The Vision of Digital Dental Photography

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We live in a society that has to see it to believe it. Instant, live pictures of events broadcast from around the world help to confirm what is being reported. Patients are no different; they want to visualize the conditions in their mouths to understand the recommendations the dentist makes.

With the paradigm shift from disease-based dental treatment to a more encompassing smile-based and health-based model, treatment decisions are significantly influenced by appearance. Photographs are invaluable in communicating with patients the outward view of their smile. Imperfections not readily visible to an active patient are apparent in a still photograph. Photographs allow the patient to visualize with the same acute perspective as the dentist and help the patient understand the rationale for recommended treatment.

Often, unusual features can distract the dentist from focusing on the entire smile with the patient in the chair (Figure 1). Photographs give the dentist unlimited time to evaluate smile nuances so that a more comprehensive aesthetic treatment plan can be developed. Dental photography allows the dentist to evaluate critical smile components. Key tooth proportions can be measured and ideal proportions calculated (Figure 2). The use of computer imaging can be an excellent way to demonstrate the desired results of treatment prior to beginning the operative phase of treatment (Figure 3).

Digital dental photography has been crucial to the advancement of cosmetic dental procedures. It is an effective and necessary tool in the aesthetic dentist's armamentarium. Practice will allow the dentist to archive treatment results and allow every case to be improved.

Communication with specialists is greatly enhanced with dental photography. Images of suspect oral pathology can be forwarded via e-mail to specialists. Sending a detailed description of the lesion, history of the patient, and an attachment of the image can serve as an excellent screening device (Figure 4). The pathologist can then determine the appropriate course of action. Communication with the periodontist prior to elective cosmetic crown lengthening procedures is enhanced with the use of dental photography. The specialist can more easily understand the desired outcome.

Figure 1. Unusual features may distract the dentist during chairside visual examination.

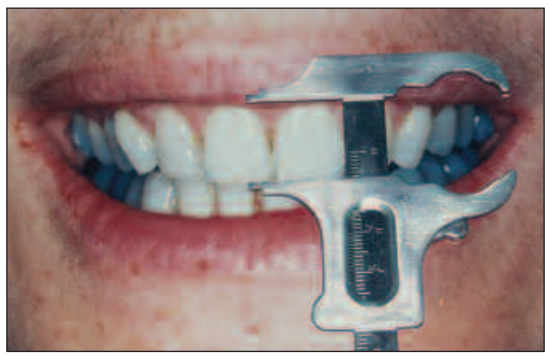

Figure 2. Measurement of critical tooth proportions.

Figure 3. Computer image of desired treatment results.

Figure 4. Image of suspect lesions forwarded to the specialist for screening.

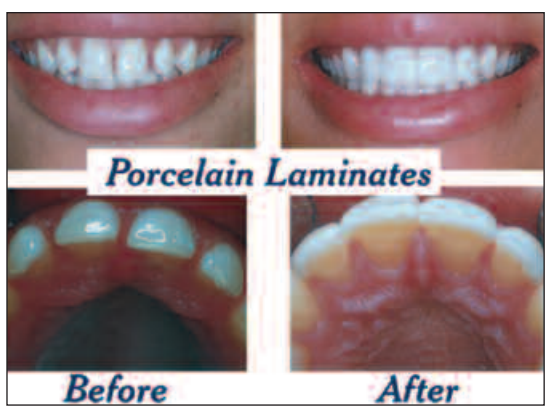

Figure 5. Pages communicate different treatment modalities with patients.

Figure 6. Photographs communicate texture, reflection, and nuances of adjacent teeth.

ADVANTAGES OF DIGITAL PHOTOGRAPHY

There are many advantages of digital dental photography. High-resolution digital sensors produce images that rival those obtained by traditional film. The ability to review an

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Figure 7. Ring flash on digital SLR camera.

Figure 8. Rhodium-plated mirror and cheek retractors.

Figure 9a. Viewfinder image of standard 35-mm film camera at 1:2 magnification.

Figure 9b. Viewfinder image of standard digital camera at 1:2 magnification same distance from object.

Figure 9c. Viewfinder image of standard digital camera at 1:3 magnification farther back from object, resulting in same image size.

image instantly following exposure ensures satisfactory results. There is no direct cost associated with exposing an image, since expenses are incurred only when images are printed. This encourages multiple exposures with different angles and settings and increases the likelihood of a useable view. The remaining images can be stored on a memory card, on the computer hard drive, on a disc, or be deleted.

Images can be easily downloaded into the computer and viewed. With experience, dentists can learn how to edit, crop, and balance images to salvage previously unusable images. Frustrating color inaccuracies occurring during film development from professional photo labs can be reduced. An often-asked question is if a digital image is a legal document. As long as the image has not been modified, it can be used in a court of law. An enhanced image can be readily detected by a photo professional and deemed inadmissible.

USES OF DENTAL PHOTOGRAPHY

Photographs are excellent ways of communicating your treatment capabilities to patients. Dentists should prepare books of finished cases to demonstrate their skills and experience. Pages assembled by type of treatment can be useful for allowing patients to make decisions (Figure 5). Photos are an excellent way for dentists to self-evaluate their final treatment results and identify areas for improvement.

Pictures are an indispensable tool when communicating with the dental laboratory. The ability of laboratory technicians to view the face and smile of the patient for whom they are fabricating prostheses is invaluable. Looking at surface texture, shading, and gingival characteristics allows for more customized fabrications (Figure 6). Laboratory technicians are further motivated to produce the finest results, since they can see that their efforts benefit a real human, and not just fit well on a plaster model.

Dentists planning to treat a patient with any form of anterior prosthesis should have a series of preoperative photographs along with complete radiographic films and models. In today's medical/legal environment, a pretreatment series of photographs is imperative. Imagine appearing in court and being asked to show what a patient looked like prior to your treatment. Plaster models and radiographs do not adequately communicate appearance to nondental professionals.

DIGITAL DENTAL CAMERAS

Digital dental cameras can be divided into 3 main categories. The first type is the point-and-shoot fixed-lens camera readily available for consumer use. This type of camera allows varying amounts of exposure control and mixed results in the unique setting of the oral cavity. Full-face photos can be acceptable, but intraoral and close-up views remain variable. The point-and-shoot fixed-lens cameras offer the easiest use for the most basic results.

The second type of camera dentists use is the modified consumer fixed-lens camera. Consumer cameras may be modified through the addition of a close-up lens adapter and a light diffuser to allow enhanced focusing and more even distribution of light with intraoral pictures. Several of the commonly modified cameras have custom functions and settings that can be accessed to optimize the amount of image that is in focus. Persons accustomed to previewing the image through an LCD screen on the back of the camera often feel more comfortable with this type of camera. Cost and ease of use are the primary advantages of this camera. The modified consumer fixed-lens camera may be suitable for offices where multiple staff members with limited photographic experience will be exposing the pictures, or where the dentist does not possess the desire or knowledge for more exacting results.

The third type of camera used is the digital SLR (single lens reflex) camera. The photographer looks through the viewfinder to see the image that will be recorded. A 90- to 105-mm telephoto macro lens is fitted to the camera body to allow the image to be flat and undistorted. A ring flash is placed around the lens to distribute the light evenly with intraoral exposures (Figure 7). Some cameras are also fitted with point flashes to reduce red-eye with full-face views. Experienced professional photographers may be able to produce better 3-dimensional images with a point flash, but more consistent results can be obtained by the average dentist using the ring flash intraorally.

There are many advantages of the SLR type of camera. The images produced usually demonstrate excellent clarity, contrast, sharpness, and detail. The dentist has complete control of the exposure, including the depth of field, white balance, relative perspective, and brightness. A standardized protocol used for every patient should be developed and followed so that all before-and-after pictures are exposed from the same perspective. Protocols developed by accreditation boards can be obtained and universally followed. Though these cameras are more expensive, they should provide consistently superior results from the experienced and dedicated photographer.

PURCHASING A DIGITAL DENTAL CAMERA

When deciding what type of camera to buy, several questions need to be asked. What is the intended use of the photographs? Who will be exposing the images? What are the cost constraints? If a camera is to be used primarily for full-face and full-smile views, and the person exposing the images is an auxiliary, then a modified consumer fixed-lens camera may be appropriate. If a dentist plans to perform more advanced aesthetic procedures, is preparing for organizational accreditation, or wishes to document treatment, then an SLR may be necessary. A more advanced camera requires a commitment by the photographer to learn how to expose quality pictures properly.

Digital SLR cameras can be ordered from many sources, but a reputable dealer is important. Not only are you buying the hardware, you are also buying the technical support. Digital dental cameras must be set up by a professional to ensure optimal results. Special functions involving the aperture, sensitivity, shutter speed, and flash setting must be pre-set. Cameras purchased from a local camera dealer and set on automatic will not yield satisfactory results.

The ability to communicate instantly with a dental camera professional is important. Just as with other computerized devices used in the dental office, telephone support is critical. Trying to identify a camera malfunction in an instructor manual while a patient is seated in the chair can be frustrating. The result may be the loss of documentation of a critical or unique case.

It is recommended that a purchased SLR camera provide an image greater than 6 megapixels and be fitted with a 90- to 105-mm macro lens. A ring flash with through-the-lens (TTL) metering should be employed. Several medium-sized memory cards are recommended to allow pictures to be taken and downloaded into a computer while another is in the camera ready for use. Necessary accessories include a rhodium-plated mirror and cheek retractors (Figure 8). An inexpensive blue or black felt background purchased at the local fabric store can be hung on the wall to add to the professional image of the picture.

MAGNIFICATION

Most currently available digital SLR cameras can use existing 35-mm film camera lenses, but the resulting magnification will be different on a digital camera body than on a film-based body. The size of a SLR-based film image is 36 mm wide by 24 mm high. Sensors of most SLR digital cameras are smaller. The view of the printed image taken the same distance from the object will be magnified by approximately 50% compared to the image printed from a film-based camera. To compensate, the dentist must be positioned farther away from the object. If standardized magnification protocols are used, then the difference must be factored. Therefore, if a dentist wishes to expose a digital image similar in size to the 1:2 magnification normally viewed with a 35-mm film-based camera, then the camera lens will need to be set at a 1:3 magnification set-

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ting (Figures 9a to 9c). In order to expose a standardized series of views, the lens is set at a manual focus setting, and then the photographer moves forward or backward until in focus with the subject. Full 36x24-mm digital sensors are available on expensive professional cameras, but the cost is significantly higher.

SETTING UP A DIGITAL DENTAL CAMERA

It is recommended that the camera be equipped with TTL metering. A pre-flash is emitted, and the amount of reflected light passing through the lens is metered. This allows the camera to predetermine the amount of light that will strike the sensor before the actual exposure begins. The camera then tells the flash how long to stay on to ensure the proper exposure. The exposure setting should be set to "aperture priority" (often displayed as *Av* on many cameras). In this mode the photographer sets the desired *f*-stop (opening of the lens). The setting with the largest *number* (smallest-diameter opening) possible for the view and flash will give the best depth of field. A large depth of field ensures that all the teeth will be in proper focus. This may be confusing because the larger the number of the *f*-stop, the smaller the diameter of the opening of the aperture. With a larger *f*-stop more light output is required from the flash. The light reaching the sensor has traveled through the inside flatter part of the lens, making more of the image in focus and creating a larger depth of field.

It is recommended that a fast shutter speed be employed to reduce the color effects of operatory lights. A speed of approximately 1/200 second helps to minimize the prevalent yellow spectrum of light found in dental offices. Camera light meters are designed to make all pictures approximately the same lightness. Teeth are inherently lighter than normal scenes. If the camera is set on automatic, then the light sensor will tell the flash that the teeth are too white and will tell the flash to shut off quicker. The teeth will appear to be too dark. In order to compensate for the light nature of teeth, the flash should be set to stay on for a longer period of time. This is accomplished by setting the TTL to overexpose by approximately 1 to 1.5 *f*-stops, which allows the flash to remain on for a longer period of time.

STANDARDIZATION OF VIEWS

A standardized method of exposing views is recommended. By using the same magnifications and views for all patients, before-and-after pictures will be from a similar perspective. Communication is easier among dental professionals when requesting certain views. Dental organizations that accredit members have developed a specific protocol with standardized views and magnifications. The views described are the author's personal views and may not be the same as accrediting organizations.

The camera is set at 1:15 (digital camera body) to expose the 1:10 full-face view (Figure 10). A blue or neutral background should be placed behind the patient and the patient's head, which is located about 6 inches in front of the background (Figure 11). The patient should be instructed to smile, and several exposures are taken. Vertical views are preferred for display to patients, and horizontal or landscape views are best for presentations to other dentists. Focusing is critical with this view because a smaller-numbered *f*-stop (larger-diameter opening) is used, and the depth of field is diminished.

The patient is reseated in the dental chair, and the camera lens magnification is set to 1:3 (digital camera body; Figure 12) for the 1:2 full-smile view (Figure 13). The *f*-stop is reset since the flash is closer and a smaller opening will allow adequate light. This will give better depth of field. Multiple exposures are taken with a full smile, a smile in repose, laughter, and with the patient saying "E."

The *f*-stop and magnification are left unchanged, and the left and right lateral views are taken (Figure 14). The image should be centered between the lateral incisor and the cuspid. This angulation takes practice, and several attempts should be made on both sides. The patient is once again instructed to smile.

Staff assistance is invaluable during exposure of the retracted views. One or 2 members may be employed. A retracted smile view is taken at the same settings with the slightly separated (Figure 15). In all of the 1:2 views it is important that the photographer be parallel to and even with or very slightly above the horizontal plane of occlusion.

Next, 1:1 views are taken (Figure 16). The photographer should steady the camera, since the magnification is so great. The teeth are parted significantly, the cheek retractors are pushed upward, and a black background may be inserted for dramatic effect.

Finally, mirrored occlusal and mandibular views are taken at the 1:2 to 1:1.5 setting (Figures 17 and 18). Cheek retractors remain, and an assistant may blow air on the mirrors to reduce fogging. The patient should be instructed to place the tongue behind the mirror for the mandibular view. These views require experience, but practice makes perfect.

The images can then be downloaded by removing the memory card or plugging the camera directly into a computer. The images can be stored, transmitted via e-mail or Internet, or printed. If no printer is available, they can be taken or forwarded to the professional developer for printing. Memory cards can be enclosed along with impressions to the dental laboratory with each case. Images viewed by the laboratory on a monitor vividly reproduce the appearance of the adjacent teeth, and are often superior to printed images.

Finished case photos can be taken in the same sequence. These can then be assembled in albums, used in programs, or viewed by the dentist for evaluation. Smile photos of before-and-after views can be given to the patient.

SUMMARY

Digital dental photography has been crucial to the advancement of cosmetic dental procedures. It is an effective and necessary tool in the aesthetic dentist's armamentarium. Practice will allow the dentist to archive treatment results and allow every case to be improved. Dentists wishing to advance their techniques and to complete accreditation protocols should master these techniques.

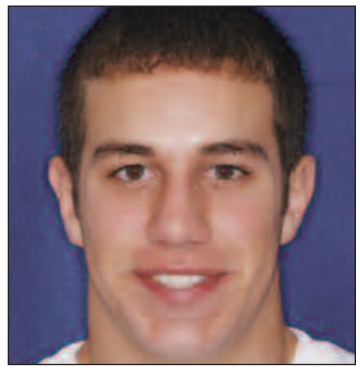

Figure 10. Full-face view.

Figure 11. Patient standing in front of blue background.

Figure 12. Lens set at 1:3 to provide 1:2 magnification.

Figure 13. Full-smile view.

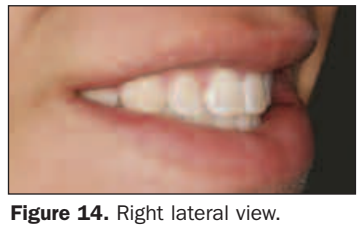

Figure 14. Right lateral view.

Figure 15. Retracted smile view.

Figure 16. Retracted close-up view.

Figure 17. Mirrored maxillary occlusal view.

Figure 18. Mirrored mandibular occlusal view.

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