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CAD/CAM

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3 2012

special

Clinical digital dental photography

research

The implant-retained bar overdenture: The SFI-Bar

case report

CAD/CAM-based restoration of an edentulous maxilla

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Dear Reader,

Tzvetan Deyanov
Business Development Manager
CAPP Asia

_It is my pleasure to welcome you to this year's third issue of CAD/CAM!

As the organiser, I am pleased to invite you to the first Asia Pacific edition of the seventh CAD/CAM & Computerized Dentistry International Conference in Singapore from 6 to 7 October 2012. I am very excited to be involved in the organisation of such an event, which has built extremely important bridges between the dental team, dental technicians and industry. We look forward to an amazing weekend at the Marina Bay Sands Hotel in Singapore.

The main scientific conference (6–7 October) and the dental technicians' parallel session (7 October) will cover the latest trends and developments in digital dentistry. The impressive two-day programme will see 20 international speakers giving expert cutting-edge presentations to the 400 expected dentists, dental technicians and other dental professionals, all hungry for knowledge from Asia Pacific, Europe and the Middle East. Participants will also have direct contact with 25 industrial players in a networking environment, creating a forum for discussions, questions and the exchange of valuable feedback, while viewing the latest technologies at the exhibition.

Only six years ago, when the Middle Eastern market was still in its early stages we held the first CAD/CAM & Computerized Dentistry International Conference in Dubai with enthusiasm and confidence in this exciting field. We are confident that we will be able to transfer this concept to the Asia Pacific region successfully and play a significant role in the development and improvement of digital dentistry.

Similar to Dubai, Singapore is a commercial hub for the entire region. In addition, the digital dental industry in Asia is growing tremendously rapidly. Increasing demand for higher quality restorations, for example, has boosted purchases of CAD/CAM solutions. Continuous growth in the privatisation of hospitals, the expansion of dental clinics and the ageing population has resulted in CAD/CAM paving the way forward for dentistry, offering improved accuracy and efficiency. These developments have created the need for dentists to further develop their skills and knowledge in digital dentistry in order to keep up with the latest tools provided by the industry for their benefit.

Looking to the future, it is inevitable that digital dentistry will become standard in all dental clinics in both Asia and the rest of the world. Industry forecasts for Asia estimate double-digit growth in the CAD/CAM market for the next few years.

For these reasons, I would like to invite all dental professionals to the largest annual international event focused entirely on computerised dentistry. I look forward to seeing you in the vibrant city of Singapore!

Yours faithfully,

Tzvetan Deyanov
Business Development Manager
CAPP Asia


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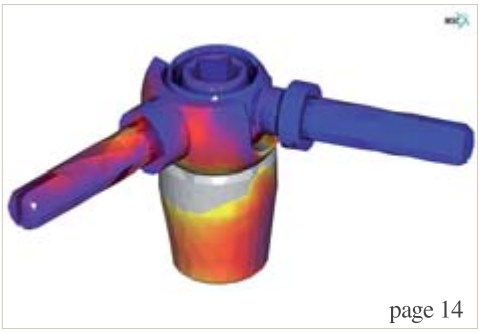
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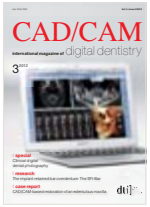

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From left: G. Ubassy, Dental Technician, France | M. Roberts, Dental Technician, USA | M. Temperani, Dental Technician, Italy | D. Hornbrook, Dentist, USA | O. Brix, Dental Technician, Germany | U. Brodbeck, Dentist, Switzerland | G. Gürel, Dentist, Turkey | C. Coachman, Dentist, Ceramist, Brazil | A. Shepperson, Dentist, New Zealand | A. Bruguera, Dental Technician, Spain | S. Kataoka, Dental Technician, Japan | S. Kina, Dentist, Brazil

* The IPS e.max Scientific Report Vol. 01 (2001 – 2011) is now available at: www.ivoclarvivadent.com/science_e

[1] M. Kern et al. "Ten-year results of three-unit bridges made of monolithic lithium disilicate ceramic"; Journal of the American Dental Association; March 2012; 143(3):234-240.
[2] Mean observation period 4 years IPS e.max Press, 2.5 years IPS e.max CAD. See the IPS e.max Scientific Report Vol. 01 (2001 – 2011).
[3] Based on sales.

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Clinical digital dental photography

Author_ Dr Amit Patel, UK

Fig. 1a

Fig. 1b

Figs. 1a & b_Canon EOS 40D 105 mm lens with ring flash and dual flash lighting systems (SLR).

_In today's environment of patient's high expectations and increased litigation, especially with regard to cosmetic dentistry, good record-keeping is essential. Clinical photography is a very important tool in general practice in documenting treatment, especially in aesthetic and cosmetic cases.[1]

Clinical photography and academic presentation have undergone a transformation over the past ten years.[2] In the past, clinical slide photography and carousel slide lecture presentations were the gold standard in both dentistry and the medical fields. Over the past decade, the availability of digital photography, digital imaging systems and digital presentation software programs has revolutionised teaching and lecturing.

Before the advent of digital photography, it was expensive to purchase dedicated 35 mm dental photographic equipment and accessories, and it was more likely to be dentists who were also amateur photographers who bought such equipment.[3] Since the development of digital cameras, the costs have been brought down quite considerably. This has made it more accessible for most dentists in their everyday practice. The main advantages of digital versus film photography are instant image acquisition, reduced costs of film processing and a relatively easy learning curve.

It is very difficult to outrace technology, as it is evolving daily at a rapid rate and one will always be behind. So don't plan on using your current digital equipment for the rest of your life; it is always outdated within a couple of years. Over time as our own skills and knowledge improve with digital pho-

Fig. 2

Fig. 3

Fig. 2_Nikon Coolpix 4500 (point and shoot).
Fig. 3_Nikon Coolpix 4500 with ring light (point and shoot).


Fig. 4


Fig. 5


Fig. 6

tography, we will want to improve on our old images; therefore, reinvesting in technology is part of the challenge in the pursuit of excellence.

One of the biggest advantages of digital photography is that the images can be viewed instantly and can be edited in many ways, such as improving brightness and contrast, cropping, changing hue and saturation, adding text and symbols, using software.

_Types of cameras

Digital SLR (single-lens reflex) cameras are high-end cameras designed for semi-professionals to professionals (Figs. 1a & b). Recently, most of the major camera brands have developed a range of affordable DSLRs, allowing us to develop our clinical photography skills over time to achieve higher standards in our practice.

DSLR cameras have the advantages of interchangeable lenses, including macro and telephoto, metered lenses, and ports for accessory flashes, such as a ring flash or a dual flash system. One can also choose between manual focus and autofocus cameras. Although the modern camera can control a number of key settings relating to the exposure and flash levels, these can normally be set manually.

These types of cameras can be expensive and bulky to use for clinical photography. A good number of the point-and-shoot style of digital cameras are available at reasonable prices and take excellent clinical photographs even at a macro level. I have been using a Nikon Coolpix 4500 (Figs. 2 & 3) since 2003, which allows macro images up to 2 cm from the object and with which I have obtained good results (Figs. 6–14).

The advantages of the smaller point-and-shoot style cameras over DSLRs is that they are less bulky, lightweight and compact, and work well for most clinical cases. There is also no need for multiple lens changes.

_Digital camera jargon

Digital cameras capture images as elements, known as pixels. A megapixel is equal to one million pixels. The more pixels contained in an image, the higher the image resolution. Resolution relates primarily to print size and the amount of detail in an image when viewed on a computer monitor at 100 per cent magnification.

Images with more megapixels yield better print images. Many amateur and professional digital photographers crop their photographs, sometimes reducing them dramatically in size, to focus on the key element of the image. Obviously, the more pixels in an image, the more can be cropped while retaining a useful image.

I consider that six megapixels is sufficient for use in clinical digital photography. It gives one the

Fig. 4_Small Aperture gives a large depth of field.
Fig. 5_Large Aperture gives a narrow depth of field.
Fig. 6_Front view.

Fig. 7_Right mirror view.
Fig. 8_Left mirror view.
Fig. 9_Upper occlusal mirror view.
Fig. 10_Lower occlusal mirror view.
Fig. 11a_Right side mirror view.
Fig. 11b_Right side, lips retracted, no mirror used.


Fig. 7


Fig. 8


Fig. 9


Fig. 10


Fig. 11a


Fig. 11b


Fig. 12


Fig. 13


Fig. 14a


Fig. 14b


Fig. 15

Figs. 12 &13_The black background improves image quality and emphasises the translucent regions of the teeth.
Fig. 14a_Images of film radiograph taken from lightbox.
Fig. 14b_Same image manipulated with GiMP software removing the saturation making it black and white.
Fig. 15_Set the camera to black and white setting and take photo of film from lightbox.

Fig. 16_Using OpenOffice Impress to present a case.
Fig. 17_Shade tab for laboratory technician.

ability to use the images for presentation to patients and for lectures using software such as Microsoft PowerPoint (www.microsoft.com) or open-source software that can be obtained from the Internet, such as OpenOffice (www.openoffice.org), and to print reasonable size images (300 x 450 mm) for poster presentations.

The images are stored on a CompactFlash card (CF card) or Secure Digital card (SD card), for example. There are many file types (RAW, JPEG and TIFF) that all serve different purposes. A RAW file is comparable to the latent image contained in an exposed but undeveloped piece of film. This means that the photographer is able to extract the maximum image quality possible, whether now or in the future. This format is mostly used in professional photography.

A JPEG file is a file that is compressed and when saved loses its quality. This results in a lower quality and smaller image file. For many applications, the image quality is more than sufficient. The smaller files also make it easier to transmit electronically. A TIFF file is also compressed but the file does not lose quality upon being saved; therefore, TIFF files are larger than JPEG files. TIFF format images can be utilised in presentation software, the only drawback being that the software may run more slowly owing to a larger file format. I am inclined to use the JPEG Fine format to save the images, as they are easily transferred to the computer and can be used for presentation purposes.

Fig. 16

Fig. 17

_Standardising images

It has never been easier to take standardised photographs and use high-quality controlled clinical images. Focal distance can be standardised by securing a piece of dental floss or chain to the bottom of the camera and holding it near an appropriate area (chin) of your patient.[4] This ensures that you will be at the same distance from the patient for all views.

For macro photography, a macro lens and ring flash for a DSLR can be used for capturing close-up images of the subject. Ring lights (usually a ring of LEDs fixed to the lens) can also be obtained for most point-and-shoot cameras (Fig. 3). It is not always essential to have all these accessories, as you do not need to get close to the subject. These cameras automatically compensate for various lighting conditions and some can compensate for macro distances.

Getting too close will overexpose some areas and block the flash in other areas, causing shadows. The best technique is to keep away from the subject and use the optical zoom to get close to the area. By doing this, you are far away enough for the flash to disperse over a larger area. With digital editing, you can crop any extraneous anatomy. If the image is taken at a high resolution, your image will be of sufficient magnification after cropping the unwanted structures (macro-like).[5]

_Basic functions

There are four exposure settings (modes) in the majority of DSLR cameras and all employ a through-the-lens metering system:

Aperture priority

The aperture is the lens opening. So the aperture control allows the photographer to

control how far the lens is opened when a picture is taken. The farther the lens is opened, the greater the amount of light that is allowed into the camera and the lighter the exposure. Once the aperture value has been selected, the camera automatically selects the correct shutter speed to produce an acceptable exposure. By setting the aperture value, the photographer decides on the depth of field (the plane of sharp focus) in the image. One can select a small aperture value (a high f-number) for a larger plane of sharp focus (Fig. 4) and a large aperture value (a small f-number) for a narrow plane (Fig. 5).

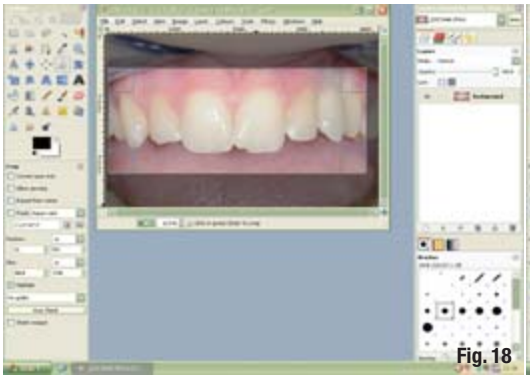
Fig. 18


Fig. 19

Fig. 18_Cropping tool using GIMP.
Fig. 19_The cropped image without the retractors using GIMP.

A depth of field problem is that the entire dentition can only be photographed completely in sharp focus if the focal plane is positioned carefully. Therefore, do not focus on the anterior teeth (yellow circles on Fig. 4). For a frontal view, the point of focus should be around the canines (yellow circle on Fig. 5).

Shutter priority

The shutter speed controls the amount of light that enters the lens when the picture is taken. The more light desired, the slower the photographer should set the shutter speed. Once the shutter speed has been selected, the camera automatically selects the correct aperture value to produce an acceptable exposure. This mode is not used for the purpose of intra-oral photography.

Program

The camera automatically selects both the aperture and shutter speed based on a built-in program.

Manual

The photographer selects both the aperture and shutter speed, but the camera's built-in meter can still be used to calculate the correct exposure.

For dental photography, it is important to be in control of the exposure features. Therefore, either the aperture priority or manual exposure settings are preferable.

_Accessories for intra-oral photography

Cheek retractors and intra-oral photography mirrors are essential tools for dental photography (Table I). Using these tools allows us as clinicians to teach and improve team involvement of all the staff. I feel that it is important to delegate the process of intra-oral photography to other members of staff; therefore, it is essential to teach and emphasis the standardisation of all the images taken so that any member of staff trained will achieve the high standards required.

Orientation of the image is important. The occlusal plane should run parallel to horizontal frame of the photograph through the view-finder, as a photograph taken from below will distort and alter the perspective of the teeth. Lateral photographs should be taken perpendicular to the teeth using a mirror (Figs. 7, 8 & 11a). Lateral photographs without mirrors will only show a few teeth, as the metered focus will be on the canines and first premolars (Fig. 11b). For occlusal views, the camera should be as near as perpendicular to the occlusal mirror (Figs. 9 & 10).

Tips for dental photography

_Use cheek retractors;
_Use dental photography mirrors (warm using the three-in-one to remove fogging and saliva bubbles);
_If the image if too bright, increase the f-number (reduce aperture size);
_If the image is too dark, decrease the f-number (increase aperture size);
_Take as many photographs as you like, as you can delete them later.

Table I

Tips for dental presentations

_Use the crop tool to remove cheek retractors;
_When using presentation software, use a black or white background for your images;
_Don't use too many transitions, as this can be distracting to the audience;
_Definitely don't use any sound effects.

Table II

Recommended digital SLR cameras and their settings for intra-oral photography

Camera	Nikon DSLR	Canon DSLR	Nikon DSLR
Flash	Nikon R1C1 flash	Sigma ring flash or Canon ring flash	Sigma ring flash
Power setting	TTL	eTTL	1/4
Aperture value	F22	F25	F25
Shutter speed	1/160	1/125	1/160

Table III