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AAO heads to Philadelphia

Orthodontists to meet at 113th annual session

The American Association of Orthodontists will host its 113th annual session from May 3-7 at the Pennsylvania Convention Center in Philadelphia.

The meeting's scientific program will span pivotal orthodontic topics including "New Technology in Tooth Movement: Fact or Fiction," featuring Drs. David L. Turpin, Dubravko Pavlin and Anthony M. Puntillo and seven other "Point & Counterpoint" presentations.

Attendees can interact with lecturers like Dr. William R. Proffit, speaking on "Evaluating the Chance of Successful Treatment," in the "Asking the Experts" series and learn from internationally recognized lecturers addressing 3-D imaging, enamel and roots, heredity and orthodontics, TMD, biomechanics, technology, esthetics, early treatment, accelerated tooth movement, ortho/perio,

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Philadelphia is the site of the 113th annual session for the AAO. Photo/www.sxc.hu

Comparison of tooth mesiodistal angulation measurements

Between 3-D CBCT volumetric images and 2-D CBCT-derived panoramic images

By Ammar Siddiqi and Nicole Sakai, DDS
Advisor: Hongsheng Tong, DDS, PhD

One of the major goals orthodontists try to achieve with every patient is to obtain ideal angulations and positions of all teeth at the end of active treatment.

In order to accomplish this, two-dimensional (2-D) panoramic radiographs have conventionally been used to visualize both the maxillary and mandibular arches as well as root angulations. However, because of inherent flaws in panoramic imaging, three-dimensional cone-beam computed tomography (CBCT) has been recommended to provide a more accurate and less distorted image of the dentition.

Literature review

Orthodontics is a specialty of dentistry that is concerned with the study and treatment of malocclusions,

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Curriculum is changing for today's instructors

By Dennis J. Tartakow, DMD, MEd, EdD, PhD, Editor in Chief

For each graduating resident, career decisions come down to determining which environment is best suited to his or her personality with regard to orthodontics. Choosing a path that coincides with one's beliefs, philosophy, personality and lifestyle is omnipotent. There are compelling advantages to both private practice and academics, but in order to consider teaching as a career, clinical experience is certainly necessary.

For the most part, postgraduate orthodontic programs have been content with faculty members teaching in the same manner as he or she was taught (show, tell, do). However, the process of education itself is changing as well.

We are moving toward an age where new academic skills such as the (a)

‣ See CURRICULUM, page 3

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methods of teaching, (b) *process* of course designing and (c) *modality* of learning have become the new standards of the educational process.

There are core areas of knowledge that teachers will be required to learn and understand. Without such basic knowledge of education and the learning process, students may remember information by rote but might never possess a broad and deep understanding of how to apply or adapt such knowledge in all situations.

In "Pedagogy of Freedom: Ethics, Democracy and Civic Courage," Freire (1998) emphasized that teacher preparation must consider a sense of ethics inherent in all forms of educational practice.

As Freire suggested, educators should consider the best methods for serving our residents. With this in mind, the efforts of educators would best be focused on learning modalities, which are not the same for all individuals. One of the learning theorists whom educators often look to for guidance is Dr. Howard Gardner.

Gardner's work encourages reflection upon the praxis involved for translating theory into action by considering the different learning modalities in new and creative ways. Students utilize different core methods of learning to process information, which includes: (a) visual, (b) spatial, (c) auditory, (d) tactile, (e) logical, (f) interpersonal and (g) intrapersonal modalities at an unconscious level, not necessarily in any particular order.

According to Gardner (1993), most learners retain a dominant and an auxiliary learning modality throughout life. Human beings access information through all senses, but generally favor one or more processes such as visual (sight), auditory (sound), kinesthetic (moving), and tactile (touch).

Recently, new and creative programs in orthodontic education have been created that address new academic skills to improve the teaching ability of orthodontic faculty members. These conferences are intended to provide our educators with the tools and methodology to implement a rigorous, thorough and broad curriculum on classical clinical situations.

The preservation of pedagogy in orthodontic education, the potential social justice implications, and impact on the public are directly related to: (a) education of well-trained orthodontists, (b) health-care delivery, (c) outreach programs, (d) welfare agencies and (e) public service communication. Teaching is all about the fundamentals of education.

Most postgraduate orthodontic faculty members have never had any formal training in the methodology of teaching or course design. They teach what they learned from their own clinical experiences. With this in mind, it is encouraging to see the creation of a few new and novel educational programs designed for junior and mid-career orthodontic faculty members to learn such academic skills. These conferences are part of a 2012 AAOF Educational Innovation Grant.

One of the first workshops on faculty career enrichment in orthodontics (FACE) occurred in October 2012. The second FACE workshop was held on March 7 at the University of Michigan School of Dentistry. These workshops, led by recognized orthodontic teaching experts included an interactive format with topics such as:

- principles of course design starting with the end in mind,
- methods to encourage active learning in the classroom and clinic setting, and
- methods for successfully incorporating technology into the classroom.

Another related program for faculty members is the James L. Vaden Educational Leadership Conference on May 3. This conference will emphasize excellence in orthodontic education, concentrating on graduate program standards. These programs will hopefully improve the education of our orthodontic faculty members and train our students to become better clinicians. Incremental changes for teaching skills is often needed if putting the student at the heart of the system is to be anything more than a hyperbole.

Improving the standards of education can lead to trying times but abhorring ignorance, I prefer to quote Aristotle (384–322 B.C.), "Education is an ornament in prosperity and a refuge in adversity."

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Corrections

Ortho Tribune strives to maintain the utmost accuracy in its news and clinical reports. If you find a factual error or content that requires clarification, please report the details to Managing Editor Sierra Rendon at *s.rendon@dental-tribune .com*.

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which may be a result of tooth position irregularity, disproportionate jaw relationships or both. The specialty of orthodontics has continued to evolve since its advent in the early 20th century. In the 1890s, Dr. Edward H. Angle, regarded as the "Father of Modern Orthodontics," published his classification of malocclusion based on the occlusal relationships of the first molars (Angle, 1899).

This was a major step toward the development of orthodontics because his classification defined "normal occlusion." He believed that if all of the teeth were properly aligned, then no deviation from an ideal occlusion would exist (Angle). His theories suggested that achieving the correct tooth position within the dental arch was critical for ideal angulation, occlusion and esthetics. With the advent of modern imaging technology and improved software in the field of orthodontics, Angle's principles of proper alignment and positioning have become easier to apply.

Although there have been constant changes in diagnosis, treatment philosophy, mechanics and appliances, core orthodontic treatment principles have generally remained the same over time. The main treatment objectives of orthodontics include obtaining (a) proper esthetics and alignment, (b) ideal functional occlusion and (c) long-term stability. In order to achieve these goals, it is critical to have ideal angulations of all teeth in all three planes of space at the end of active treatment (Andrews, 1972). Proper mesiodistal angulations (tip) are necessary for distributing occlusal forces through tight interproximal contacts and are an important factor in maintaining a stable treatment result (McKee et al., 2001; McKee et al., 2002).

For decades, the norm in orthodontic imaging has been using 2-D panoramic radiographs to visualize the entire tooth including the root to judge the angulation of teeth.

Most orthodontists use panoramic radiographs at the start, in the middle and at the end of treatment in order to judge root parallelism to reposition brackets if necessary. This imaging technique produces a single tomographic image of the facial structures that includes both the maxillary and mandibular dental arches as well as their supporting structures.

The principal advantages of panoramic radiography are the (a) broad anatomic areas, (b) relatively low patient radiation, (c) convenience, (d) ease and (e) speed of the procedure (Sakai, 2011). Additionally, panoramic radiography is recommended by the American Board of Orthodontists to assess root angulation and parallelism as a part of the objective grading system for an orthodontist to become board certified.

However, the use of panoramic radiographs to check mesiodistal tooth angulation is fundamentally flawed primarily due to dimensional and angular distortions as a result of image layer (focal trough) discrepancy. Investigators have also attributed the inaccuracy of panoramic images to projection geometry, variable vertical and horizontal magnification factors and patient positioning errors (Bouwens, Cevidanes, Ludlow and Phillips, 2011). Part of the reason why traditional panoramic radiographs are inaccurate in capturing the angulations

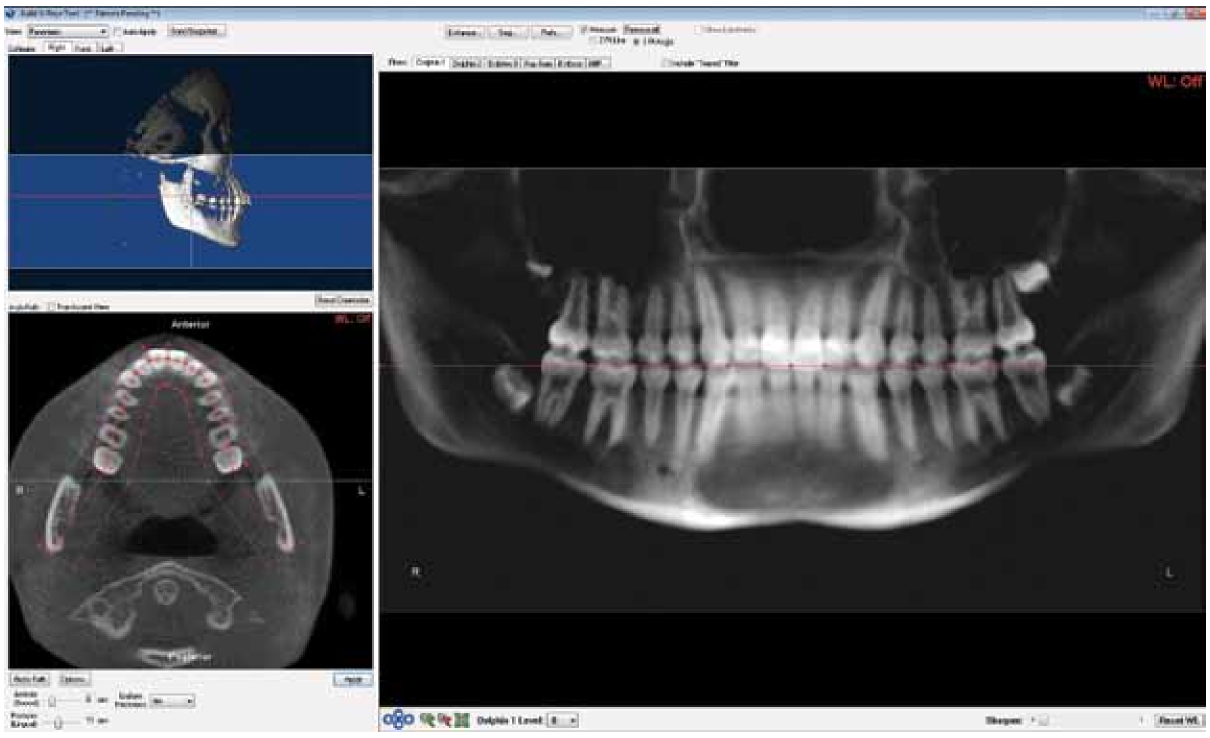

Fig. 1: Constructing a 2-D panoramic-like image from a 3-D CBCT patient scan. Photos/Provided by Ammar Siddiqi and Nicole Sakai, DDS

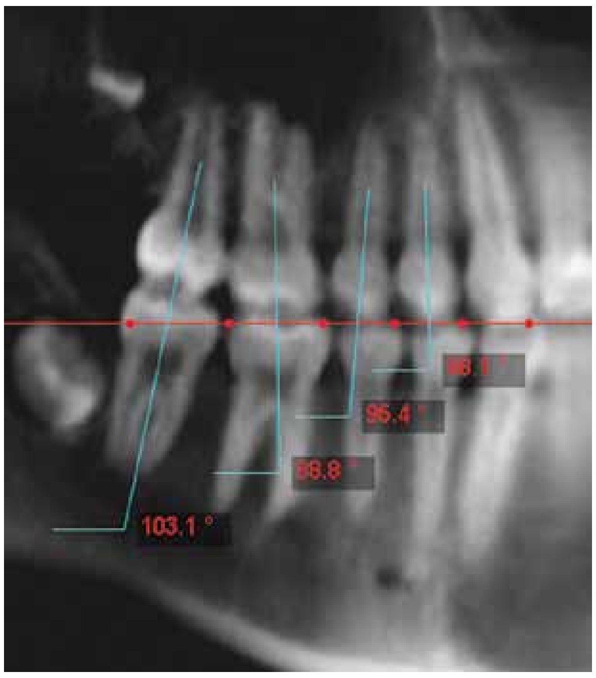

Fig. 2: Using the three-point angle to measure the mesiodistal angulation of the teeth on the 2-D panoramic images.

Tooth #	2D Mean	3D Mean	Mean Diff. 2D-3D	STD	P-value
2	-7.36	-6.18	-1.18	2.36	p<0.001
6	13.05	11.91	1.13	1.49	p<0.001
8[1]	3.7	5.82	-2.12	2.93	p<0.001
9	4.38	5.86	-1.48	2.81	p<0.001
10	8.36	7.34	1.02	2.59	0.003
11	11.66	10.93	0.72	1.87	0.004
12	6.62	7.44	-0.81	1.56	p<0.001
13	5.31	6.05	-0.73	1.84	0.003
14	-0.26	2.11	-2.37	2.09	p<0.001
15	-8.23	-5.41	-2.81	2.7	p<0.001
18	16.6	17.14	-0.53	1.38	0.005
20	7.82	8.57	-0.75	1.32	p<0.001
23	0.89	-0.51	1.4	2.24	p<0.001
25[1]	1.19	0.51	0.67	2.01	0.003
28[1]	5.48	5.03	0.44	1.47	0.005
26	1.34	-0.38	1.73	2.22	p<0.001
30	10.87	10	0.86	1.49	p<0.001

Table 1: Comparison between 2-D and 3-D mesiodistal angulation measurements using the paired t-test. Significance was calculated at $p<0.05/7=0.0071$ level (Bonferroni correction). For teeth with non-normal data, the Wilcoxon Signed-Rank Test was used.

of teeth may be attributed to the in-orthogonal nature of the X-ray beams as the X -ray tube and the sensor move around the target, as well as the large variations in the size and shape of the dental arches (Sakai, 2011).

To overcome these problems, panoramic-like images constructed from 3-D CBCT volumetric images have been recommended. Three-dimensional CBCT images have been shown to capture the target at a 1:1 ratio with very little dimensional and angular distortions and the trough used to generate the panoramic-like images can be customized to closely follow the dental arch size and shape (Sakai, 2011).

Research has also shown that linear and angular dimensions are more accurate using a CBCT-derived panoramic radiograph compared to traditional panoramic radiographs (Hutchinson, 2005).

The introduction of CBCT specifically dedicated to imaging the maxillofacial region heralds a true paradigm shift from a 2-D to a 3-D approach in data acquisition and image reconstruction. Utilizing this new technology, orthodontists can now visualize the dentition in all three planes of space. CBCT has opened up a new horizon for 3-D diagnosis and treatment planning in dentistry, particularly in orthodontics where shape, form, structure and position are of critical importance.

Purpose

The short-term goal of this research was to prove that using CBCT is a valid method in orthodontic treatment planning and can aid in the visualization and proper alignment of roots within the dental arch. With these 3-D images, it is finally possible to see how far root apices have moved during treatment. Additionally, placing the root in the right position will facilitate and maximize tooth stability and retention resulting in better treatment outcomes.

Although there have been many studies describing the distortions in 2-D panoramic images, there has not been a study that has looked at a trend in the distortions and compared it to an ideal coordinate system such as a 3-D CBCT. An orthodontic research study was carried out at the Herman Ostrow School of Dentistry of University of Southern California (USC) from February 2012 to January 2013 to investigate this subject matter. The objective was to determine if there are differences in tooth mesiodistal angulation measurements between 2-D panoramic-like images (constructed from CBCT scans) versus measurements obtained directly from 3-D CBCT volumetric images.

Materials and methods

The study was conducted under chief investigator Dr. Hongsheng Tong along with a team of residents and a predoctoral student at the Graduate Orthodontic Department of USC.

The research design aimed at recording mesiodistal angulation measurements for both the 2-D panoramic-like images as well as the 3-D CBCT scans using Dolphin imaging software. The patients of this research were a subset (59 patients) from another related USC orthodontic imaging study, which was designed to obtain the standard tip and torque values for each tooth from 76 patients with near normal occlusions. Three-dimensional images

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were generated with a NewTom 3G volumetric scanner at the Redmond Imaging Center at USC. Images were rendered using Dolphin 3D and tip and torque were measured with a custom USC Root Vector Analysis program (Tong et al., 2012). The 3-D measurements data were made available for the current study.

For the construction of 2-D images, the head orientation was set to the same orientation that was used in the 3-D coordinate system with the sagittal plane equally dividing left and right, coronal plane at the maxillary molar buccal grooves and the transverse plane set at the functional occlusal plane bisecting the anterior overbite and the posterior (maxillary first molar) overbite. Two different panoramic-like images, one for the maxilla and one for the mandible were constructed for each patient (Fig. 1). The long axis was drawn through each tooth and the angle was measured against the occlusal plane using a three-point line angle tool within the Dolphin software (Fig. 2).

All 59 cases were measured twice (one week apart) by the same investigator and an intra-class correlation coefficient (ICC) was calculated to check for reproducibility of the data.

The averages of the two-time 2-D measurements were compared with the average of the two-time 3-D measurements available from the previous study (Tong et al. 2012). All data were entered into a spreadsheet and analyzed using Microsoft Excel and Statistical Package for Social Sciences (SPSS).

The data were tested for normality using the Kolmogorov-Smirnov-test. To compare the 2-D and 3-D measurements, paired t-tests were performed for normal data and Wilcoxon Signed Rank tests were performed for non-normal data. Significance was established at $p < 0.05/7 = 0.0071$ based on the Bonferroni adjustment.

Results

For the nine cases used for calibration, the average ICC for the two-time measurements for all the teeth was 0.939, indicating reproducibility in measurements obtained in two different trials by the same investigator. Paired-t test revealed significant differences in 17 of 28 teeth between measurements from 2-D constructed panoramic-like images and 3-D images as evidenced by Table 1.

Discussion

Although it was hypothesized that there would be no differences between constructed 2-D and direct 3-D mesiodistal measurements for each tooth, statistically significant differences were found in approximately 60 percent of the teeth. This indicates that the panoramic X-rays derived from CBCT scans currently may not be the optimal choice of imaging for obtaining precise mesiodistal tooth angulations.

Two-dimensional constructed panoramic images have been shown to have less distortion compared to 2-D conventional panoramic radiographs (McKee, 2002). However, the accuracy of the constructed images may be compromised due to one or more of the following reasons: (a) the position of the tooth in the dental arch (curved or straight), (b) 3-D torque, (c) 3-D tip, (d) tooth size, (e) center trough location and other variables (Sakai, 2011). With the increasing body of evidence showing distortion on 2-D radiographs with no clear trend in those differences, more studies are likely to arise to determine if the distortions can be quantified.

Measuring mesiodistal angulation directly from 3-D volumetric images, although probably the most accurate method so far, may suffer from a number of limitations: (a) the resolution and image quality of CBCT scans, (b) subjective nature of identifying the long axes of teeth and (c) time and effort involved in digitizing center points for each root and crown in 3-D images.

An alternative to the method used for digitizing each tooth would be to define the tooth long axis mathematically, allowing the software to find the crown and root centers automatically and objectively. Once the digitizations are made, the tooth-specific coordinate system for measuring individual tooth tip and torque would be done mathematically and the errors kept to a minimum. This would require very complicated algorithms but may be a possibility in the future.

In a clinical setting, there are also a couple of drawbacks to the use of CBCT imaging, one being the high cost of owning the unit (approximately \$100,000-\$200,000) and the other being the elevated dose of patient radiation exposure. The effective radiation dosage is 3-11 uSv for panoramic radiographs and 5-7 uSv for cephalograms. For a CBCT scan, the radiation dosage can be 40-135 uSv (Sakai, 2011). Therefore, the selection of CBCT for dental and maxillofacial imaging should be based on professional judgment of patient needs for diagnosis and treatment.

This must be in accordance with the best available scientific evidence, weighing potential patient benefits against the risks associated with the level of radiation dose.

Overall, this study on panoramic X-rays and CBCT is still ongoing and will require further investigation in order to achieve definitive results. This is in part due to the need for multiple trials and sample sizes in order to confirm trends and discrepancies in the data. The results of this study should be interpreted with the knowledge that they may only be relevant to the patients selected in this specific sample group and caution should be used when applying it to all orthodontic patients.

The current study used a small sample size of patients with near-normal occlusion and provided a foundation but continued data collection and interpretation is necessary to reach conclusive evidence with regards to panoramic imaging versus CBCT in the field of orthodontics.

Conclusion

This study demonstrated that 2-D mesiodistal angulation measurements from the constructed panoramic-like images may not be as accurate as direct measurements from 3-D volumetric images derived from the USC Root Vector Analysis Program inside Dolphin 3D software.

Presently, the most accurate method available to orthodontists clinically may be using direct 3-D CBCT data to find the appropriate mesiodistal angulations of the teeth. According to Tong, CBCT may eventually replace panoramic radiographs in orthodontic diagnosis and treatment planning because of its ability to provide detail and precise 3-D information without distortion (H. Tong, personal communication, January 11, 2013). Having different views in one scan, such as frontal, right and left lateral, 45-degree views and sub-mental, also adds to the many advantages of CBCT. Coupled with advanced imaging programs that allow for digital models, CBCT not only can provide a great diagnostic tool but also can eliminate the need for taking impressions and fabricating stone models in the near future.

The visualization of all roots and crowns in ideal occlusion in addition to the maxillofacial complex also has implications in other areas of dentistry such as implantology, oral surgery and restorative dentistry. For example, CBCT is largely used in orthognathic surgery planning, the assessment of impacted teeth and visualization of supernumerary teeth. (Alshehri, Alamri and Alshalhoob, 2010).

With increased demand for replacing missing teeth with dental implants, accurate measurements are needed to avoid damage to vital structures. This can be achieved with conventional CT scans, but with CBCT providing more accurate images at lower dosages, it is the preferred option in implant dentistry today (Alshehri, et al., 2010).

Further studies on this topic will help to determine if similar results can be obtained when different variables are introduced into the study such as patients with non-normal occlusion, patients that have undergone extraction treatment, and patients with conventional panoramic radiographs (Sakai, 2011).

Ultimately, the goal of future research is to use modern imaging technology to establish norms in measurements of both mesiodistal angulation (tip) and buccolingual inclination (torque) so that orthodontists have an ideal guide that can be used for accurate diagnosis and treatment planning.

The accuracy of a CBCT volume is limited only by resolution and/or pixel size (Sakai, 2011). However, as the resolution of images are improved by (a) emerging technology, (b) new data processing software and (c) avoidance of patient movement during scanning, more precise results will arise. This could lead to improved, exact and realistic visions of virtual three dimensions for records, treatment planning and treatment outcome evaluation in orthodontics.

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The mobile-friendly dental practice: Why your website should be optimized for mobile-device users

By Diana P. Friedman

> **At the AAO**
> Stop by Sesame booth No. 301 to learn how your practice can leverage mobile technology.

Forty-five percent of American adults owned a smartphone as of December 2012.[1] As these powerful devices increasingly make their way into the pockets of your existing and potential patients, it's a business imperative that your website deliver the experience these users expect.

A strong mobile presence helps you get in front of prospective patients at the moment they're looking for your business. On the other hand, if your site doesn't look good or function properly on a smartphone, it won't take long for patients to move on to one that does.

Not sure if mobile is important to your practice? Here are three reasons you could be missing the boat — and missing easy opportunities to attract new patients to your practice.

Mobile is where your patients are

Many of your patients probably use the mobile web — 87 percent of smartphone users access the internet using their phones[2]. Mobile web usage has exploded during the past few years, and many industry experts project that mobile internet usage will exceed desktop Internet usage by 2014.[3]

For many smartphone users, mobile has also become their preferred way to use the web: 31 percent of current mobile web users mostly go online using their phones.[4]

A Sesame Communications research case study found that a mobile website drove an average of 19 calls per month to the practice.

Mobile is how your patients research — and make — buying decisions

More people are using the mobile web to research and buy goods and services. Ninety-two percent of smartphone users seek local information on their device, and 89 percent have taken action after looking up local content.[5] More significantly for your practice, 52 percent of smartphone owners have used their phones to search for health information.[6]

Without a mobile-optimized site, your practice will have a harder time driving new and repeat appointments from the mobile web. Mobile shoppers are more likely to buy something if the company's site is optimized for mobile, and are more likely to return to a site in the future if their mobile experience is good.[7]

Not mobile? You may be frustrating current patients ... and driving away potential ones

Mobile users now expect any brand they engage with to have a mobile-optimized site. More than half of mobile users say they won't recommend a business with a poorly-designed mobile site.[8]

If smartphone users reach a site and see that it's not optimized for mobile, what will they do? They might leave — 74 percent of mobile users are only willing to wait five seconds or less for a single web page to load before leaving the site.[9] Or worse, they might visit a competitors' site — 61 percent of customers who visit a website that isn't mobile-friendly will leave to visit a competitor.[10]

The bottom line is that not having a mobile-optimized site can hurt your relationships with current patients, and drive away prospective ones.

The mobile web is where many of your patients are, and where they go to find and research your practice. Optimizing your website for mobile will help you best capitalize on the mobile web as a tool for building and strengthening relationships with patients. In selecting a partner to launch your mobile site, make certain they understand on-the-go patient online behavior and leverage your existing online practice brand and social media channels to optimize the impact of your new mobile site.

References are available upon request from the publisher.

About the author

Diana P. Friedman, MBA, is president and chief executive officer of Sesame Communications. She has a 20-year success track record in leading dental innovation and marketing. Throughout her career, she has served as a recognized practice management consultant, author and speaker. She holds an MA in sociology and an MBA from Arizona State University.

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Before

After

Before

After

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