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## NOVELTIES IN DERMATOLOGY

### Guide to Buying a Camera for Dermatological Photography<sup>☆</sup>

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**Abstract** Choosing a camera for use in the dermatology office is difficult, particularly in the case of a digital camera because the market is constantly evolving. This article explains the features that should be taken into account, including camera type, sensor, lens and macro capability, aperture priority mode, screen, viewfinder, operating speed, flash, battery, memory card, and image format. The most recent advances in the field of digital photography relevant to the dermatologist are discussed.

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#### Guía para la compra de una cámara fotográfica para Dermatología

**Resumen** La elección de una cámara fotográfica para su uso en Dermatología suele resultar un proceso difícil, tanto más si esta es digital, ya que el mercado evoluciona constantemente. En el presente artículo se enuncian y describen los parámetros en los que debemos basar nuestra elección y que incluyen el tipo de cámara, el sensor, el objetivo y su capacidad macro, el modo prioridad a la apertura, la pantalla, el visor, la velocidad de funcionamiento, el flash, la batería, la tarjeta y el formato de imagen. Se apuntan los últimos avances en el terreno de la fotografía digital que pueden tener utilidad en las cámaras de uso dermatológico.

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At some point in their career, all dermatologists need to buy a camera. Digital camera technology is advancing at a rapid pace, and it can be difficult to keep up with the

features of new models. This article highlights the most recent developments relevant to dermatology.

If you are not interested in technical details and only need a quick guide to buying a camera, see [Table 1](#). If you wish to familiarize yourself with all the details in order to make an informed decision, please keep reading.

In the pages that follow we analyze each of the factors dermatologists should take into account when choosing a digital camera.

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**Table 1** Recommended Characteristics of a Digital Camera for Dermatological Photography.

Characteristic/Feature	Recommendation
Camera type	SLR Mirrorless Advanced compact
Sensor (format/size/pixels)	APS-C (in an SLR camera) APS-C or Micro 4/3 (in a mirrorless camera) Size $\geq 1/1.7$ in (in a compact camera)
Lens	8-14 megapixels (in an SLR, mirrorless or compact camera) 40, 50, or 60mm macro lens in an SLR camera with an APS-C sensor; 60 to 105 mm macro lens in an SLR camera with a 35 mm (full-frame) sensor 45 mm (approximately) macro lens in a mirrorless camera, if possible Minimum focus distance of 1 to 5 cm in macro mode
Aperture priority mode	Standard feature on SLR and mirrorless cameras. Only available in mid-range to high-end compact cameras
LCD screen	2-3 in At least 400 000 pixels Ideally with flip-out screen
Viewfinder	Irrelevant in compact cameras Irrelevant in mirrorless cameras (unless electronic) Ideally with coverage of $\geq 95\%$ in an SLR camera
Operating speed	Start-up time: max. 1-2 s Shutter lag: max. 0.5 s Shot-to-shot speed: max. 1-2 s
Flash	Ideally ring flash or similar (in an SLR camera) Adjustable intensity Manual on/off Located near the top of the camera body
Battery	Ideally NiMH 200-350 shots per charge Capacity $\geq 1000$ mAh
Memory card	SD (or SDHC or SDXC variants)/CompactFlash Capacity $\geq 4$ GB Speed $\geq 20$ MB/s for video

Abbreviations: APS-C, Advanced Photo System Classic (a digital camera sensor format of approximately  $23 \times 15$  mm); GB, gigabyte; MB, megabyte; NiMH, nickel-metal hydride (materials used to make NiMH rechargeable batteries); SD, Secure Digital; SDHC, Secure Digital High Capacity; SDXC, Secure Digital Extended Capacity (digital-camera memory card formats).

## Camera Type: Single-Lens Reflex, Compact, or Mirrorless?

Choosing a camera type is probably the most difficult decision. There are 3 basic types of camera: single-lens reflex (SLR), compact, and mirrorless.

In SLR cameras, a reflex mirror reflects the light passing through the lens upward through a pentaprism, where it is reflected through the viewfinder (Fig. 1). The inclusion of the reflex mirror makes SLR cameras bulkier and more expensive; however, because they have a larger sensor, SLRs provide excellent image quality. SLR cameras also include all the features required in dermatology, including, in particular, the option of attaching macro lenses and using a ring flash (Fig. 2).

Compact cameras do not have a reflex mirror, so they are smaller and more compact (hence the name). Most cameras of this type have no viewfinder—or, at most, a viewfinder of limited utility—and the image is displayed on a liquid crystal display (LCD) screen (Fig. 3).

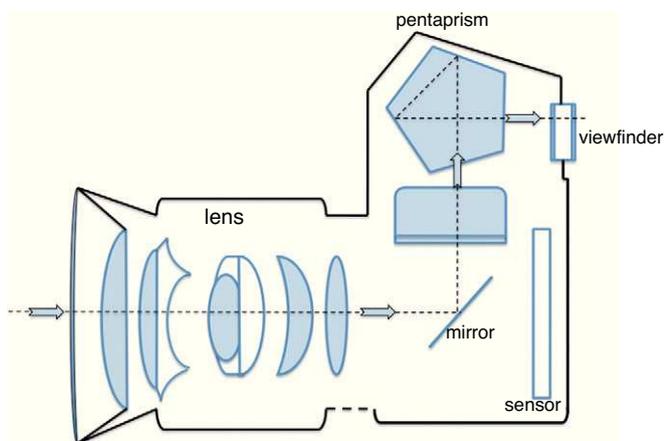
Because compact cameras are small and light, they are very portable and easy to use. However, their image quality is inferior to that of other types of camera.

On most compact cameras, the lens cannot be replaced and the quality of the built-in lens is not comparable to that of the fixed-focal-length macro lenses available for SLRs.

Very few compact models are equipped with a hot shoe for mounting a ring flash. In any case, the use of a ring flash significantly increases the weight and volume of a compact camera, thus negating its main advantage (Fig. 4). High-end compact cameras do offer the advanced features that are essential to dermatologists, such as aperture priority mode and flash intensity control.

In recent years, new camera types have been introduced to fill the growing gap between SLRs and compact cameras. Of these, mirrorless cameras are the category that has gained the most ground in the last 2 or 3 years.

As the name implies, mirrorless cameras have no reflex mirror. Therefore, they are small-bodied, like compact cameras, yet they offer superior features and lens



**Figure 1** Diagram of the interior of an SLR camera showing the reflex mirror inside the camera body. The mirror reflects the light that passes through the lens upward into a pentaprism, which in turn reflects the light through the viewfinder.



**Figure 2** SLR camera with a macro lens and ring flash attached.



**Figure 3** Back of a compact camera with a liquid crystal display (LCD) screen.



**Figure 4** Compact camera with flash for macro photography. With this setup, image quality is increased but the convenience of the compact camera is lost.

interchangeability—in particular, the possibility of attaching a macro lens (Fig. 5).

The mirrorless design reduces the size of the camera body but also obliges users to either compose their photographs on the LCD screen, as in a compact camera, or else to use an electronic viewfinder (a tiny screen viewed through an eyepiece). The viewfinder may be built in or optional (in certain models that do not include it as standard).

The lack of a through-the-lens optical viewfinder is the main difference between mirrorless cameras and SLRs. Nevertheless, mirrorless cameras, like their larger counterparts, have advanced features and accept high-performance macro lenses (although the range of compatible lenses available is limited).

The lenses on mirrorless cameras, unlike those of compact models, do not retract into the camera body, making the mirrorless a bulkier and less portable option.

With certain limitations, a ring flash can be attached to a mirrorless camera, although, as in the case of compact cameras, it reduces portability and ease of use. The prices of mirrorless cameras fall midway between those of SLRs and mid-range compact cameras.



**Figure 5** Example of a mirrorless camera, which is similar in size and appearance to a compact camera but offers superior features.

**Table 2** Comparison of the Characteristics of the 3 Camera Types.

Characteristic	SLR	Compact	Mirrorless
Macro lens	Yes (sold separately)	No	Yes (sold separately, has some limitations)
Ring flash	Yes (sold separately)	Very rarely (decreases portability)	Yes (sold separately, has some limitations)
Sensor (quality)	Excellent	Good	Very good
Raw image format <sup>a</sup>	Available	Only on advanced models	Available
Volume	Large	Small	Small-medium
Weight	Heavy	Light	Light-moderate
Need for photographer to move up/back for close-up/distance shots	With a fixed-focal-length lens, yes; with a zoom lens like that of a compact camera, no	No (the lens zooms in and out)	With a fixed-focal-length lens, yes; with a zoom lens like that of a compact camera, no

<sup>a</sup>A raw image format is a format in which images produced by a digital camera can be saved. Raw image files—the digital equivalent of negatives—give the best photographic results. Unlike JPEG files, however, they require additional processing with specific software before they can be used.

In addition to these three main camera types, the following are also available: compact cameras with larger sensors and fixed-focal-length lenses, compact cameras with small sensors and interchangeable lenses, and even small cameras with interchangeable lenses and sensors.

Of all the variants in this intermediate group intended to bridge the gap between SLRs and compact cameras, at present only mirrorless cameras are truly appropriate for dermatological photography.

Table 2 compares the characteristics of the 3 camera types.

## Sensor

The sensor of a digital camera is equivalent to the film used in analog photography: it captures the light that enters through the lens. A sensor is made up of millions of photodetectors that convert light energy into an electronic signal.

The number of photodetectors in a sensor corresponds to the number of pixels in the images it generates. Thus, a sensor with 12 million photodetectors generates 12-megapixel (12-million-pixel) photographs.

The larger the size of each photodetector, the greater the camera's ability to capture light and, consequently, the better the sensor's signal-to-noise ratio.

To illustrate this point, it is useful to think of the noise or hissing sound made by an analog cassette tape when the volume is turned up. If the original signal is strong and clear—as is the case with larger photodetectors—there is no need to raise the volume, and no hissing sound can be heard. However, if the original signal is weak—as is the case with smaller photodetectors—the volume has to be turned up, and the hissing sound becomes audible.

In photography, digital noise appears as colored specks that cloud the representation of a photograph or as image granularity similar to that seen with high-sensitivity analog film (Fig. 6).

A large sensor not only has larger photodetectors than a smaller sensor with the same number of pixels but also has more space between photodetectors than its smaller

counterpart. This extra space decreases digital noise by reducing interaction between neighboring electric currents.

Sensors with larger photodetectors also tend to have a wider exposure latitude, which improves the tonal gradation, that is, the number of different gray tones that can be discriminated in the final image.

In short, with a given number of photodetectors (and therefore pixels), a larger sensor is generally preferable to a smaller one as it yields a higher-quality final image.

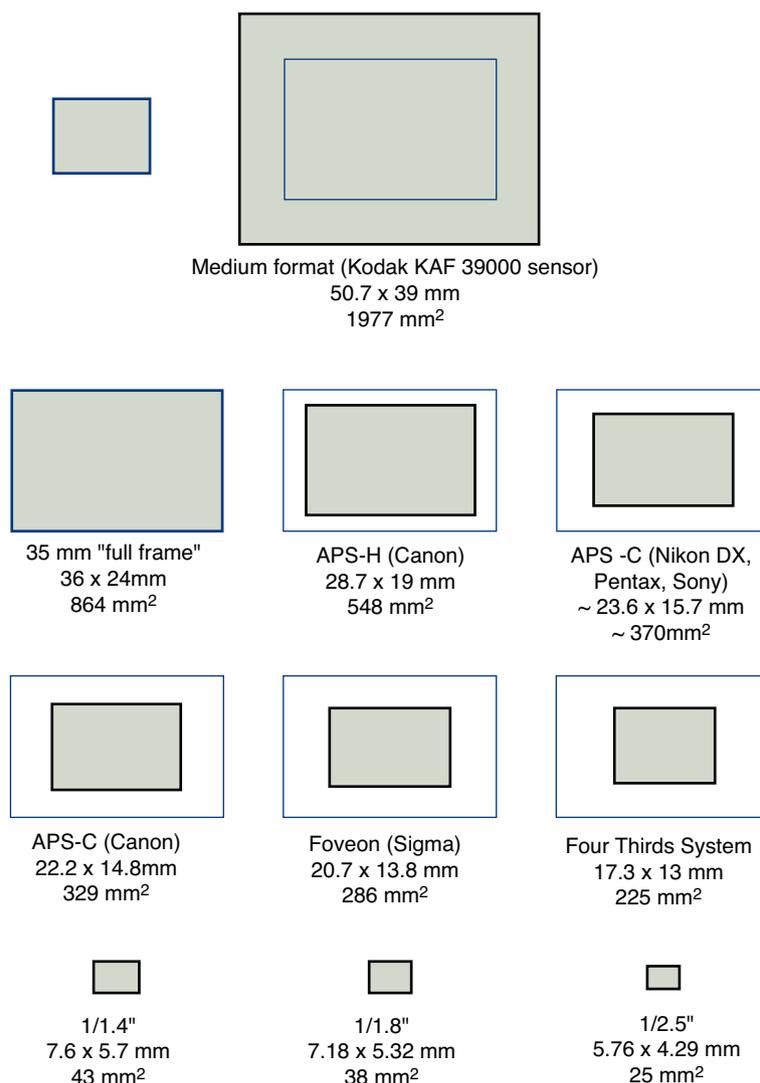
In SLR cameras, sensor formats range in size from full-frame (the size of a 35 mm slide), which measures 36 × 24 mm, to Advanced Photo System Classic (APS-C), which measures approximately 21.1 × 16.7 mm; the actual size varies slightly between manufacturers. The Four Thirds (4/3) system uses sensors measuring 18 × 13.5 mm.<sup>1</sup>

In addition to the formats described above, which are standard for SLR cameras, a number of smaller sensor formats are also used in compact cameras, including 1/2.5" and 1/1.6" (Fig. 7).

Full-frame and APS-C sensors adhere to the traditional 3:2 aspect ratio (3 mm in width for every 2 mm in height), while the 4/3 format has an aspect ratio of 4:3.



**Figure 6** Noise in a digital photograph, which appears as granularity or colored specks.



**Figure 7** Relative sizes of various types of digital camera sensors. Adapted from: [http://en.wikipedia.org/wiki/Image\\_sensor\\_format](http://en.wikipedia.org/wiki/Image_sensor_format) [Accessed on 20 August 2011].

The sensors of compact cameras do not adhere to the traditional 3:2 aspect ratio; they tend to be closer to square or follow—or approximate—the 4/3 format.

Micro 4/3, developed by Olympus and Panasonic, is a mirrorless camera system that uses 4/3 sensors.

NEX,<sup>2</sup> by Sony, is the leading line of mirrorless cameras with APS-C sensors.

There are other options, such as mirrorless cameras with sensors larger than those of compact cameras—the NX series by Samsung and the GXR series by Ricoh, for example—but the cameras in this market segment have not been well received and have sold poorly.

Nikon recently introduced 2 mirrorless camera models (J1 and V1) with sensors midway in size between compact camera sensors and Micro 4/3 sensors.

In terms of technology and architecture, there are basically 2 classes of sensor: charge-coupled device (CCD) sensors and complementary metal-oxide semiconductor (CMOS) sensors. In theory, CCD sensors allow a wider tonal

range, while CMOS sensors consume less energy and are more affordable.

Most mid-range and high-end cameras with a 35 mm or smaller sensor format have CMOS sensors, which are continually improving in quality and are every bit as good as CCD sensors.

Compact cameras use both CCD and CMOS sensors.

A camera's sensor determines the number of pixels in the photographs it produces. Too much importance is often placed on the number of pixels, which is not the most important parameter for a dermatologist to consider when buying a camera.

With between 8 and 14 million pixels, the dermatologist's photography needs are covered. With 8-megapixel photographs, it is possible to print images measuring about 30 x 20 cm with a resolution of 300 dots per inch (professional printing quality). With 14 million pixels, it is possible to print images measuring up to 40 x 25 cm without sacrificing resolution.

Rarely is it necessary to print photographs larger than the aforementioned sizes. More pixels would only be needed to maintain good resolution or size when cropping to eliminate unwanted details from a photograph.

## Lens and Macro Capability

In compact cameras, the lens is just as important as the sensor, or even more so. Most compact cameras have zoom lenses, which can make distant objects appear closer and nearby objects appear farther away.

The wide-angle zoom range (zoom moved to the left) makes a nearby subject appear farther away, therefore allowing it to fit within the frame. Traditionally used for landscape photography, the wide-angle range comprises focal lengths between 24 and 35 mm (Fig. 8A).

The telephoto zoom range—typically used for portraits, detailed shots of faraway objects, etc.—makes a distant subject appear nearer. The telephoto range comprises longer focal lengths, starting at 70–80 mm (Fig. 8B).

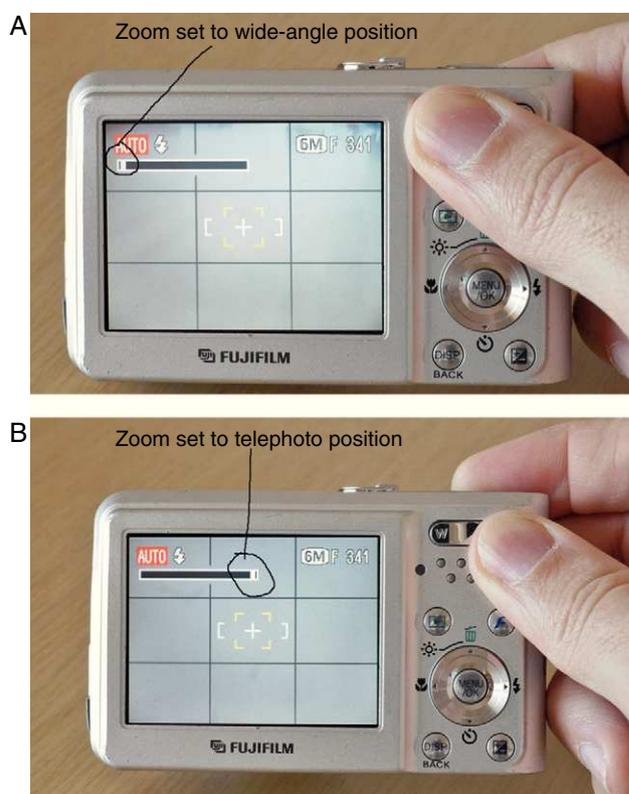
Dermatological photographs should be taken with the zoom halfway between the wide-angle and telephoto ranges, ideally at focal lengths of 50–60 mm, although focal lengths of up to 105 mm are acceptable. A zoom lens set to the wide-angle position can cause the subject to appear distorted and therefore should not be used in dermatological photography.

Unfortunately, for technical reasons, most compact cameras only allow the use of macro mode—for focusing at very close range—in the wide-angle position. In dermatological photography, the macro mode is essential to ensure that tumors, nails, and other small details fill most of the frame.

When choosing a camera, it is essential to consider its macro capability, which is defined as the minimum focus distance in relation to focal length.

Manufacturers are reluctant to provide precise details on the macro capability of their compact cameras. Macro capability is often described as follows: “Macro: wide-angle 1 cm / telephoto 100 cm-infinity.” This description means that in macro mode the camera can take photographs with auto-focus as close as 1 cm from the subject, provided that the zoom is set to the maximum wide-angle position (all the way to the left); however, with the zoom set to the telephoto range—ideal for dermatological photography—the minimum focus distance is 1 meter, and therefore the actual magnification ratio is poor. Therefore, when choosing a compact camera, dermatologists should look for a camera with a minimum focus distance between 1 and 5 cm in wide-angle mode and no more than 30 to 40 cm in telephoto mode. These parameters will vary, of course, according to the wide-angle focal length of each camera. Photographing a subject 1 cm away with a focal length of 24 mm is not the same as photographing the same subject with a focal length of 35 mm. This principle also applies to telephoto focal lengths: it is not the same to photograph a subject 30 cm away with a focal length of 70 mm as with a focal length of 140 mm; the magnification ratio of the latter is twice that of the former.

Dermatologists who buy an SLR camera have to consider the camera’s sensor format when choosing a lens. Cameras with a 36 x 24 mm sensor (a format only available in high-end SLR cameras) do not require the user to apply a focal length



**Figure 8** A, In a compact camera, moving the zoom indicator to the left activates the wide-angle range (to make a nearby subject appear farther away). B, The zoom indicator to the right of the scale indicates the telephoto range (to make a distant subject appear nearer).

multiplier. However, cameras equipped with a sensor in any of the APS-C formats do require the use of a focal length multiplier. In such cases we recommend using a macro lens with a focal length of 50 to 60 mm and a lens speed of  $f/2$  to  $f/2.8$ . Using a focal length multiplier of, for example, 1.5 (or thereabouts, as in the case of the APS-C formats), the focal length of the lens is effectively multiplied by 1.5; thus, a macro lens with a focal length of 60 mm would have the same field of view as a lens with a focal length of 90 mm.

A focal length of about 90 mm allows the photographer to achieve good magnification ratios without having to stand too close to the subject. Moreover, at the resulting focus distances, the flash does not cast shadows on the area being photographed. For half-body shots, however, the photographer is obliged to move further away from the subject, and in a small consultation room this can be very inconvenient.

An SLR camera with a full-frame sensor can be fitted with a macro lens with a focal length either in the 50 to 60 mm range or in the 90 to 105 mm range. Macro lenses with a focal length in the 50 to 60 mm range force the photographer to move in very close when photographing small subjects; these lenses are very practical for half-body shots, however, because the photographer does not need to stand back as far as with longer focal lengths. To achieve a field of view similar to that of an SLR camera with an APS-C sensor and a lens with a 50–60 mm focal length, we recommend using a macro lens with a longer focal length (90–105 mm). Lenses of this type, however, can be expensive and heavy.

## Aperture Priority Mode

Aperture priority mode is a semiautomatic program that allows the user to select the desired aperture value while the camera selects the most appropriate corresponding shutter speed (the length of time that the shutter remains open, exposing the sensor to light). This feature is standard on SLR and mirrorless cameras while in the compact range it is only available on advanced models.

Aperture priority mode is an essential feature for dermatological photography. Small apertures must be used to achieve a good depth of field and ensure a zone of sharpness that includes all planes of the image. Dermatologists should not consider any compact camera that does not have a semiautomatic aperture priority mode.

## LCD Screen

The LCD screen on the back of the camera body is used to check that the photograph has been taken correctly. In compact cameras, the LCD screen is also used to compose photographs (Fig. 3).

The LCD screen may not seem like a very important feature, but in some respects it makes a great difference. Users of the first digital cameras would often find, upon downloading their photographs to a computer, that some images were out of focus or blurry. With the tiny LCD screens available on these early cameras, it was virtually impossible to review images on the spot. The higher the resolution of the screen (represented by the number of pixels) the greater the photographer's ability to review the quality of each shot.

Today, digital camera LCD screens range in size from 2 to 3 inches and in resolution from 200 000 to 1 million pixels.

Screen size is of key importance, but resolution is even more so. At a resolution of 900 000 pixels or more, it is possible to zoom in on an image sufficiently to determine whether or not it is in focus. Only high-end cameras have screens with 900 000 to 1 million pixels. We recommend screens with at least 400 000 pixels.

One recent advance in screen technology is the introduction of organic light emitting diode (OLED) screens, which are more energy-efficient and are said to produce less glare. However, OLED screens have other disadvantages, such as a shorter lifespan and reduced performance in bright outdoor conditions.<sup>3</sup>

A flip-out screen is very desirable, although not essential. Flip-out screens allow the user to comfortably compose photographs in positions that would otherwise be awkward. For example, without a flip-out screen, photographing a patient lying on a stretcher may be difficult because the camera has to be positioned above the patient's body.

To date, Canon is the only manufacturer offering cameras (SLR models EOS 550D and 600D) in which the LCD screen and the sensor have the same aspect ratio (3:2). The advantage of these models is that the previewed images fill the entire screen rather than being letterboxed.

Some cameras have a touchscreen, which the photographer uses to control certain menu functions. This feature is unimportant and should not influence a dermatologist's choice of camera.

## Viewfinder

In compact cameras, optical viewfinders are irrelevant, because photographs taken with this type of camera are usually composed on the LCD screen.

High-end mirrorless cameras offer a high-quality electronic viewfinder—useful for composing photographs in bright outdoor light conditions—as a standard or optional feature. Low-end mirrorless models do not offer an electronic viewfinder even as an optional feature.

With mirrorless cameras, the decision to use the LCD screen or an electronic viewfinder is entirely personal, as dermatological photographs are taken indoors.

The LCD screen on an SLR camera can be used in live-view mode to compose photographs in real time. This use of the screen is uncommon, however, as the optical viewfinder is the primary tool for composing photographs in such cameras.

Composition results depend largely on the luminosity and size of the viewfinder. A viewfinder with 100% coverage is always preferable to a viewfinder that covers just 90%, 92%, or 95% of the final image. With a viewfinder that provides less than full coverage, distracting elements not seen during composition may be visible at the edges of the image, making it necessary to crop the final photograph.

## Operating Speed

The operating speeds of compact digital cameras have improved considerably. Nevertheless, buyers should be aware of the acceptable ranges, and avoid models that offer subpar speeds in the following areas:

- Start-up time: the delay between the 'on' button being pressed and the camera being ready to shoot. Acceptable maximum: 1 to 2 seconds.
- Shutter lag: the delay between the shutter-release button being pressed and the photograph being taken. This delay can be broken down into 2 parts: the autofocus time, which begins when the shutter-release button is pressed halfway down, and the time required for the actual shot, which begins when the button is pressed the rest of the way down. The total shutter lag should not be more than 0.5 seconds.
- Shot-to-shot speed: the time that the camera needs to be ready to shoot again after a photograph is taken. Acceptable maximum: 1 to 2 seconds.
- Memory card writing speed. The time it takes to save a photograph to the memory card mainly depends on the speed of the card itself as well as parameters such as the image format (raw vs. JPEG). This factor is not particularly important in dermatological photography.

SLR cameras tend to be faster than compact cameras. Operating speed is rarely a handicap with any of the digital SLRs currently on the market.

Prospective buyers should regard advertised technical specifications with a skeptical eye. On handling some cameras, the user may find that the photo-taking experience is hampered by a weakness in one of the operating-speed factors mentioned above. Whenever possible, therefore, prospective buyers should test cameras before purchase to

ensure that their expectations are met and to find one they feel comfortable handling. Some stores—usually the more expensive ones—allow customers to return cameras after a few days if they are not satisfied.

## Flash

For dermatological photography, the ideal flash is a ring flash with multiple flash tubes that can be individually adjusted for intensity. This allows the photographer to use flat light to avoid shadows or angled light to highlight the relief of the lesions.

Once mounted, many ring flashes can be rotated around the main (i.e. front-to-back) axis of the lens to avoid unwanted reflections.

The much higher-quality results obtained with a ring (or ring-type) flash are yet another reason for dermatologists to choose an SLR camera over a compact or mirrorless model (Fig. 2).

SLR cameras come with a specific hot shoe for mounting a ring flash. Some ring flash models can even be operated wirelessly, without being connected to the hot shoe.

Most mirrorless cameras and high-end compact cameras have a hot shoe for mounting an external flash. However, if the photographer wishes to maintain the small size and easy portability of these camera types, it makes little sense to use a bulky external flash unit (Fig. 4).

Most compact camera models have a low-intensity flash built into the camera body. With these built-in flashes, the camera lens tends to cast a shadow in close-range photographs. Furthermore, the light emitted by a built-in flash strikes the subject head-on; the resulting glare can only be avoided by changing the angle of the shot, not by rotating or moving the flash.

Built-in compact camera flashes differ from one another mainly in whether they have flash intensity adjustment and flash exposure compensation features, and whether the flash can be turned off manually. Flash exposure compensation is essential because many photographs—particularly close-ups—appear washed out when the flash intensity is excessive.

## Battery

Above a certain quality level, most compact, mirrorless, and SLR cameras use proprietary rechargeable batteries rather than general-purpose batteries.

A typical compact camera battery allows between 200 and 350 shots per charge. Some SLR models have batteries with an average life per charge 2 or 3 times greater than that of a compact camera battery, or even more. As compared to their compact counterparts, SLR batteries have greater capacity but similar charging times.

In dermatological photography, most shots are taken with flash. Dermatologists who use the built-in flash on their camera—whether SLR, mirrorless, or compact—should always carry a spare battery in their camera case, as the use of the built-in flash shortens battery life. Dermatologists who use an external flash should carry spare general-purpose batteries for the flash.

Most digital cameras use nickel–metal hydride (NiMH) batteries, which perform better than other types. We recommend using batteries with a capacity of at least 1000 mAh.

## Memory Card Type

In recent years, memory cards have moved towards standard formats and become very affordable. For these and other reasons, the choice of a card type is no longer very important. The most common format, Secure Digital (SD), is used in the compact, mirrorless, and low-end SLR models. Secure Digital High Capacity (SDHC) and Secure Digital Extended Capacity (SDXC) are high-capacity variants of the SD format.

CompactFlash is the standard memory card format in high-end SLR cameras.

It is advisable to use a high-capacity memory card capable of storing many high-resolution photos; nevertheless, photographs should be downloaded to a computer on a regular basis in order to avoid accidental loss.

The read and write speed of the memory card are not important because dermatologists, unlike sports or nature photographers, never take multiple photographs in rapid succession. The only reason for having a high-performance card would be to record high-resolution video, an operation that requires a minimum card speed of  $133\times$  (20 MB/s).<sup>4</sup>

The memory card's read speed affects the time needed to download photographs from the card to a computer. However, download speed also depends on other factors.

## Raw Image Format

The images produced by a digital camera can be saved in different file formats. The most popular is the JPEG (or JPG) compression format, named after the Joint Photographic Experts Group. Digital cameras can save JPEG files in different sizes with varying degrees of compression (depending on the model). With greater compression, photographs take up less space but lose quality. To maintain high image quality, the camera should be set to a low level of JPEG compression.

A raw image format is the digital equivalent of a negative. Because they are in an uncompressed format, raw image files give the best photographic results. If a photograph is initially saved in a raw format, copies can be saved and later modified using specific software while the original is left intact.

If a photograph with defects such as under- or overexposure (dark or washed out) or color imbalance (dominance of a particular color) is initially saved in a raw image format, it may be possible to recover details, correct the color balance, etc., without losing quality. Photographs initially saved in JPEG format allow much less room for maneuver. Also, every change made to a JPEG image leads to a further loss in quality because the image must be decompressed and recompressed each time it is retouched.

Unfortunately, photographs in a raw image format are much larger than JPEG files, so a memory card can hold fewer raw files. Time is also a factor: whereas JPEG is a ready-to-use image format, photographs saved in a raw format require additional processing before use.

Some high-end cameras allow the photographer to save photographs in both JPEG and a raw format simultaneously. This feature enables the photographer to use the JPEG file directly from the memory card while retaining the raw file in case a photograph should require extensive retouching.

In dermatological photography, raw image formats are not widely used. It is probably not necessary to use this format as long as photographs are taken correctly, at a good size, and with low JPEG compression.

In conclusion, dermatologists considering the purchase of a digital camera should learn more about the macro capability of the various compact models available on the market, for example by visiting <http://www.dpreview.com/reviews/>. This website gives each camera's minimum focus distance in macro mode for both the telephoto and wide-angle ranges. It also specifies, for both ranges, image quality issues such as chromatic aberrations, distortion, and blurriness in the center and corners of images.

For an example of a description of a compact camera's performance, we recommend reading the following analysis of the Canon G11 in macro mode: <http://www.dpreview.com/reviews/canong11/page8.asp>.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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