Digital dental photography

Settings for your camera and lighting systems

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Fig. 1

Fig. 1_Barrel of the lens with printed ratios.

_Introduction to digital dental photography

Dentistry as a profession can either be a source of immense satisfaction or a routine treadmill. One of the ways to enhance satisfaction is by using dental photography,[1] which is a wonderful means to appreciate what can be achieved with current treatment, gratifying to both the clinician and patient, and helping to transform routine practice into a passionate pleasure.

We are exceptionally fortunate that digital photographic equipment has evolved to the level we see today.

The ability to capture numerous images on a high-capacity flash memory card and the ability to review the image on the liquid crystal display viewer immediately have liberated us from the confines of film and the inconveniences of the photograph-processing laboratory. This savings in time alone makes digital photography more affordable and less daunting than film photography is. It is fun, and so easy that anyone can learn to obtain great images with just a little training.[2, 3]

Please note that some small point-and-shoot cameras that are not digital single-lens reflex (DSLR) cameras are available and very useful for everyday practice. Small cameras however are not considered adequate[2] for the calibre of photography presented in this article. Therefore, most of the discussion will concentrate on DSLRs.

This article discusses specifically how to simplify the taking of digital images. Once you have set up your camera for digital dental photography, very few adjustments are necessary

for taking all of the cosmetic and surgical photographs required for your practice.

_Camera system

The most versatile camera for dental photography and for achieving the best results is without doubt a DSLR camera. A DSLR offers through-the-lens viewing and metering, precise focusing and accurate framing.

The major advantage of DSLRs is that parallax is eliminated because the viewfinder, lens and image sensor all share the same optical axis. This means that what is seen in the viewfinder is identical to that recorded on the resulting image.[4]

The standard lens of a DSLR has a focal length of 50 mm; a shorter focal length lens, 28 mm for example, is classified as wide angled (e.g. for landscapes), while a longer focal length lens is a telephoto (e.g. for sport or wildlife).

For dental applications, a dual-purpose lens is necessary, firstly for portraiture and secondly to focus down for close-up photography. The ideal choice is therefore a lens that combines both these features, that is, a macro-telephoto lens.

A word of caution about macro lenses: many compact cameras claim macro facilities but this only indicates close-focusing facilities; a true macro is capable of producing a 1:2 or 1:1 magnification. A 1:1 magnification is the ideal and means that the image recorded by the sensor is the same size as the object in real life. For 35 mm format DSLRs, a 1:1 image usually translates to about four maxillary incisors.

Depending on the manufacturer and arrangement of optics within the lens barrel, the focal lengths of macro-telephotos vary from 50 to 1.05 mm. Also, many sensors are smaller than the 35 mm film format and therefore have a multiplication factor. For example, attaching a 100 mm lens to a 35 mm camera body will effectively increase the focal length of the lens to 150 mm, that is, the sensor has a multiplication factor of 1.5 (see below). However, some newer high-end cameras have larger sensors and therefore the lenses do not require a multiplication factor.[4]

It is difficult to recommend manufacturers or models of cameras because the market is rapidly changing and new products are introduced annually.[4] Commonly, Canon or Nikon DSLR cameras are recommended. A basic DSLR body with a 100 mm macro lens can be purchased at many photography stores or online.

Fig. 2

Fig. 3

Figs. 2 & 3_Camera-mounted electronic flashes.

Settings for optimum results

As cameras will commonly require about a 1.5 times increase (conversion) in the setting on

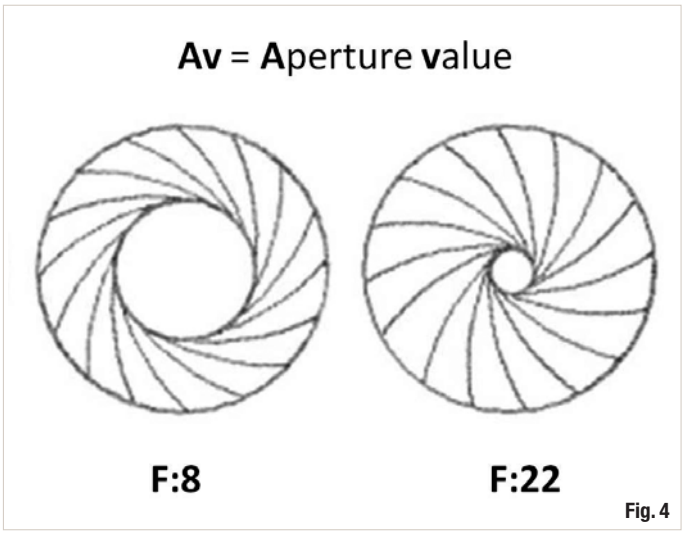

Fig. 4

Fig. 4_Aperture settings.

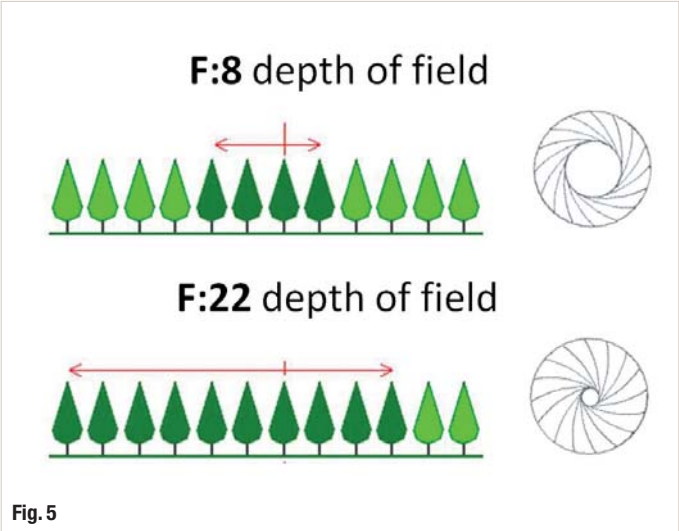

Fig. 5

Fig. 5_A wide-open lens with an aperture of f/8 has little depth of field, but if stopped down to f/22 almost everything from front to back will be sharply focused.

the lens barrel, the lens magnification ratio is closer to 1:15 for portrait photography; 1:3 for dental views, including normal smile and retracted views, as well as occlusal views; and 1:1.5 for dental views, including close-up retracted views.

Please note that these ratios can vary with sensor (with full-frame sensor) and patient face size. Selecting the correct settings is easy because the ratios are etched or printed on the barrel of the lens (Fig. 1), and there are only three sets to think about and to switch between during the shots.[2]

_Lighting system

Many practitioners choose a ring flash for ease of use. A ring flash creates a uniform burst of light, useful for taking pictures of posterior teeth, areas of difficult access and intra-oral images using mirrors. Camera-mounted electronic flashes are available in numerous shapes and sizes. The best way to choose a flash is to visit a dental retail showroom (Figs. 2 & 3).

Fig. 6_Most contemporary cameras have automatic exposure setting.

Fig. 6

_Technical jargon

Aperture or f/stop: This important setting controls the amount (intensity) of light striking the sensor. It is actually an adjustable hole (aperture) in the lens through which the light passes (Fig. 4). The aperture size is calibrated in f-stops and numbered from about f/2.8 to f/32 for most DSLR cameras; the larger the number, the smaller the lens opening. The f-stop affects the depth of field.

Depth of field: This determines which parts of an image are in sharp focus. Cameras are unable to focus on everything simultaneously, unlike the human eye. The depth of field determines the extent of focus in front of and behind the plane of critical focus.

Furthermore, the depth of field for close-up photography is usually small (a few millimetres) and hence the point of focus is crucial for obtaining sharp images. The depth of field varies inversely with the aperture opening. A wide-open lens with an aperture of f/8 has little depth of field, but if stopped down to f/22 almost everything from front to back will be sharply focused (Fig. 5).[5]

White balance: This setting adjusts the camera so that colours in the image look natural.[2] You will want to set your camera's white balance for flash illumination from standard to neutral.

_Settings for optimum exposure

Achieving correct exposure is a quintessential requirement of photography.[5] Exposure is the process of recording light on the digital sensor. The amount (intensity) of light is controlled by the aperture setting, while the sensor's sensitivity is controlled by adjusting the ISO number (discussed below).

More specifically, exposure is the amount of light that strikes the sensor over a specific period.[2] Time is controlled by the shutter speed, measured in fractions of a second.

Most contemporary cameras have automatic exposure, which calculates the shutter speed once the aperture has been set (in aperture priority mode metering, printed Av; Fig. 6). However, with dental photography one aspect in

particular requires attention. It is ensuring an adequate depth of field, which leaves little latitude but to select a small aperture opening, usually f/22 for all dental views.[5] Use f/8 for portraits.[2]

The ISO setting controls the sensitivity of the camera's capture chip or sensor to light. The lower the ISO number (e.g. 100 or 200), the less sensitive the chip, the sharper the image, and the more light needed to obtain a good image. Conversely, a higher ISO setting requires less light, but the image obtained can be noisy or grainy; in other words, less sharp. For dental photography, the recommended ISO setting is 200. Automatic ISO setting is not recommended for dental photography.[2]

You may find that you need to experiment a bit to obtain just the right amount of light for correct exposure by changing exposure compensation.[6]

Flash-to-subject distance influences light intensity, which depends on the inverse-square law. Simply stated, illumination is less bright the further away from its source because it has a greater area to cover.

The inverse-square law is applicable when taking intra-oral images using mirrors. In these circumstances, the light from the flashes travels a greater distance by being reflected off the mirror surface before it can illuminate the teeth. Exposure compensation is therefore necessary (e.g. –0.7) to avoid under-exposed images.[6] Exposure compensation is also necessary (e.g. –1.3) to avoid over-exposed close-up retracted views. However, exposure compensation should be set once for all views.

You may find that you need to experiment a bit to obtain just the right amount of light for correct exposure by changing exposure compensation.[7] If an exposure compensation setting of –1 is necessary on dental views for Nikon bodies (Fig. 7), this may be different for Canon (please note that a shutter speed set to 1/200 in manual mode is necessary for Canon bodies, while for Nikon bodies the shutter speed is set automatically) and other camera/flash set-ups.

_Conclusion

For dental photography, it is essential to have a small aperture opening, f/22 for example, so that as many teeth as possible or a large area of soft tissue is in focus. In theory, to obtain a greater depth of field one could consider using an even smaller aperture, f/32 for example, but this deteriorates the image quality owing to diffraction. Therefore, setting the aperture to smaller than f/22 will diminish image clarity considerably without a substantial gain in depth of field.[5]

Fig. 7

Fig. 7_If an exposure compensation setting of –1 is necessary for Nikon bodies, this may be different for Canon bodies and other camera/flash set-ups.

Optimum settings for dental photography:

_(1:15), f/8 for portrait photography;
_(1:3), f/22 for dental views, including normal smile and retracted views, as well as occlusal views;
_(1:1.5), f/22 for dental views, including close-up retracted views.

This article has offered a simple settings guide based on the author's experience on capturing the standard photographic views required in aesthetic dentistry.[8]_

Editorial note: A list of references is available from the author.

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