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Digital Photography and Imaging for the Cosmetic Dermatologist: Part I
Cameras, Lenses, and Flashes

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This is the first installment of a two-part series. Part II will be published in February.

It is great to be alive in the new millennium, as we are truly witnessing a paradigm shift. We are seeing emulsion film photography, a system that has existed for almost 150 years, being replaced by photographs made by numerical digits.

Technological advances in digital photography have increased exponentially over the past decade. Not only is it now possible to make truly instant images, but, equally important, so much can be done with these images after they are made. The Internet allows us to effortlessly transmit them all over the world in a matter of seconds. The clinical implications of this technology are limitless.

An understanding of several areas of digital photography and imaging is needed in order to successfully set up and use these technologies in a clinical practice. These areas are imaging hardware (digital cameras and scanners), computer imaging hardware (computers, notebooks, backup devices, printers), computer imaging software, and photographic techniques. Although photographic techniques have changed little over the past century, hardware and software are changing rapidly.

In this article, the first in a two-part series, I discuss digital cameras, lenses, and flashes.

Digital Cameras

To discuss digital cameras, one must grasp the often misunderstood concept of resolution. Many people believe that resolution is the only important factor in digital photography. They mistakenly assume that the higher the resolution, the clearer the picture. Although this statement holds some truth, resolution actually relates to the size of an image. An image captured at 640 × 480 pixels will print at about 7 × 9 inches (16 × 22 cm). This is the same resolution achieved with NTSC video signals or the same size achieved with videocassette recorders. An image about twice as large (1024 × 1280 pixels) will print at about 14 × 18 inches (36 × 45 cm). The gold standard for resolution is still found in 35-mm slide film—approximately 3000 × 4000 pixels, which theoretically equals 12 million pixels. The maximum resolution of consumer-grade digital cameras at the time this article was written was 3.3 million pixels, which means that, in about a decade, we have reached a point halfway toward the gold standard. Certainly, the next decade will take us the rest of the way, and we will develop extreme resolutions for digital images. Figure 1 shows a comparison of digital resolution and the resolution of 35-mm slide film.

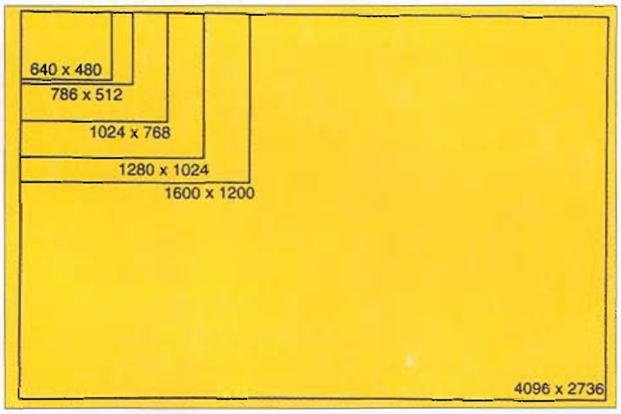

Fig. 1: This graph shows the number of pixels captured at various digital resolutions as compared with the resolution of 35-mm slide film.

As resolution has increased, so has the demand for memory. This is a blessing and a curse. Images of higher resolution are possible, but each may require 10 to 80 megabytes (MB) of memory, and storage solutions are much needed. In the early 1990s, a laptop computer with a 170-MB hard drive was a cutting-edge machine. At the time of this writing, laptops with 30-gigabyte hard drives are available. There is no doubt that image resolution and storage capacity will increase concomitantly.

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This begs the question: How much resolution is required for medical photography? A resolution of 1280 × 1024 pixels is adequate for accurate detail. This minimum standard will constantly increase in concert with digital camera resolution, and soon *minimal resolution* will be an obsolete phrase.

I use a resolution of 1280 × 1024 pixels which is midrange on most high-end consumer digital cameras. This resolution works well in terms of detail, does not overpower the Windows operating system, and is suitable for most academic applications including clinical archiving, multimedia lecturing, and scientific publications.

LENSES

The digital camera is the most important link in the chain of digital photography, and you get what you pay for. The lens systems of digital cameras are similar to those of conventional film cameras, but, instead of the image being focused on an emulsion film surface, it is focused on a charged coupled device (CCD) that converts light into digital information. For the most part, the tenets of light, lens, focal distance, and exposure are the same for both types of cameras.

Through-the-lens (TTL) focusing is another important requirement. Most of us are used to taking clinical images with 35-mm single-lens reflex (SLR) cameras (Fig. 2). These cameras have focusing systems that allow the user to preview the image that will be registered on the film; this is essentially *WYSIWYG* ("what you see is what you get"). Range-finder cameras, which do not use TTL focusing, are subject to *parallax,* in which the image previewed through the range-finder lens does not correspond exactly to the image that will be registered on the film; dealing with the difference can be very frustrating, especially with macrophotography, because the image can end up off-center or with an edge cut off.

Fig. 2: The Olympus C2500L digital camera is an example of the megapixel cameras that may be used for clinical photography. The single-lens reflex system and through-the-lens focusing of these cameras make them very similar to the 35-mm cameras with which most of us are experienced. Aftermarket ring flash and macrolenses are available.

First-generation digital cameras were rudimentary and produced grayscale images of very low resolution. Only a few months after they were introduced, grainy color digital photography arrived on the scene. Color digital cameras were eventually able to produce resolution of 640 × 480 pixels. For the first time, digital results were predictable, recognizable, and acceptable; the level of detail, however, was insufficient for dermatology. In addition, these images could not be enlarged without causing their pixels to become jagged and grainy.

As digital resolution is now higher than what dermatologists require, they can pick which resolution to use. Again, the problem with high-resolution images is that they bog down computer operating systems, consume memory, and travel very slowly via e-mail and Internet.

Many fine digital cameras are available, but dedicated clinical digital cameras are scarce. Fuji produced a great camera with three attachable macrolenses and three flashes but ceased production several years ago. Today's purchasing decision involves knowing which popular general-purpose camera can be used successfully for digital clinical photography.

FLASHES

After lens type, focus method, and degree of resolution comes another area to be considered when evaluating cameras and that is the flash. Flash technology, which revolutionized photography more than a century ago, is still important for image quality. Flashes on better digital cameras are automated and compensate for various light conditions. These flashes are great for general-purpose photographs but can fail miserably with clinical macrophotography. A standard pop-up flash suffices for full-body, partial-body, and profile and full-frontal facial photography (i.e., most high-end digital cameras suffice for these "shots" without a problem).

Control of shadows is paramount for correct clinical photography. Nothing looks more amateurish than shadow-ridden clinical images. In addition, a shadow on the subject's nose, chin, submental area, or ears can obscure the image, making it difficult to ascertain the extent of a deformity or surgical outcome. Unwanted shadows can be minimized or eliminated in many ways. Professional photographers use *bounce, slave,* and *background* flashes. With a main–slave setup, the main flash instantaneously triggers the slave flash. Higher quality digital cameras have *hot shoe* or *flash synchronization ports* that allow use of ancillary flashes. A local camera store can provide inexpensive means of adding flashes for photography.

Fig. 3: **a.** Profile shadowing, which can be a problem when taking clinical photographs. **b.** The same image taken with the camera and flash rotated 90° to the right; as the flash is projected directly toward the profile, there is no shadow cast. **c.** The same image taken with adequate room light and no flash—another means of overcoming shadows.

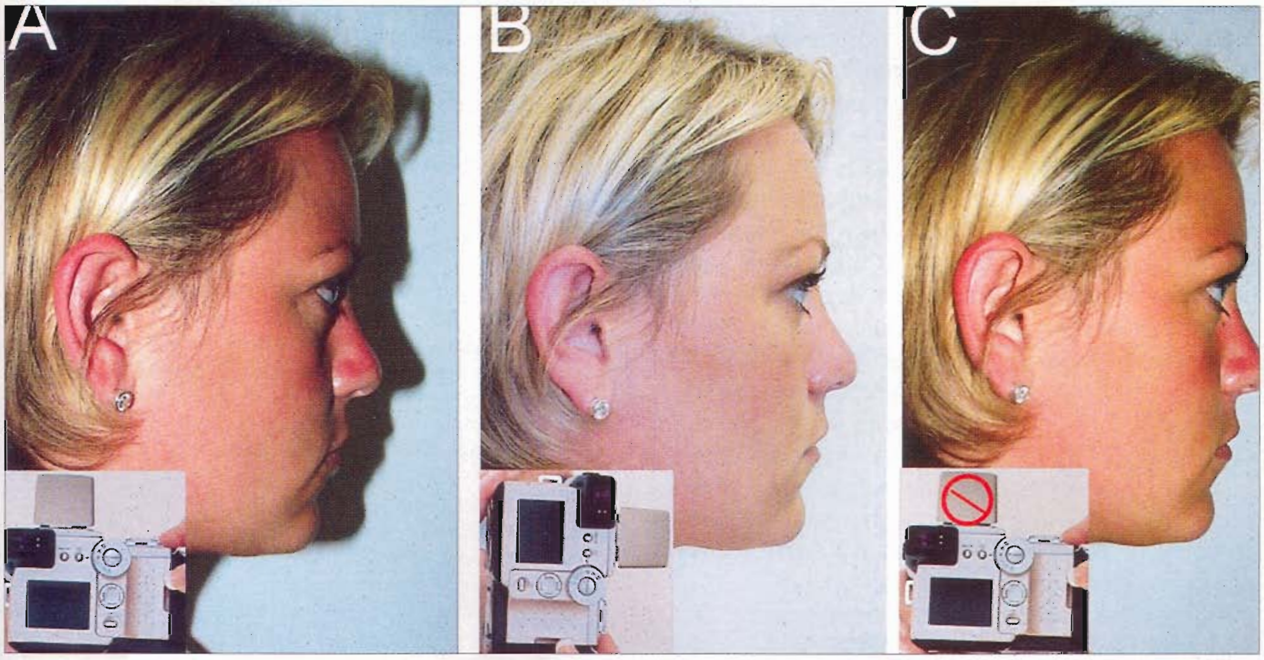

Fig. 4: **a.** This shows the problem with using a conventional digital camera for macrophotography. The lens is close to the subject, but the flash is remote and so does not illuminate the target area. **b.** A close-up taken at higher resolution. The photographer moves away from the subject and then zooms in with the camera. The conventional flash illuminates the area because the camera is farther away. At the higher resolution, the image is larger; it may be cropped to show only the target area. **c.** A close-up taken without flash in a room with good ambient lighting. When the amount of light in a room is significant, flash is not needed, and the camera may be held closer to the subject.

There are simpler means of minimizing or eliminating shadows. Flash position can have a lot to do with making good images and controlling shadows. Most doctors take all their photographs with the camera oriented horizontally. This means that the flash approaches the subject from all angles uniformly—the result being that shadows are cast on some areas no matter what. This can be a problem particularly for profile facial photography, in which the nose, chin, and submental area cast shadows (Fig. 3a). Profile shadows may be corrected by orienting the camera vertically with the flash on the same side as the patient's nose (Fig. 3b). Another means of eliminating unwanted shadow is to use a well-lighted room and forgo the flash. Most high-quality digital cameras are very light-sensitive and can take photographs in low light (Fig. 3c). One caveat is that colors, hues, and saturations may vary with use of flash light, room light, or window light. The best approach is to experiment in order to see which method or combination provides the most accurate color representation. Further control may be achieved by adjusting the exposure and film speed (ASA) settings on the digital camera.

Most dermatologists require macrophotography, which comes with its own set of challenges for digital cameras. Although digital cameras are very different from conventional film cameras, they are also amazingly similar in terms of lenses and flash.

A dedicated macro lens, though popular, renders the camera inappropriate for larger areas and useless for torso or full-body shots—which is unfortunate for doctors who perform significant conventional slide photography. The trick in the past was to switch lenses. As stated earlier, most currently available digital cameras are set up for general-purpose photography and are intended more for vacation pictures than for capturing images of melanomas and blepharoplasty incisions. The key is to adapt the camera for macrophotography. Many digital cameras advertise *macro capability,* a label that can be misleading. As any photographer knows, the macrolens is often more expensive than the camera itself. A quality lens is everything. In my experience, the more inexpensive digital cameras that advertise macro capability produce distorted, inferior images. Cheaper lenses distort the periphery of the image, which can cause problems with dermatologic photography, especially when evaluating or mapping lesions. A means to test the quality of the macro capability of a digital camera is to take a photograph of textbook print or of a piece of graph paper and then check the resulting image for distortion. The Olympus C2500L digital camera has a high-quality aspherical glass lens that in my experience produces very good macro images. This lens is capable of focusing on a subject from as little as 0.8 inch away. Another means of magnifying clinical images is to use *diopter lenses*—a series of lenses that screw onto the threads on the inside of the digital camera lens. Adding 1 to 3 diopter lenses can increase the macro capability of many cameras. Although frequent, distortion at the image periphery has not been a significant problem for my digital clinical photography.

Although the macro capability of the Olympus C2500L (and probably of other high-end digital cameras) is adequate for true macrophotography, the variable of flash again enters into the equation. First, the distance from lens to flash, which differs greatly from camera to camera, is very important. Greater distances can cause problems with macrophotography. For example, when a close-up is being taken, the lens may be focusing on one area (e.g., the patient's left pupil), but the flash, perhaps several inches away, is illuminating another area (e.g., the patient's forehead). As a result, the target may not receive the light it needs; indeed, if some part of the patient's anatomy is blocking the flash, a severe shadow may be cast on the target. Areas may also be overexposed or underexposed (Fig. 4a).

Another way to obtain a close-up without using a macrolens and a ring flash is to increase resolution. When taking a high-resolution image, move away from the subject and use the standard flash. This allows more light to reach the target area (Fig. 4b). The image will be very large. Use an image editor to crop the periphery and show only the desired area. If you plan on doing extreme macrophotography, purchase a synchronized ring flash and mount it to the lens threads on the digital camera. Figure 4c shows a macrophotograph taken using a screw-on diopter magnification lens and a synchronized ring flash. If many of your images require this type of magnification, then macrolenses and ring or point macroflashes are a necessity. If an image like the one shown in Figure 3b is adequate, then high-end off-the-shelf digital cameras will suffice without additional equipment. These work well for moderately close macro images. If there is enough ambient light in the treatment room, you can also experiment with taking close-ups without a flash. For the closest images, there is still no substitute for lens-mounted ring or point flashes; in addition, digital cameras need to accommodate multiple lenses in order to rival 35-mm functions. Digital cameras are available with interchangeable lenses, but prices are currently out of range for most clinicians.

In part II, to be published next issue, I finish up with a discussion of image editing and archiving software.

Suggested Reading

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