support is greatly appreciated.

---

1. Rate the overall level of computer usage in your program. (one answer only)

○ Extensive ○ About right ○ Too little

2. How did you select the computer system in your department? (fill in all that apply)

○ Selected by an individual faculty member.

○ Placed free of charge (or great discount) by a vendor.

○ We use a school wide system.

○ Researched by a committee.

○ We have several different systems chosen by different people.

3. How many years has your current system been in place? (one answer only)

○ Less than one year.

○ 1 to 2 years.

○ 2 to 3 years.

○ 3 to 4 years.

○ More than 4 years.

4. Is there a system in place for training faculty in the use of computers? (one answer only)

○ Yes, and it is used.

○ Yes, but it is not used.

○ No

5. Do residents receive computer training? (one answer only)

○ Yes

○ No

6. If yes, in which areas? (fill in all that apply)

○ General use of computers.

○ Digital imaging.

○ Digitizing cephalometric radiographs.

○ Networking.

○ How to evaluate and purchase software or hardware.

7. Which of the following have interfered with the ability to increase computer usage? (fill in all that apply)

○ Money/budget limitations.

○ Faculty is not interested or is currently unwilling to make the change.

○ It is not a critical part of the program.

○ Space limitations.

○ Lack of reliability of data storage.

○ None

CONTINUE ON BACK OF THIS PAGE

8. In the table below there are several procedures listed in the first column. Please fill in the appropriate circles indicating how often the residents, staff and/or the faculty perform these functions if ever. If the procedure is not computerized, please fill in the circle marked "Not computerized" in the far right column.

Procedure	Residents	Staff	Faculty	We don't do this with a computer
Accounts receivable or payable	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Electronic filing of insurance claims	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Scheduling	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Storage of patient demographics	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Correspondence/word processing	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Not computerized
Remote access to patient records	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Access the internet	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Use a flatbed scanner	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Use a digital camera	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Use a color printer	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	O Daily O Weekly O Monthly O Never	
Digitize cephalometric radiographs	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	
Digitize panoramic or FMX radiographs	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	
Store and view digital patient photographs	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	
Use digitized study models	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	O Every patient O Most patients O Some patients O No patients	

CONTINUE ON NEXT PAGE

Please answer the next series of questions using the statement: We teach our residents the following_____. **(one answer only)**

9. Organizing computer files (naming, renaming, moving, creating directories)

O Very well O Fairly well O Somewhat O Not well O Not at all

10. Word processing

O Very well O Fairly well O Somewhat O Not well O Not at all

11. Use of a spreadsheet program

O Very well O Fairly well O Somewhat O Not well O Not at all

12. Searching a database

O Very well O Fairly well O Somewhat O Not well O Not at all

13. Finding relavent sites on the web

O Very well O Fairly well O Somewhat O Not well O Not at all

14. Downloading files from the internet

O Very well O Fairly well O Somewhat O Not well O Not at all

15. Making minor repairs to computers

O Very well O Fairly well O Somewhat O Not well O Not at all

16. Sending and receiving e-mail

O Very well O Fairly well O Somewhat O Not well O Not at all

Indicate how strongly you agree or disagree with the following statements. (one answer only)

17. Computers are a necessary part of clinical orthodontics at our program.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

18. Digital records are an integral part of our residents' treatment plans.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

19. Our patients expect to see computer generated reports and pictures.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

20. Our residents regularly present cases using digital media.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

21. Our residents receive training on how to review and select computer systems.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

22. Our residents are trained to treatment plan cases with totally digital records.

O Strongly agree O Agree O Neither agree nor disagree O Disagree O Disagree strongly

23. Our residents are required to purchase the following: (fill in all that apply)

O Laptop computer O Desktop computer O Specific brand or platform of computer

O Digital camera O Scanner O Color printer

24. What platform does your program use? (one answer only)

O IBM compatible only O Macintosh only O Both IBM compatible AND Macintosh

O Both, but primarily IBM compatible O Both, but primarily Macintosh

END OF SURVEY

5. Results

The results of the surveys are listed in five parts as follows:

- **General survey response.**
- **Frequency counts by percent of each item for the orthodontic programs.**
- **Frequency counts by percent of each item for the orthodontists.**
- **Crosstabulations for items in the orthodontic survey.**
- **Chi^2 comparisons for the use of computers in private practice with orthodontic programs.**
- **Software usage in private practice by manufacturer.**

A. General Survey Response

During the last week of March, 2001, 1000 surveys were sent to orthodontists in the PCSO and to 47 orthodontic programs. Pre-sorted bulk mail was used via campus mail services. Surveys arrived at target practices as early as two days following mailing and as late as eight weeks following mailing. While the surveys were anonymous, it was possible to track the origin of each response. 334 orthodontists completed the surveys and mailed them back before the self-imposed deadline. 24 orthodontic programs completed their surveys and returned them. Another 10 surveys arrived after the deadline and were not counted. In one case, a respondent removed the barcode and serial number from their survey, presumably to protect anonymity—this survey was not counted as they did not indicate their age or gender. In several cases, respondents

indicated their age or year of graduation in writing, but not by darkening the corresponding circles. In these cases, the PI darkened the appropriate circles. Interestingly, there were entire cities that did not respond. Perhaps the use of bulk mail for such a project may not have been ideal and may have contributed to the reduced response rates. Additionally, the pre-printed envelopes which are required by the United States Postal Service are often a red flag for junk-mail—another potential contributor to the response rate.

By state, Oregon returned the largest *percentage* of surveys, while California returned the largest *number* of surveys. The table below gives a breakdown of survey origin and response rates. While the number of surveys mailed to each state varies widely, the percentage of the active and associate members receiving surveys was roughly the same for each state, and is thus a reflection of the orthodontist populations of each state.

1. **Responses by state**

State	Number of surveys mailed	Number of surveys completed	Percentage of response by state	Percentage of total tally
Alaska	14	6	42.8	1.80
Arizona	63	15	23.8	4.50
California	654	188	28.7	56.45
Hawaii	23	6	26.0	1.80
Idaho	16	8	50.0	2.40
Nevada	20	6	30.0	1.80
Oregon	83	48	57.8	14.4
Washington	124	56	45.1	16.8

B. Frequency of Responses by the Orthodontic Programs

Responses are listed as a percent which was calculated by dividing the number of individual responses for that item by the number of responding programs. In total, 24 programs returned completed surveys. Any items which were not answered, or were incorrectly answered were eliminated from the count. Items which permitted multiple answers are reported differently as indicated by the description immediately above that item's table.

2. **Rate the overall level of computer usage in your program**

About right	33.3
Extensive	41.7
Too little	20.8

3. **How did you select the computer system in your program**

This item permitted multiple responses. Accordingly, the table lists the number of times each response was chosen. In this case, the most popular response was, "selected by an individual faculty member." Further, there was no unique pattern of multiple answers worth mentioning. In other words, the balance of responses were uniform and "across the board."

Selected by an individual faculty member	10
Placed free of charge by a vendor	7
Use a school wide system	9
Researched by a committee	4
We use several systems chosen by different people	5

4. **How many years has your current system been in place**

Less than one year	4.2
1-2 years	29.2
2-3 years	33.3
3-4 years	12.5
More than 4 years	20.8

5. **Is there a system in place for training faculty in the use of computers**

Yes, and it is used	58.3
Yes, but it is not used	12.5
No	29.2

6. **Do residents receive computer training**

Yes	79.2
No	20.8

7. **In what areas do your residents receive computer training**

This item permitted multiple responses. Accordingly, the numbers listed below represent the number of times each item was chosen, but do NOT represent the combination response rates. In this question, there was a noteworthy pattern of response, namely, the combination of the first three choices. 29.2% of the programs selected this combination of answers, which was the most popular overall response.

General computer use	14
Digital imaging	20
Digitizing cephs	19
Networking	7
How to evaluate and buy a computer system	6

8. Which of the following have interfered with your ability to increase computer usage

This item permitted multiple responses, accordingly, the numbers listed below indicate the number of times each choice was selected. In this case the most common answer was "Money or budget," followed by "No limitations." There was no notable pattern of multiple answers for this question.

Money or budget	13
Faculty not interested	1
Not a crucial part of the program	1
Space limitations	4
Lack of reliable data backup	0
No limitations	8

9. Likert scale questions for orthodontic programs

The next two charts are summary representations of the five point Likert scale questions. The first is a series of self-ratings by programs of residents' computer skills, the second deals with the perception of the importance of computer use. Note that bold numbers are the most answered choice(s).

Skill	Very well	Fairly well	Somewhat	Not well	Not at all
Organize computer files	29.2	**41.7**	16.7	8.3	4.2
Word process	**33.3**	29.2	12.5	12.5	12.5
Spreadsheet	16.7	16.7	**25.0**	16.7	**25.0**
Database search	16.7	**41.7**	20.8	8.3	12.5
Find sites on the web	13.0	**43.5**	17.4	21.7	4.3
Download from the internet	12.5	**41.7**	20.8	16.7	8.3
Make minor repairs	0	0	20.8	37.5	**41.7**
Send and receive e-mail	**54.5**	18.2	22.7	0	4.5

(9 continued) **Likert scale questions for orthodontic programs**

Condition	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Disagree Strongly
Computers are a necessary part of clinical orthodontics at our program	**78.3**	17.4	0	4.3	0
Digital records are an integral part of resident treatment plans	**45.8**	25.0	12.5	16.7	0
Our patients expect to see computer generated reports	4.2	12.5	**58.3**	25.0	0
Our residents regularly present cases using digital media	**62.5**	29.2	4.2	4.2	0
Our residents are trained on how to review and select a computer system	4.2	33.3	**41.7**	12.5	8.3
Our residents are trained to treatment plan with totally digital records	12.5	29.2	8.3	**45.8**	4.2

10. **Our residents are required to purchase the following**

This item permitted multiple responses; however, there were only three unique patterns of response, one of which was a multiple answer. No program requires their residents to purchase a desk-top computer, a specific brand of computer, a scanner, or a printer.

Laptop computer	20.8
Laptop and digital camera	12.5
Digital camera	29.2

11. **What platform does your department use**

IBM compatible only	62.5
Mac only	0
Both IBM and Mac	20.8
Both but mostly IBM	8.3
Both but mostly Mac	4.2

This concludes the frequency reporting from the orthodontic programs survey. In total, 24 programs responded to the survey and 24 did not. These programs were located across the United States. To protect anonymity, there is no inclusion of program location in this paper; however, it is fair to say that geographically speaking, there is a diverse range of locations included.

C. Frequency of Responses by the Orthodontists

Responses are listed as a percent which was calculated by dividing the number of individual responses for that item by the number of responding orthodontists. Any items which were not answered, or were incorrectly answered were eliminated from the count. Fifteen offices indicated they did not use a computer at all and seven of these indicated that within the next two years they would be computerizing. Eight non-computerized orthodontists said they would not computerize within the next two years. The following table shows the reasons given for not computerizing.

12. **Rational for not computerizing in private practice**

Don't need them	66.6
Too expensive	33.3
Too close to retirement	26.7
Staff doesn't want them	0
I have worked with them, but they are too much trouble for my office	20.0

13. **Rate the overall usage of computers in your office**

About right	39.3
Extensive	38.4
Too little	17.0

14. **How did you select the computer system in your office**

This question was one which permitted multiple responses. The most common *single* response was, "researched the system myself" at 26.2% The most common multiple response was a combination of, "recommended from a peer, saw system at a convention, and researched the system myself" at 6.8%. The following table shows the total number of times each response was chosen. Note that the responses are given as raw numbers not percentages due to the fact that multiple selections were permitted. These figures are not indicative of whether each response was chosen alone or in combination with other choices.

Staff reviewed and selected the system	58
Recommendation from a peer	117
Saw the system at a convention	113
Exposure during CE	19
Exposure during residency	21
System was already in the office	50
Researched the system myself	184

15. Who is the key person that understands/troubleshoots the computers in your office

Orthodontist	35.8
Partner/associate	2.2
Treatment coordinator	31.6
Receptionist	7.9
Clinical assistant	0.9
Outside source	21.5

16. Likert scale questions for private practice

The next two charts are summary representations of the five point Likert scale questions. The first is a series of self-ratings by the orthodontists regarding computer skills, the second deals with the perception of the importance of computer use. Note that bold numbers are the most answered choice(s).

Skill	Very well	Fairly well	Somewhat	Not well	Not at all
Organize computer files	**31.2**	20.9	20.6	12.8	14.6
Word process	**39.1**	36.3	10.6	6.3	7.8
Spreadsheet	15.3	19.9	20.6	**23.1**	21.2
Database search	20.4	**32.3**	22.9	12.5	11.9
Find sites on the web	37.5	**41.3**	11.6	3.4	6.3
Download from the internet	30.2	**34.6**	17.4	9.3	8.4
Make minor repairs	14.8	**23.3**	21.7	21.7	18.6
Send and receive e-mail	**55.6**	25.9	9.7	2.5	6.3
Troubleshoot software	7.2	22.2	**28.1**	21.6	20.9

16 Continued: **Likert style questions for private practice**

Condition	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Disagree Strongly
Computers are a necessary part of clinical orthodontics in our office	**57.4**	26.3	6.3	7.5	2.5
Digital records are an integral part of our treatment plans	**34.1**	22.5	19.1	14.1	10.3
Our patients expect to see computer generated reports	9.7	19.9	**36.1**	25.9	8.4
I feel my peers are more computerized than me	1.9	19.4	**40.9**	29.7	8.1
I would feel comfortable evaluating and selecting a computer system	26.6	**47.2**	16.6	8.4	1.3
I'm adequately trained to use the computer system in my office	20.0	**35.6**	17.8	22.8	3.8
I feel I could treatment plan my cases with entirely digital records	20.0	**30.0**	18.1	25.6	6.3

17. **Have you obtained training in computer technology**

Yes	40.5
No	53.3

18. **If so, where have you obtained computer technology training**

This question permitted multiple responses. The most common *single* response was, "from the software manufacturer of my office system" at 10.7%. The most common multiple response was a combination of, "community or local college, in continuing education classes, and from the software manufacturer" at 2.4%. The following table shows the total number of times each response was chosen. Note that the responses are given as raw numbers not percentages due to the fact that multiple selections were permitted. These figures are not indicative of whether each response was chosen alone or in combination with other choices.

Community or local college	27
Local computer store	19
During college	29
During residency	28
In continuing education classes	52
From software manufacturer	96

19. **Do you provide computer training for your staff**

Yes	72.0
No	21.4

20. **What platform does your office use**

IBM compatible only	77.4
Macintosh only	3.9
IBM and Mac	9.0
Both, but primarily IBM	9.0
Both but primarily Mac	.6

21. **Gender**

Male	86.0
Female	13.1

22. Age of orthodontists by created variable decade

The age of the respondents was requested at the end of the private practice survey. To simplify the relationships between age and individual responses on the surveys, each survey which included a valid age was placed into one of five categories. These categories were assigned a new variable name called, "decade," and calculated as follows: If the first number of the respondent's age was a 2 or 3, they were placed in group 3. Each decade of life through age 69 was placed in the group corresponding to the first number of that age. Those orthodontists who were 70 or older were placed in the 7 group. The following table shows the percentage breakdown of practitioner age by the created variable. The most common age was 52, which represented 5.6% of the respondents. 95% of the respondents were under 65 years of age, and 50.3% were 48 years or younger. Respondents ranged from 28 to 82 years of age.

3	22.8
4	29.4
5	29.1
6	16.3
7	2.5

This concludes the frequency reporting from the private practice survey. In total, 334 surveys were counted in the final data set. 666 surveys were not counted because they were not returned, were returned too late, or altered in such a way as to not be legible by the computer system.

D. Crosstabulations

This section of the results is based on crosstabulations of two variables within the private practice survey. The Pearson Chi^2 test was used to evaluate the significance of the correlation, and is listed in the column titled value. The p-values are listed in the column titled significance. For simplicity sake, the following tables will list the significant crosstabulations only. The larger the value, the stronger the correlation. The first table below compares the created variable "decade" with the items listed in the first column. The decade variable was created as described in the age section above.

23. **Crosstabulations by decade of age of the orthodontist**

Survey item crosstabulated	**Value**	**significance**
Who is the key person who understands/troubleshoots computers in your office	53.058	.000
Electronic filing	18.336	.019
Scheduling	26.643	.009
Wordprocessing	24.613	.017
Organizing computer information	45.140	.000
Rate your ability to wordprocess	44.498	.000
Use a spreadsheet	43.187	.000
Find relevant sites on the web	35.127	.004
Download files from the internet	32.970	.007
Make minor repairs to the computers in my office	32.847	.008
Troubleshoot software problems	39.980	.001
Where did you get your computer training	189.386	.000

24. Crosstabulations by self-given level of computer usage in practice

This question asked respondents to rate the overall level of computer usage in their office and offered three choices; extensive, about right, and too little. (item 3 on the private practice survey).

Survey item crosstabulated	Value	significance
Rate the overall level of computer usage in your office	58.131	.000
Word-processing	31.734	.002
Access the internet	51.870	.000
Use a flatbed scanner	29.927	.003
Use a digital camera	26.602	.009
Use a color printer	37.301	.000
Digitize cephs	32.509	.001
Digitize fmx or pano	25.229	.014
Store and view digital patient photos	41.559	.000
Organize computer information	61.233	.000
Use a word-processor well	64.694	.000
Use a spreadsheet	34.531	.005
Search a database	63.672	.000
Find relevant sites on the web	57.381	.000
Make minor repairs to the computers in my office	60.960	.000
Send and receive e-mail	52.482	.000
Troubleshoot software	38.615	.001
Digital records are an integral part of my practice	177.638	.000
My patients expect to see computer generated reports	101.510	.000
I feel my peers are more computerized than me	72.512	.000

(24.Continued) **Crosstabulations by self-given level of computer usage in practice**		
I would feel comfortable selecting a computer system for my office	82.295	.000
I'm adequately trained to use my computer system	78.897	.000
I could treat my cases with entirely digital records	91.856	.000
Have you obtained training in computer technology	16.394	.037
Do you provide computer training for your staff	15.509	.050
What platform do you use?	36.438	.003

25. Crosstabulations by gender

This section correlated gender of the orthodontists with their responses on the remainder of the survey.

Survey item crosstabulated	**Value**	**significance**
Digitizing cephs	15.430	017
Digitizing panos or fmx's	29.701	.000
Ability to use a wordprocessor	15.566	.049
Make minor repairs to the computers in the offic	17.305	.027

E. Chi^2 Comparisons for the Specific Uses of Computers in Orthodontic Residencies and Private Practice

Those items which show a significance (p-value) of less than .05 are representative of *DIFFERENCES* between the frequency of computer usage in residency programs and private practice. All of the survey items included in the following table except "use of digital study models" were significantly different between the two groups. This table most significantly addresses the research objective of this project.

26. **Residency versus private practice comparison**

Task	Value	significance
Accounts receivable or payable	11.608	.0069
Electronic filing of insurance claims	12.038	.0073
Scheduling	19.038	.0003
Storage of patient demographics	15.529	.0014
Correspondence/wordprocessing	13.032	.0046
Remote access to patient records from home or second office	30.349	<.0001
Access the internet	16.163	.0011
Use a flatbed scanner	49.663	<.0001
Use a digital camera	36.204	<.0001
Use a color printer	13.201	.0042
Digitize cephs	37.596	<.0001
Digitize panos	23.346	<.0001
Store and view digital photographs	14.171	.0027
Use digitized study models	5.830	.1202

F. Software Systems Chosen by Orthodontists

This section had 293 valid responses in the management section and 203 valid responses in the imaging section. Not every orthodontist chose to identify the specific name of the software used in their office. There were identifiably popular systems and a significant number of "small time" or "home-developed" systems with frequencies of 1 or 2. The following tables include software packages which were used in 4 or more offices and are listed as raw counts, not percentages.

27. **Management systems used by orthodontists**

Ortho II	64
Orthotrac	53
New Horizons	29
OPMS	26
Orthoware	14
IMS	14
Orthosoft	12
OMS	8
TOPS	6
Orthochart	4
Oasys	4
MacBraces	4
Integrated management	4

28. **Imaging systems used by orthodontists**

Dolphin	53
Quick Ceph	50
Vistadent	22
Orthotrac	17
Orthovision	11
Photoshop	6
Oasys	4

6. Discussion

This project yielded a tremendous amount of data. While the results section contains a comprehensive description of the data, there are several points worthy of discussion. One of the core objectives was the identification of difference between computer use in residencies and private practice. It appears for the criteria included in the "frequency of use" section of the surveys, the orthodontists are not using computers the same way the residents use them. The items in this section are arranged by type. The first items are administrative, including scheduling, billing, insurance filing, and demographics maintenance. The next section deals with internet and remote access. The last section deals with computerized patient records. In short, orthodontists are using computers for administrative purposes more than diagnostic purposes, while residents are doing the opposite. This would seem to justify the addition of more administrative and adjunctive computer instruction in orthodontic curricula.

Some additional observations about training in residency programs versus private practice are worthy of discussion. Over 83% of the responding residencies reported training their student-orthodontists in the area of digital imaging, yet 58.3% of orthodontists never use a digital camera and only 20% use a digital camera on a daily basis. 58.3% of the responding programs report training their student-orthodontists in general computer use, and 55.6% of the orthodontists report they are adequately trained to use the computer systems in their offices. 79.1% of the programs train their

student-orthodontists to digitize cephalometric radiographs, and 61.3% of orthodontists never digitize cephalometric radiographs. Only 19% of orthodontists report digitizing cephalometric radiographs on every patient. 54.8% of the responding orthodontists report that they researched the computer systems in their offices on their own. This was a multiple response question, meaning that that answer was chosen in combination with other responses, but overall, it was selected by over half of the respondents. 25% of the residencies report training their student-orthodontists on how to evaluate and buy a computer system. 6.3% of the time orthodontists reported that they selected a computer system because of exposure during their residency. These data suggest that orthodontists would benefit from more structured instruction on the selection, purchase, and implementation of computer systems during their formal training. Residency is perhaps the last place in an orthodontist's career where they have the potential to experience multiple opinions without significant commercial bias.

Responses correlated by age offer more information about the differences between private practice and what is taught in school. Given that residency-based computer training and usage did not exist for orthodontists in the 5,6, and 7 age groups, it is not surprising that the 3 and 4 age group orthodontists report receiving computer training during college and residency. However, younger orthodontists are not the majority of this sample. Thus, in a survey of the use of technology which has only recently been included in most orthodontic programs, it may be safe to assume that computer use will change in private practice as the makeup of each age category evolves. This idea is

somewhat diluted by the lack of significant crosstabulations between age and nature of computer use. That is to say, to the credit of our specialty, there is not a significant correlation between the use of computers in diagnostic areas with age. While older orthodontists use the computer for less administrative functions, they are not different than their younger counterparts with regard to diagnostic imaging. Theoretically, more mature practitioners should be in a better position to afford the integration of costly technology than their younger counterparts. These data suggest that the differences are not related to the acceptance or use of the technology, but to the training, troubleshooting, and repair of the information systems.

In addition to system maintenance, those tasks which require networking with the world outside the office appear unappealing to the mature doctor. The history of online access has changed radically in the past two decades. As little as twenty years ago, one had to physically place a telephone into a audio coupling device to allow their computer to talk to the internet at 300 bits per second. Ten years ago, 14,400 bits per second and then 28,800 bits per second without a physical telephone couple were possible. These rates of communication were still not viable for the transfer of very large amounts of data. Such large volume connections were only possible with incredibly expensive dedicated lines from the telephone company and were limited in use to only the largest businesses. In the last 3 years, digital subscriber lines and cable modems have become available and have revolutionized the link between small businesses and the internet. Given the rapid rate of change in this area, it is safe to

assume that issues like electronic filing, internet access, electronic study-clubs, remote access to records, and direct patient to database interactions will occur in increasing numbers.

The area of self-given level of computer usage in private practice offered the largest number of significant crosstabulations. Orthodontists who feel they use computers extensively report that their patients expect to see computerized reports and photographs, while those who feel they use computers too little report that their patients do not expect to see these documents. Given the extent of the investment in both time and money in computers in private practice, one could question which came first. Did the need drive the purchase for the technology, or did the technology create a rationalization and justification? Those orthodontists who feel that they use computers extensively also feel that computers are an extremely necessary part of the delivery of clinical care in their practices. Interestingly, there is a relationship between the ability of the doctor to make minor repairs to their computer systems and their level of computer use. In reality, computers do require a certain degree of troubleshooting. It is interesting to note that extensive users are more savvy regarding troubleshooting. Those orthodontists who are able to quickly resolve minor problems associated with computer use may be more likely to fully embrace the technology. Accordingly, it may drive the prioritization of computers in clinical care. It seems unlikely that there are two subsets of patients, one of which requires a computerized experience and one which does not.

Doctors who report an extensive use of computers show significantly increased frequencies of technology use in almost all areas of the survey. The largest Chi^2 value returned in this section was for the statement, "digital records are an integral part of my practice." This is a very interesting piece of data. Clearly, this survey shows that a significant number of orthodontists do not use the computer on a regular basis for the delivery of clinical care, rather they use the technology for adjunctive tasks such as scheduling, receivables, and the like. This is not an age related issue, rather it seems to apply to all orthodontists. It is this author's contention that the issue is one of attitude. If the orthodontist posses the skills to easily embrace the technology and feels it is valuable, then it is used! It is not an issue of age or gender. Further, those who report extensive use indeed use the computer more frequently and in more areas of their practice.

The Likert scale questions show that over 95% of the orthodontic programs report computers are a necessary part of clinical orthodontics in their program. Likewise, 83% of the orthodontists agree that computers are a necessary part of clinical orthodontics in their private practices. What is engaging about this statistic is that everyone reports on the importance of computers in clinical orthodontics, yet the use of computers is quite different between the two groups. What is the definition of clinical care? Is an electronic schedule and a computerized ledger a part of clinical care? Here again, attitude is not in keeping with actual use. Everyone feels that information technology

has an important place in clinical orthodontics. In the residencies, the vast majority (91.7%) of student-orthodontists present their cases with digital media. Yet they report that the majority of student-orthodontists could not treatment plan their cases with totally digital records. The private practitioners report less overall use of digital records but an increased ability to treatment plan their cases with entirely digital records.

A crosstabulation revealed some gender differences in both the frequency and Likert sections of private practice survey. Male orthodontists report a significantly better ability to make minor repairs to the computers in their offices. (Perhaps the women are just more honest!) Women report knowing how to use a word-processor more than men. Female orthodontists are less likely to digitize panoramic and cephalometric radiographs than their male counterparts. While these differences may have little practical value, they are statistically significant.

There was a write-in area on the private practice surveys where orthodontists could share the names of their imaging and management software packages. Of the 334 responses, 293 gave the name of a management package and 203 gave the name of an imaging package. Of those who wrote responses, only brand names which reoccurred more than 3 times were included in this paper. This resulted in 242 management packages and 163 imaging packages. Interestingly, this means that 51 management packages and 40 imaging packages are what this author considers very small time or home-developed. 41 offices chose not to indicate any management

software brand name and 131 offices chose not to include any imaging software brand name. The second most common imaging package was Quickceph. This includes all versions combined in one total. Over 77% of the offices report using IBM compatible computers only. Based on the small number of reported Macintosh based management packages, it is safe to conclude that orthodontists who use Macintosh computers are using them for imaging, and most likely with Quickceph.

Critically speaking, this survey asked questions about the entire population of orthodontists, but surveyed a portion of them. There may be some inherent bias in that the entire country might not be uniform with regard to the issues discussed in these surveys. Further, having only half of the orthodontic programs contributing to this body of data is limiting considering the small number of programs. This project may be able to help orthodontic programs keep pace with a very dynamic area. But this is just the beginning. The mission of developing and improving orthodontic curricula is an essential part of the AAOF. Perhaps this work might serve as a pilot for further investigation.

7. Conclusion

There is a great deal of literature addressing the age and attitude of healthcare providers as they relate to computer usage. For many years, the cost and availability of computer technology capable of high quality image management was just too expensive for practical implementation in orthodontics. In the year 2001, the issue of

cost is much less significant, but the issue of appropriate computer training remains relevant. It appears that computer usage during residency is somewhat more focused on diagnosis and presentation while in private practice the usage is more administrative and adjunctive. If one subscribes to the argument that residency programs should be training residents for private practice, perhaps a more managerial and administrative penchant should be placed on IT training in orthodontic curricula. Issues such as selection, implementation, maintenance, and training are essential to the wholesale use of computers in orthodontics. Orthodontic programs would be serving their students well by including a more comprehensive training in these areas of information technology.

If residents are using computers for different purposes than practicing orthodontists, does this mean that residents are being taught the wrong thing? The data are not that clear. Perhaps residencies are teaching concepts that will become more popular as the makeup of orthodontists evolves. Perhaps some modification should be made to reflect current practice trends. Currently, the majority of orthodontists in this survey were not trained for the use of computers in their residency. As this proportion shifts over the years, so too may the nature of computer use. There are discrepancies between the perceived value of computers and their actual use. It appears that attitudes and understanding of computerization are accurate predictors of the nature of computer integration in orthodontic practices.

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