The popularity of digital photography is booming. In a recent survey, 47% of dentists who responded owned a digital camera and 13% planned to purchase one in the next 12 months. Out of those who were surveyed, 90% use their digital pictures for laboratory communication. Digital photography makes it possible for the immediate taking and sending of images between the patient, dental laboratory, general dentist, and specialist. Pictures, especially for laboratory communication, are a necessity when trying to match teeth for color, luster, shape, and character with fabricated crowns and veneers. Photographs are much better than hand drawn maps of teeth. In fact your digital camera, with specialized software, can provide accurate shade prescriptions. This reduces subjectivity and the difficulty of shade matching. To be competitive in the dental industry, understanding and implementing digital photography is essential.

Clinical photographs also give an emotional connection between the technician and patient (Figure 1). The ceramist is not just looking at a stone model; they see the teeth, the patient's face, the shape of the head, the symmetry of the smile, and what is exposed in the esthetic zone. All are assets that will assist the ceramist do their best work.

Choosing a Digital Camera that Best Fits Your Needs

Because camera technology changes quickly, what was true a year or even a month ago may not be so today. Relying on someone else's opinion is as fool hearty as asking the waitress what she thinks is good to eat from the menu. Your needs are as unique as your palette.

I suggest doing some meaningful research to avoid misunderstandings and dogmas. A camera's specifications alone are not a reliable way of determining its ability to take dental pictures. Needs, budgets, and performance are important determinates in deciding your best camera choice. This will be discussed in this article along with taking images for case communication, archiving, and electronically sending your images. Here are some terms and related discussion points about digital cameras.

Megapixel (MP)

The first question I hear most often about digital cameras is, “What is a MP?” The reality is that this is probably one of the last things to concern you because most cameras today meet or exceed what is needed. Each “pixel” represents a color point on the digital cameras conversion sensor (CCD) or complementary metal oxide semiconductor (CMOS). One MP equals 1 million dots of the color (red, green, or blue). It is the mixture of these colors that makes up all color and makes up the image.

Have you wondered why your pictures vary in file size? In nature you see more greens and blues than reds, and the camera manufacturers set their sensors up to maximize this. So, even though there are 1 million pixels, my research shows that there are a higher number of the green and blue pixels over the red ones. So in this case, the picture of pure green or blue is around 1,780k and the picture of red is 35% less at 1,162k. This variability is why different camera makes are skewed to particular colors (Figures 2 through 4).

Approximately, 1 MP is capable of printing a 4-in × 6-in sheet without any deterioration; 2 MP does the same for an 8.5-in × 11-in sheet. To put it in perspective, most computer monitors are just smaller than 1 MP (1024 × 768 = 786,432 pixels). A 6-MP image would be 6 times as large as your screen and up to 13 megabytes (MB) (noncompressed raw image). This is too large for practical storage, manipulation, or electronic communication. Here is an important point, a 2-MP image that is sharp and clear is better than a 6-MP image that is blurry. Cameras have quality settings which also affect the image size. My recommendation for most uses is to adjust your camera so the image size is between 1 MB to 2 MB. The cameras mentioned in this article reached a point where the resolu-
tion (around 6 MP) exceeds the needs of most users. Emphasis should be placed on usability and image quality.

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White Balance/Color Adjustment
Each camera will have its own color characteristics and adjustment methods. Usually, white balancing, which is calibrating the camera to your lighting environment, usually gets color close to accurate. The procedure is not difficult and is illustrated in your owner's manual. Not all cameras have the white balance function and give you less ability to correct your color. This is true of the Kodak DX7590 camera (Kodak Dental Systems) that has no white balance feature and gives you a magenta look.

Aperture (f-stop)
The larger the number increases the depth of field. So f22 is good for your intraorals pictures, all the teeth are in focus. F5.6 would be for a full-face portrait where you would want a blurry background.

Digital Cameras
Here are two classes of cameras: the DSLR (digital single-lens reflex) and point-and-shoot-cameras. Here is some information about each.

DSLR Cameras
In the DSLR cameras, the most popular brands (in order) are the Canon Digital Rebel XT (Canon USA, Inc) (Figure 5), Canon Digital 20D (Canon USA, Inc), (Figure 6), the Fuji S3 Pro (Fuji Photo USA) (Figure 7), and Nikon D70 (Nikon Corporation).

Lighting
All these cameras are sophisticated with high capabilities that they go beyond dental photography; they should have a front mounted ring flash, point flash or dual-mounted lights (Figures 8 and 9) and are usually manually focused for close-up photography. Without a ring flash, your macro pictures might be washed out. The external flash is metered through the lens by the cameras mentioned, except the Nikon. With the Nikon, you have to set the flash power manually which then may need readjusting depending on the picture. Controlling the power and angle of light on the teeth gives you different important information. This will be discussed in the photography part of the article.

Lens
Most owners outfit the cameras with a 100-mm macro lens. The macro lens has the ability to focus up close. Because the digital camera uses a CCD or CMOS sensor that is of a different size than 35-mm film, a 100-mm lens on a 35-mm camera converts to 160-mm on a digital camera. I bring this up because a higher magnified lens gives a flattening effect on pictures. Canon recently released a 60-mm macro lens (EF 60-mm f/2.8) which equates to 96 mm. This is a better choice.

Image Size—MP
All these cameras are around 7 MP and have many adjustments so the image quality will not be a problem.
Not all cameras have the white balance function and give you less ability to correct your color.

The alternative, long-camera straps, too often catch on a door knob or the arm of a dental chair.

Point-and-Shoot Cameras

As noted above, do not let camera size or M P drive your purchasing decision. High quality and DSLR features can be found in a small package that takes superb pictures. Some of these cameras have been modified and some are off the shelf. Regardless of the specifi-cations, some cameras have the capability to take dental photographs, and some do not. These cameras are between 5 M P and 7 M P, enabling good quality images. Things we look for is ability to focus close up, color control, proper lighting, exposure control, depth of field, overall ease of use and support.

The Canon DentalFoto (Dental Learning Centers/Patterson Dental Supply) (Figure 10), Olympus SP320 (Olympus America, Inc), and Canon G6 (Canon USA, Inc) are three good examples in this classification. These cameras have similar features to the DSLR cameras. They are lighter but do not have the range of settings as the DSLR or interchangeable lenses. In addition, viewing is done through a liquid-crystal (LCD) screen not TTL.

Lighting

The Canon DentalFoto (using the A620 PowerShot at 7.1 M P) and Olympus SP320 (7.1 M P) use onboard lighting located on the camera body, but very close to the lens. The light is diffused and eliminates a need for a ring flash. The Canon G6 needs either the Canon MR-14EX (Canon USA, Inc) ring light or a proprietary diffuser. Lighting is very good.

Lens

The Canon DentalFoto which has a proprietary lens extension and the Canon G6 need a snap-on lens accessory for close-up pictures. Both of these cameras have memorized presets that zoom in for you if it is set up right. The Olympus SP320 uses no additional close-up lens. This camera works best at about 8 in away from the subject which is further away then the other two.

Image Size—MP

As stated previously, the cameras are from 5 M P to 7 M P and can be set at different compressions. They should be set around 1.5 M B per image for storage and emailing.

Settings

Like the DSLR cameras, important settings are color, exposure, and depth of field. The advantage here goes to the DentalFoto and G6 over the Olympus SP320 because memorized settings that are programmed into the camera. The DentalFoto also has an optional digital photography course for laboratory technicians and dentists on digital photography with 4 hours of continuing education credits given. The kit cost is $1,538 with dental mirrors costing $1,746.

I discovered from Lester A. Dine, Inc that the Olympus SP320 camera works well but is reported to slightly over expose the image unless modified. The on-board flash sits by the lens lessening any shadow effect.

The Canon G6 has been out for quite a while and will be retired soon. To work in the dental photography environment, it must be outfitted with a Canon MR-14EX ring light or a diffuser making it pricey. These cameras all provide good lighting and offer controls like the DSLR cameras. They differ in that:

- you view an LCD not TTL.
- diffusers, ring lights, or onboard flash are used.
- the camera focuses rather than being manually focused.
- the camera is lighter and less bulky.
- they do not have the depth of field as the DSLR.

A good choice for performance and cost is the Canon DentalFoto with the dye sublimation printer.
Intraoral Photograph Series

Figures 21 through 26 are examples of pictures taken with the Canon DentalFoto digital camera needed for patient and laboratory communication usually taken at the dentist office. The series includes natural smile, retracted anterior view, upper and lower occlusal and buccal corridors. You can see existing shapes, color, texture, anatomy, and character of the teeth as well as irregularities to give vital information for esthetics and tooth fabrication.

Full-Face Photographs

Full-face photographs should be shot at around f5.6 putting more emphasis on the face and less on the background. My personal preference is to take a full-face photograph in the vertical position. This gives less wasted space because the head is more vertical. If you ever put a before-and-after picture on one page, it fills up a horizontal page better. If you use a background, black or gray looks better than white or color. The human eye, even from an expert, can be easily fooled concerning these things. That is where computerized shade analysis software is invaluable.

Setting Up an Archiving and Email System

When you have taken or received pictures, you should archive them on your hard drive. Do not worry about the cost of storage space, as the cost of memory has
dropped significantly over the years. One gigabyte (GB) can store about 800 images. For less than $250 you can purchase a 200-GB hard drive giving you about more than 100,000 image capacity. The challenge is not storage, it is in finding what you want when you want.

I am a believer in dental image management software provided by most of the major practice management vendors. There is also non-dental software, one of which is Thumbs Plus (Cerious.com) (Figure 32). It is an inexpensive and easy to use archiving, editing software. You simply create folders into a “tree.” For example, you can create a folder with the patient’s name, then three or more folders covering the alphabet. Each patient falls into the alphabetized folder for easy access. The software also has resizing and editing features.

When emailing, most people use Microsoft Outlook. Here is how to email with an attachment:

- Put in the email address and put in any message.
- Click on the “Paper Clip” (see red arrow) (Figure 33).
- This Window comes up allowing you to browse to the picture or pictures. Click on the picture that you want to attach. There are practical limits as to the file size of the communication set forth by your ISP provider and band width (Figures 34 through 35).

Conclusion

Choosing and implementing the necessary equipment and software to take, store, and retrieve digital images is an important task for both the dentist and dental laboratory. Steps are not always clear so coaching and guidance from dental digital technology experts is recommended when you think things are getting too technical. Usability and performance can be obtained from any of the cameras discussed. Do not be swayed by what someone else has done but what best meets your needs. Too often I have seen a “ready-fire-aim” approach with unhappy results because things that do not perform or are too complicated to use. Digital photography is not a fad but a wonderful communication aid for the dentist, patient and dental laboratory.

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References