

DIGITAL CAMERAS

A HANDY TOOL IN 21ST CENTURY DENTISTRY

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ABSTRACT

Digital camera has earned its place as a handy tool in a dental office setup. Getting knowledge about various aspects of digital camera is equally important like gathering information about dental chairs, instruments or various dental materials before setting up 21st century dental office. This article mainly concentrates on the basics of digital cameras that every dental practitioner should accustom with for their day to day dental practice.

INTRODUCTION

Why do we need Digital Cameras in Dentistry? This is a very common question that may arise in the mind of many dental clinicians. Yes. Digital camera has become one of the tools that give 21st century dentistry a new horizon. Gone are those days when the clinician had to spend a lot of time to create mental picture to explain the treatment to be performed or the patient had to imagine how their treatment outcome would be. Now with the help of a digital camera and a computer/ laptop, you can pinpoint as to what you are saying to the patient or show pictures of similar old cases and give communication a better platform. Apart from this other uses of digital cameras are:

- For better diagnosis and treatment planning
- For easier patient management
- For pre and post treatment record keeping
- For proper laboratory backup and support
- For easier patient referral
- For publication in journals
- For academic purpose

Conventional film cameras can still be used to give dentistry a better meaning, but the drawback of this method is that, it requires a lot of time for the image development and the cost of developing the photograph. At times as the photograph could not be seen immediately dentists had to click a lot of extra photographs or had to be satisfied with poor quality images. This was really annoying, but with the development of digital cameras most of these drawbacks of conventional film cameras has been overcome. Instant image viewing, analyzing and re-clicking if necessary are some of the advantages a digital camera has to offer and not mention cost efficiency as no film is necessary.



Pre-treatment Photograph



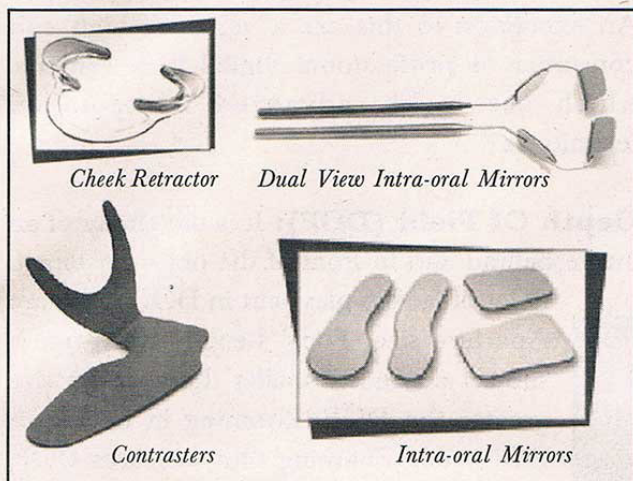
Post-treatment Photograph

As you continue reading on this page, you'll find a lot of "buzz words" you will want to familiarize yourself with regarding digital cameras. You don't need to be a human encyclopedia - come back and read it several times, and it'll all start to sink in... I promise. Then when you finally get out to the store to buy your digital camera for your dental setup, the big tech words the shopkeeper throws at you won't confuse you. You'll know what he's talking about, and can avoid being lassoed in to a sale that's not meant for your dental practice.



INSTRUMENTS REQUIRED FOR DENTAL PHOTOGRAPHY

- Digital Camera,
- Intra oral Photography Mirrors,
- Cheek Retractors,
- Contrastors.



DIGITAL CAMERA BASICS

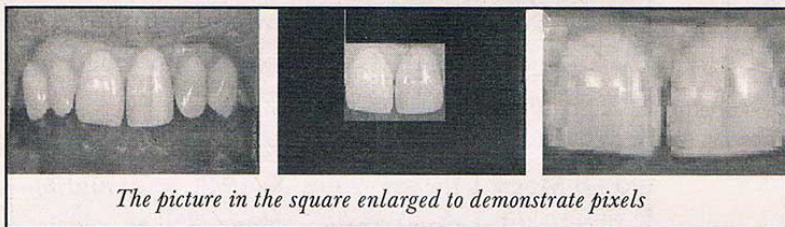
Mega pixels:

Goes along with “resolution” and pixels. At the store, you’ll hear salesman there say something like, “Oh you HAVE to have this new camera, it’s 8 mega pixels and the latest thing!” A Mega pixel refers to the maximum number of pixels that will make up the largest photo size for that camera. An example is that a 3 mega pixel image is around 2048 by 1536 pixels in size, a 4 mega pixel is around 2240 by 1680 pixels - well, you get the idea. The more mega pixels you have, the larger the physical and file size of the photo will be, and the better that printed photos should look when printing them out at larger sizes. Since most monitor resolutions are in the 72 to 100 dots-per-inch range, even a small mega pixel image should look good on your monitor, but today’s printers can print at resolutions of up to 2880 dots-per-inch, so low mega pixel camera images may not look so hot when printing them at larger sizes. Here’s a small chart to let you know pretty much what the maximum size photo would be that you can print based on a camera’s mega pixel rating (keeping in mind you’re using a decent printer, and good photo quality print paper, and also keeping in mind that the camera you’re using is a good quality one with a good lens, etc.)

Sub-Mega pixel (VGA)	<p>This would be a camera that usually has a maximum image pixel resolution of 640 by 480 or 1024 X 768 pixels, which is not large enough to classify it as a “mega pixel” camera. You may see it described in some sites as a “VGA resolution camera”. Images would look ok on a monitor, or for use in emails and web pages, but prints larger than 2.5 X 3.5 inches are most likely going to disappoint you. This class of camera is good for kids, and beginners who don’t need A+ quality photos or do not need to print many photos.</p>
5 - 8 Mega pixel and higher	<p>In the 2592 X 1944 and higher pixel range. Near 35mm photo quality 8 X 10 prints in the 5 mega pixel range, and 11 X 14 prints and higher from 6-7 mega pixels onward. Big time overkill for those just wanting to view photos on their computers or want to stick them on their web pages or just print small snapshots. If you’re super nutty about your 8 X 10 prints looking “perfect”, or need to make super large prints (larger than 11 X 14), then you may wish to look at the 8 mega pixel models, or even the more professional digital SLR models (have your American Express ready!).</p>

MAKE A NOTE: Many people make the mistake of ONLY looking at a camera’s mega pixel rating when purchasing their first camera. This can lead to disappointment. The quality of the lens among other things can have an effect on the image quality. Many if not most cameras made by Olympus, Nikon, Canon, and Fuji for instance, use very good optics and generally produce excellent images. So keep in mind - mega pixels alone do not make a good camera.

Pixels: Pixels are what make up an image. Some call them “dots”, when in fact they’re not always a round “dot”, but can be squarer in shape. Still, it’s a word you’ll hear around. Depending on the camera, you may or may not see the pixels in an image when looking at a printed version of it. In use you may hear, “This photograph is 800 by 600 pixels”, which means that in size, the photograph is 800 pixels wide by 600 pixels tall? Just hearing someone say that a camera, “makes 1280 by 960 photos”, will then mean the maximum size of the photo physically will be 1280 pixels by 960 pixels, about 1.5 times larger than most people have their monitor viewing areas set for.



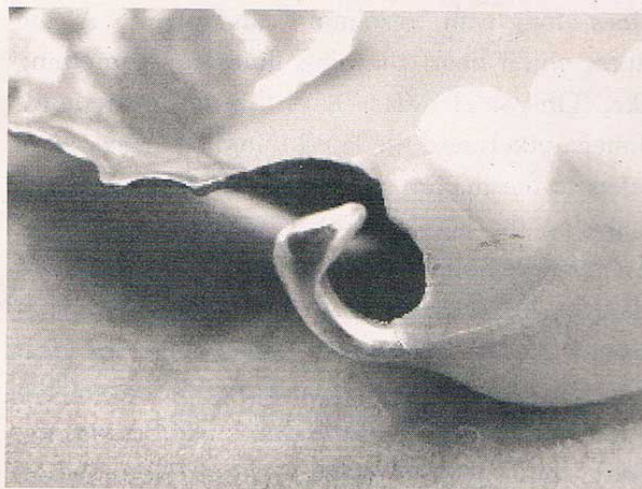
The picture in the square enlarged to demonstrate pixels

Resolution: Ok, the BIG buzz word at the stores... resolution. Probably the most thrown-around word used by sales people to get you to buy the newest and most expensive model of digital camera in the place. Resolution basically is the size of the photo in pixels (dots, basically). The higher the resolution, the larger the physical size of the photo in pixels, and the more space (file size) it will take up. In theory, the higher the resolution, the better that printed photos will turn out, for just as with film, the larger the image that’s shrunk to a snapshot sized photo, the clearer it will be. What you need to know however, is that you may very well not need the highest resolution camera on the store shelves.

Interpolation: When dealing with a camera’s resolution, you need to make sure that the camera maker is not talking about an “Interpolated” image size. Interpolation is where a camera can “add extra data” to an image in order to make the image a larger resolution size; in other words, interpolation is “fake resolution”. An example might be that you find a cheap digital camera in the store... on the side of the box it may read, “Camera resolution = 1024 X 768 pixels (interpolated)” What this would most likely mean

is that the REAL resolution of the camera is a smaller 640 by 480 pixels, but the camera adds data to make it larger. As you may guess, this added “fake” data does not help an image’s quality - it usually makes it worse. So if you’re in the market for a digital camera of a specific resolution, make sure the word “interpolated” isn’t on the box. An exception to this are a very few high end consumer or professional digital SLR cameras which use highly advanced interpolation techniques.

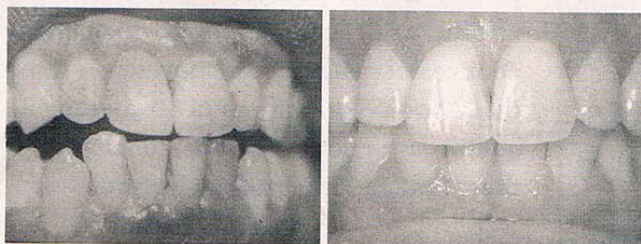
Depth Of Field (DOF): It is the clarity of an image behind and in front of the object or target. A lot of factors play part in DOF. They are Aperture size, Focal Length and camera subject distance. Smaller the aperture size greater the DOF, Zooming in decreases DOF while Zooming Out increases DOF, for dental Photographs the focal length is 90-105mm, farther the distance between the camera and the subject greater is the DOF.



Depth of Field

Lens: The lens too, plays a very important roll in the quality of photos you take with any digital camera. You can buy a 6 mega pixel camera, but if it has a cheaply made lens on it, the images may not even contain as much detail as a high quality 3 mega pixel camera from a major brand. Some cheaper models of cameras have plastic or poor grades of glass for a lens. Other more expensive models have coated multi-level glass lenses. While pixels and the quality of the image sensor play rolls in how well your photos will turn out, neither does the job on its own. The lens must be a high

quality lens in order for you to take good photos. Canon, Nikon, Fuji, Sony, and Olympus are popular for their high quality of lenses on their digital cameras.



Poor lens quality

High lens quality

Macro: “Macro mode” is something you’ll read in camera reviews a good bit, such as, “This camera has an excellent macro mode”. Macro is simply another word that describes a camera’s ability to do extreme close up shots. Most cameras will have a button or switch that when pushed, adjusts the focus so that you can get in very close to an object, sometimes as close as 1 inch or even less! This is an important feature for dental photographs and requires 90-105mm lens.

Optical vs. Digital Zooms: Let’s face it, you want to sometimes get a close image of someone or something, without having to physically move closer to the subject. Well, you must have a camera with a zoom on it in order to do so. One buzz word you’ll hear, especially in cheaper cameras, is that they have a “digital zoom”. Let’s clear this up now... a digital zoom is not worth having, and do not allow it to steer you on your purchase.

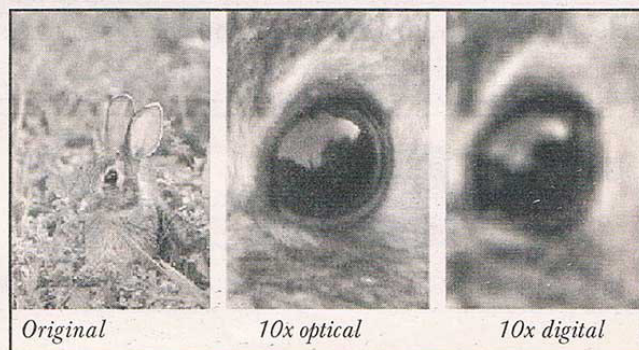
An optical zoom, is a REAL zoom, working much like a binocular or small telescope, where the camera moves the lens back and forth to bring the subject you’re aiming at closer.

A digital zoom simply takes the center of the photo, digitally enlarges it, and that’s that. The image quality suffers, and lacks detail, and you don’t have a true zoom photo.

Many cameras have an optical zoom AND a

digital zoom, and will use this to try to make their camera sound as if it’s zoom is larger than it is. For example, a camera may have a 3X optical zoom, and a 2X digital zoom in the camera, and advertise it as “Comes with a 6X zoom!!!”. Nope, it does not. It comes with a 3X zoom that’s “enhanced” with a digital zoom, to “fake” a 6X zoom.

Another thing to remember is what a real zoom is - for example, some makers like Kodak and Canon have several models with only a “2X” optical zoom. Sounds nice, but at only 2X, the “zoom” is just barely greater than what a human sees with their naked eyes. It’s not really a “zoom” so to speak. Many cameras have a 3X optical zoom these days, which will bring you a bit closer to the subject, but for dental photographs a 6X optical should suffice.



Flash: Fires a burst of light to illuminate an area or subject for poor or indoor lit conditions. Most good digital cameras have a flash, but some of the very inexpensive beginner’s models do not. Without a flash, indoor shots are nearly impossible. Many digital camera flashes are not the strongest in the world. You shouldn’t expect much more than a 6 foot effective range on many of them. Some higher priced models can light up a subject 10 or more feet. A few are not coming with “hot shoes” like on a SLR film camera, so you can attach a more powerful external flash to them. For Dental photography a ring flash with adequate light producing capacity is advised, but they do not come cheap. All digital camera models do not accept ring flash so check whether the camera accommodates a ring flash before you buy.

There are several different flash options that are available for digital cameras.

Auto Flash	The camera decides if the flash fires, depending on the amount of light in the shot.
Fill Flash	The camera will fire the flash in any lighting condition, even bright sun. This is useful in a shot with uneven lighting or shadows. This is good for intra-oral photography (Also called Flash On).
Red-eye Reduction	The flash fires a "mini" flash of light to fool the iris of the subject's eyes into closing a bit before the real flash fires and the picture is taken. This is good for portrait photographs.
Slow-Sync Flash	The flash fire time is extended to better illuminate the darker or background areas of your shot.
External Flash	Many high-end cameras enable the user to attach an external flash unit to the camera.
No Flash	No Flash is an option for those times when the camera thinks you want a flash, but you don't.



Camera Shake: This is a term that refers to movement made by someone when they hold a camera and use the zoom. For example, if you've ever held binoculars or a telescope before, you know how when you look through how even a slight movement on your part results in a very pronounced movement on the other end? The longer the zoom the stronger is the effect. Well imagine using a digital camera with a big 10X zoom. You can now understand that if you use one of these cameras at full zoom, how much even the slightest movement you make will be exaggerated through the lens, resulting in blurry photos. Now in good light, (as in a very bright sunny day), the camera should automatically pick a very fast shutter speed, which will "freeze" the motion on the other end, but on hazy, cloudy, or darker days, it will pick a slower shutter speed, resulting in blurry photos. A few cameras are now adding a feature known as "image stabilization"

or "steady shot", or some similar buzz words. These are technologies that help stabilize the lens when using them at long zooms, greatly reducing your risk of getting a blurry photo. If you want a camera with a big zoom, and want to maximize your chances of getting clear shots when using that zoom, you will want to investigate getting a camera that does offer one of these image stabilization features.

Noise: Think of "noise" as static on an image, or as an effect very similar to film grain. Some cameras are better at reducing noise than others. Noise shows up like small specks in parts of an image such as a solid blue sky, or in solid colors in darker images. Once you research more, and begin reading reviews on specific camera models, make sure and look for any mention of that particular camera having any more than usual amounts of noise in the photos. Note that most consumer level digital cameras have adjustable "ISO" levels (similar to film speed - the higher the ISO you pick, the more sensitive to light it is, but the higher the noise will be). So noise is pretty common in dark indoor photos. There are programs you can buy that

reduce noise in a photo at the cost of some sharpness. Digital SLR cameras are much more expensive, but handle low-light photos much better, and have less noise in their images.

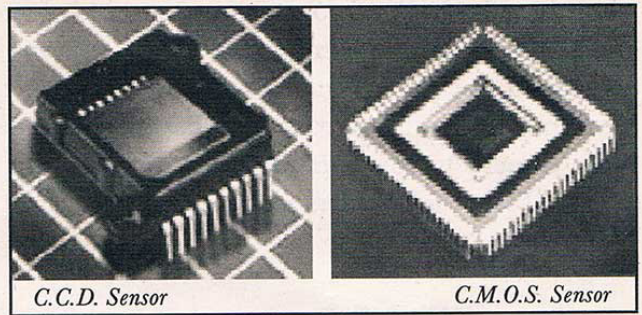
White Balance: With film you can buy "daylight balanced film" for shooting outdoors or "tungsten balanced film" for shooting indoors under normal domestic lighting (not fluorescents!). If you use daylight film under tungsten light the images will be very yellow. If you use tungsten film in daylight the images will be very blue. With film you have to correct for the "color temperature" of the light using filters or by the right choice of film.

With digital you can pick your white balance to suit your light source, so that white looks white, not yellow or blue. Normally there is an automatic setting and the camera decides what white balance

setting to use. However if you know what your light source is you can usually set the camera to it and this may give better results. Most digital cameras have settings for sunlight, shade, electronic flash, fluorescent lighting and tungsten lighting. Some have a manual or custom setting where you point the camera at a white card and let the camera figure out what setting to use to make it white.

Compression: A camera must “compress” an image file in order to store it on a memory card or floppy disk, (in most cases unless you’re shooting in an uncompressed TIFF mode, but that’s another lesson). When it compresses an image, it takes data out of the image, to make the file size smaller. The more compression, the smaller the file size, and the more photos that can be stored on a card or disk; however, the more an image is compressed, the worse it will look. Different cameras have different compression rates. Cheaper digital cameras that use a memory card however, may compress an image more even on their best quality settings - up to 9-to-1 in some cases so this is yet another factor that can make some camera photos look worse than another, even if they’re the same mega pixel rating.

C.C.D. & C.M.O.S. Sensors: These might not be the top of the list of words you need to know when buying your first camera, but it’s a good to have knowledge about it. A digital camera uses a sensor to snag an image to store on its memory card. Higher quality digital cameras use a “C.C.D.” (charge-coupled-device) sensor to do this. These come in different quality and sizes, and their images are measured in pixel. Another form of image sensor is called a C.M.O.S. sensor (complementary metal oxide semiconductor), and is usually used in cheaper devices like web cams, or digital cameras, since it’s much cheaper to make than a C.C.D. sensor. Of course, a C.M.O.S. image is usually much worse as a result of its price. Today however, when buying a very inexpensive digital camera, it’s still best to make sure on the box or with the salesperson that it’s a C.C.D camera and not a C.M.O.S.



The exceptions to this rule are “digital SLR” cameras - the types where you can change the lenses much like film SLR cameras. Canon in particular uses a very high quality C.M.O.S. chip in their digital SLR cameras, which do in these cases produce excellent images.

Memory Cards: These are basically the film of digital camera or the storage media. Some examples are Smart media, compact flash, XD, MMC, Sony memory stick etc. Cards come in different memory capacities. The larger the capacity is in “mega bytes”, the more photos it will be able to store. Once you fill the card up, you simply empty it by downloading the photos into your computer, and you can then erase the card and start over. The card can be used and reused hundreds of times before they wear out. Keep your memory cards away from high heat (such as leaving them in a hot car), direct sunlight, or water.

How much memory do you need? It depends on how much the camera “compresses” the image (see “compression” below), but in general, for 1.3 to 3 mega pixel cameras, you really want a MINIMUM of 64 megabytes of memory. If the camera has a movie mode you’ll be using a lot, you’ll want to double that to 128 megabytes or even higher. For 4 to 6 mega pixel cameras and higher, then you really should budget for the highest amount of memory you can afford... at least a 256 meg card. You can go higher to 512 megs, or 1 gigabyte (1024 megs) or more. Most cameras today come with what they call “starter cards” which are usually very low capacity (16 or 32 megs), and they’ll only allow you to store a few photos at the camera’s top quality settings, and some cameras don’t even come with a card at all, but instead include a small amount of internal memory and a card slot you can put your own card in once you buy one. You can also buy a memory card reader, which is a device that

plugs into the back of your computer, which you insert your camera's memory card into so you may download the photos into your computer. This saves battery power, as you won't have to connect your camera to the computer for downloading photos. Most card readers today connect via your "USB" port.

Movie or "Video" Features: Many new or mid-priced digital cameras will advertise a "movie mode" or video feature. They do little to explain what this really is. While these cameras have the ability to take small mini-movie clips, most of them have a short limit video clips. Many times, it may only be 30 seconds, although newer generations of cameras are allowing you to take video until the memory card is full. The larger the memory card, the longer the movie you can take. Some cameras offer the ability to capture sound with the video, and others do not. The video is really in most cases not very good, and movement will be a bit choppy, as the "frame rate" is not as fast as what a camcorder or video camera uses. You need 30 frames per second for a video to look like "live TV", and most of these cameras only capture video at about 8-15 frames per second. The size of the video is usually a maximum of 320 pixels wide, so it's not full-screen. Some newer models are offering larger 640 x 480 pixel sized movies in their cameras - keep in mind that while this is a much higher quality video, it eats up TONS of memory on your card, and many times while this newer generation of movie mode is better, it still isn't quite up to matching the quality of a small mini-DV camcorder. The lesson? Do not purchase a digital camera for its video or movie features. It's a cute little feature to have-so quality moving pictures when the camcorder is not handy at the moment, but that's it... base your purchase on the camera's still image quality, and not the "fluff" features.

File Format: describes the particular computer code used to store your files. There are many different image file formats. The most common, however, are JPEG, TIFF, BMP and GIF. When attaching a picture file to an email, the two file formats that are used most frequently are JPEG and GIF. For example, you might receive a picture file attached to an email that looks like this ...puppy.jpeg. Because the file format is JPEG, you will immediately know it is an image.

JPEG	Joint Photographic Experts Group... The most widely uses file format for pictures, JPEGs are platform independent. They can be opened easily on both Mac and Windows. A JPEG image is one that has been compressed.
TIFF	Tagged Image File Format ... TIFF files are platform independent and can be opened by both Mac and Windows. Because TIFF images are not compressed they tend to be large and require lots of storage space on your hard drive. Pictures in TIFF format are a basic file format for the printing industry.
BMP	Bitmap ... BMP files are not compressed. The files are large and used primarily for Windows wallpaper images.
GIF	Graphics Interchange Format ... GIF files are platform independent and can be opened on both Mac and Windows. This early picture format uses only 256 colors and has been surpassed by other choices. GIF files, however, are still one of the easiest file formats to attach and open on email.

CONCLUSION

A Digital camera is definitely a very handy tool for your dental office. Experience the difference in your day to day dental practice with use of digital cameras and computers. These will definitely boost up your confidence and the patient will definitely thank you for the outstanding consultation and treatment.

For dental photography single lens reflex (SLR) cameras are good but they don't come cheap, however some compact lens cameras are equally good and come comparatively cheaper.

Here are some specifications of a digital camera for dental photography,

- 3.2 or higher mega pixel
- 90-105 mm macro lens
- optical zoom of 10-12 X
- magnification ratio of 1:1 for intra oral photographs
- aperture stops of at least f32
- lenses which accommodate ring flash

REFERENCES

www.Photonet.com, www.Bobatkins.com
 www.pantherproducts.co.uk, www.mediaworkshop.org
 www.picturecorrect.com