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An insight into digital photography in dentistry: Basics on digital photography

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Abstract

Photography is one of the most important aspect of clinical practice and as well as academics. A well-documented case helps the clinician in diagnosis and treatment planning, patient communication, to evaluate the treatment progress, for academic purposes in publishing the case and in case of any form of litigation, photographs serve as an invaluable tool. The first part of the series details about the basics on photography followed by detailed camera settings required for different clinical situations.

Keywords: digital photography, dental photography

Introduction

Ever since the caveman began drawing on walls, it has been widely acknowledged that "a picture is worth a thousand words." Photography is undoubtedly one of the most important inventions in history, it has truly transformed how people perceive the world. Photography lets us capture moments in time and preserve them for years to come. Photography is a universal means of communication and an invaluable tool in many fields. From family snapshots to pictures taken from aircrafts, photographs record the people and the things we see, as well as many subjects beyond our range of vision. In skilful hands, a camera can transform an ordinary scene into an image of exceptional beauty (fig1).

The term Photography laterally means photo=light and graphy=draw/painting, that translates as painting with light. The term photography was coined by Sir John Herschel

Photography now has become a part of our daily life. Nowadays, photography is touching almost every aspect of human life, be it scientific literature, art work, travel entertainment or for forensic/police documentation and so on. With reference to medicine and dentistry photography plays a pivotal role not only in academics but also in clinical practice.

In clinical practice, photography play many important roles. Firstly it allows for documentation of the patient's condition and compare it with the post treatment results. Thus it helps in documenting the progress of the treatment which also will serve as a showcase for other future patients^[1]. Photography serves as a strong tool for doctor-patient communication and also between the professionals. Documented cases are a must for postgraduate exams also. It also helps in being used as an effective marketing tool.

Photographs play a pivotal role in aiding the forensic experts in solving the identity of the deceased persons^[2].

Brief History

Arabian physicist and mathematician Ibn al-Haitham gave the first clear description of the device in the 10th century. However, Giambattista della Porta is said to have perfected the pinhole camera, which he called an optic chamber, in the 16th century. The invention was so confusing and radical to medieval society that he was arrested and charged with sorcery.

The first ever camera was the 'Camera Obscure' (fig2), huge box with a tiny opening on one side & on the opposite side, light formed an inverted image. Technology has changed over time, but purpose still remains the same.

In the 1960s, George Smith and Willard Boyle invented charge-coupled device (CCD) at bell labs followed by Kodak scientists (1986), invented the world’s first megapixel sensor, capable of recording 1.4 million pixels producing 5 × 7-inch digital photo-quality print [3]. In 1990, Logitech flooded the markets with digital consumer camera known as the Dycam Model 1 digicam. The Apple QuickTake 100 camera was the first digital camera that could be connected to the home computer via a serial cable in 1994. This camera featured a 640 × 480 pixel CCD which produced eight images stored in internal memory and a built- in flash [4].

Cameras have come a long way since then ushering the present digital camera boom. Right now the Single -lens -reflex (SLR) cameras are ruling the roost which provide accurate image reproduction and colour rendering.

The photographic film was replaced by the CCD- Charged couple device or the “complementary metal oxide semiconductor [5] (CMOS). The digital sensor is made up of millions of tiny photosensitive diodes called pixels which are coordinated in a matrix. Each pixel is a numerical value that corresponds to the 256 shades of gray at a single point in the image. Digital approximation of the image can be done tracing the analog to digital conversion within the sensors through which a copy of the original image can be reconstructed. To record colours, red, green or blue, filter is placed over the individual sensor. It affects the resolution of the camera and aids in larger print outs. Approximate recommendation for an image is at least 24bits if colour depth and a resolution between 500-700dpi [6].



Fig 1: The Oriental Kingfisher with its feed captured with a DSLR

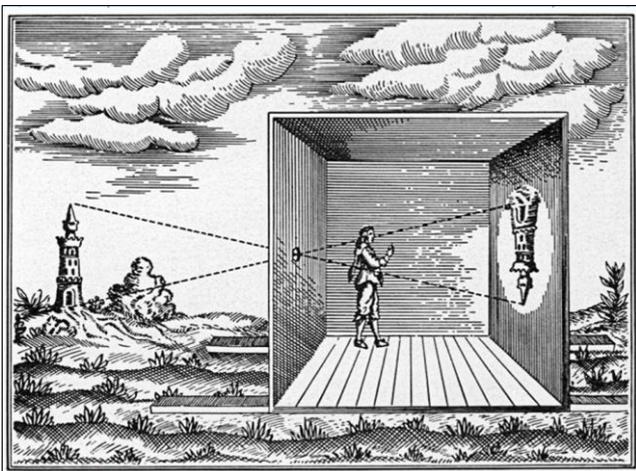


Fig 2: World’s first camera the ‘Camera Obscure’

Principle on how camera works

The camera works in much the same way as your eye. The lens in the eye focuses the image on to the nerve cells in the

retina and this image is sent to the brain by the optic nerve (fig3). This is the principle employed in the camera (fig4). The lens sharply focuses the image on to the film. To keep the image sharp even when the distance varies, the lens has to be moved either farther or closer to the film. This what we commonly call ‘focussing’.

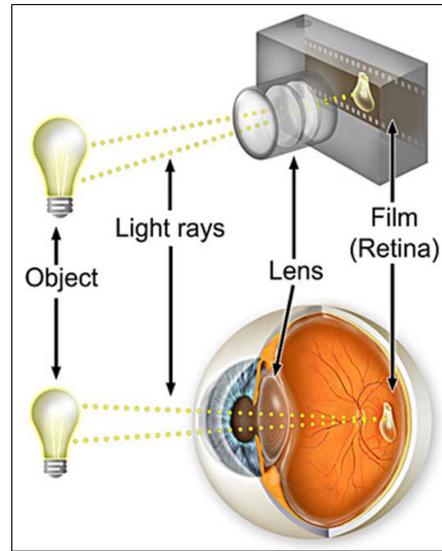


Fig 3: Principle on how an eye works and its comparison with the camera

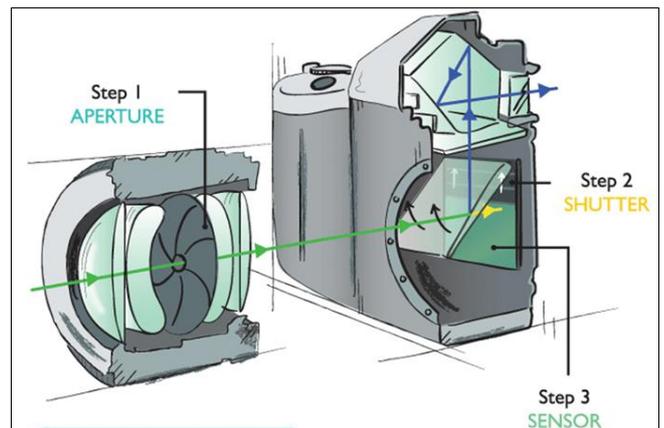


Fig 4: How a Camera works

Choosing the right camera

The most difficult part of photography for a beginner is actually deciding which type of camera to buy. Each manufacturer claims his model is the best and has more features than the rest and so on.

Regardless of the brand you chose, familiarity and practice with your camera system will eventually produce good results. At the end of the day, one must remember that camera is only as good as a person using it. Cameras only deal with the mechanical side of photography as they cannot compose pictures, choose subject or tell when the light is right. Those decisions will always have to be made by the photographer, and they are, by far, the most important points.

It is important to remember that you will ‘waste’ lot of shots to get accustomed to your camera. Upgrading equipment or changing systems is an expensive proposition. Getting the right stuff early in your career will save money in the long run. This finally will allow you to concentrate on technique and not worry about the adequacy of your equipment.

Let us now, go one by one to different types of cameras available in the market.

Compact cameras

Also referred to as consumer cameras or point and shoot cameras. These cameras are very popular for two main reasons. Firstly, they are small, light and easy to carry around. Secondly, they are a doodle to use because everything from exposure to focusing is automatic. In addition, they are less expensive. This makes them ideal for holidays, picnics and parties (fig.5). There are basically three types of compact cameras available: (i) Fixed lens, (ii) dual lens; and (iii) zoom compact.

Fixed lens are the simplest and cheapest. They have slightly wide angle lens, typically with the focal length of around 35 mm. unfortunately, it is too wide to give flattering results, and in any case it will not focus close enough.

Dual, or twin lens, offers the same lens but at the flick you have the option of using a standard focal length of 45–50 mm. This increases your options, though it is still not ideal for close-ups.

Finally, zoom compacts offers the greatest flexibility of all. The focal length range can be anything from 35-115 mm, which means you can shoot a much broader range of subjects and compose picture with greater precision.

The main drawback with compacts is that, they give very limited control. Focusing, exposure and film speed are set automatically and often the photographer cannot override the camera when he wants to change the exposure, or try certain techniques. He is also stuck with the lens the camera comes with.

Compact cameras are if you want to take snapshots at a picnic to record family and friends, but in clinical photography where you wish to exercise greater control over the picture taking process, you need a camera which will behave as per your commands. You must have the right camera if you wish to convey the message with your clinical photographs. So, what is this right camera?

It must, be able to shoot in fully manual and fully autofocus modes if you wish to pursue photography at any level. So, what does that mean? It leaves out any analogue/digital point and shoot cameras available in the market right now!

Many people think that photography is just pointing a camera and taking a photo. Unfortunately, it is not that simple.

To tell a story through the medium of a frame with four walls is an art, and to pursue this art one has to have a 'single lens reflex' (SLR) camera (fig.6-7). It may be a film or a digital version. Invest in a good SLR camera and you are ready for quality results.

Single lens reflex (SLR) is the perfect camera for all-round photography. It gives you the scope to take control over every aspect of the picture taking process when you feel it is necessary, but will happily make all the decisions for you when there is no time to think.



Fig 5: Illustration of a Compact camera

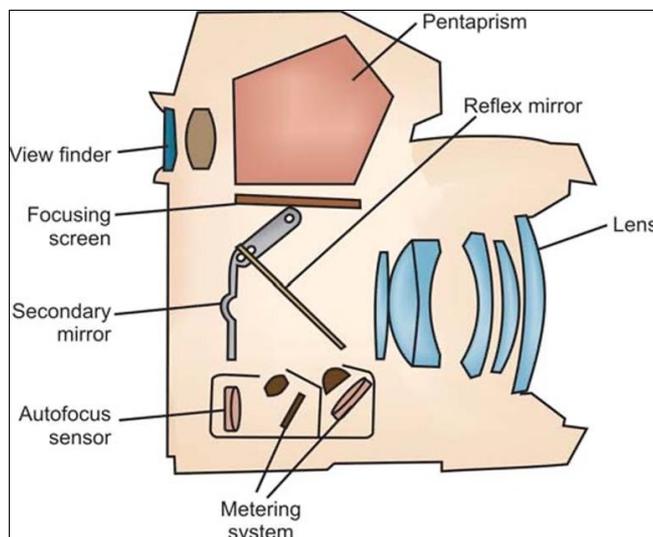


Fig 6: Diagrammatic representation of the parts of a DSLR



Fig 7: Working buttons of a DSLR

All about Focal Length & Lenses

Focal length, usually represented in millimetres (mm), is the basic description of a photographic lens. It is not a measurement of the actual length of a lens, but a calculation of an optical distance from the point where light rays converge to form a sharp image of an object to the digital sensor or 35mm film at the focal plane in the camera. The focal length of a lens is determined when the lens is focused at infinity (fig 8).

Lens focal length tells us the angle of view—how much of the scene will be captured—and the magnification—how large individual elements will be. The longer the focal length, the narrower the angle of view and the higher the magnification. The shorter the focal length, the wider the angle of view and the lower the magnification (fig9-10).

Understanding the camera lenses can help add more creativity control to digital photography. Choosing the right lens for the task can become a complex trade-off between cost, size, weight, lens speed, and image quality.

Wide angle lenses have short focal lengths, and telephoto lenses or zoom lenses have longer focal lengths.

The following (table-1) will give a rough range of focal lengths and its uses

Table 1: The following table will give a rough range of focal lengths and its uses

Lens focal Length (f point)	Type of lens called	Typical Photography that can be done
Less than 21 mm (10-22, 8 -15,)	Extreme wide angle lens	Architecture
20 – 35 mm	Wide angled lens	Landscape
35-70 mm	Normal lenses	Street & documentary
70 – 135 mm	Medium telephoto	Portraiture
135 – 400 mm + above	Telephoto	Sports, birding, wildlife

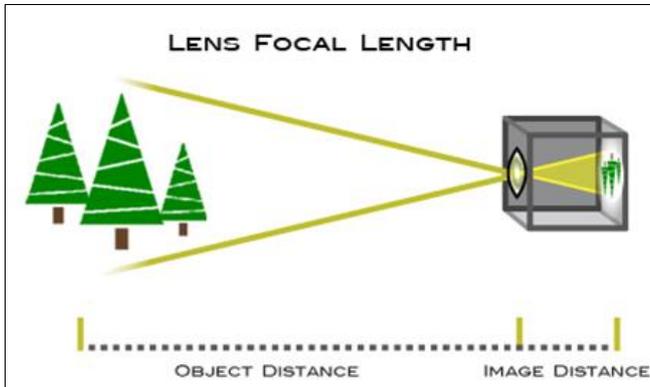


Fig 8: Illustration on how to calculate a Focal length of a lens

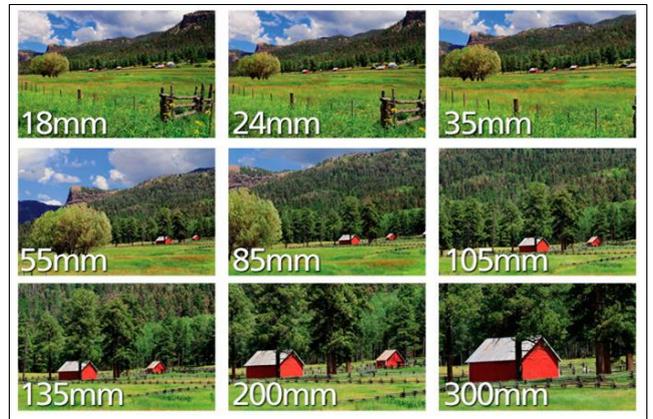


Fig 10: Sample images captured by different lenses with varied focal lengths (18mm to 300mm)

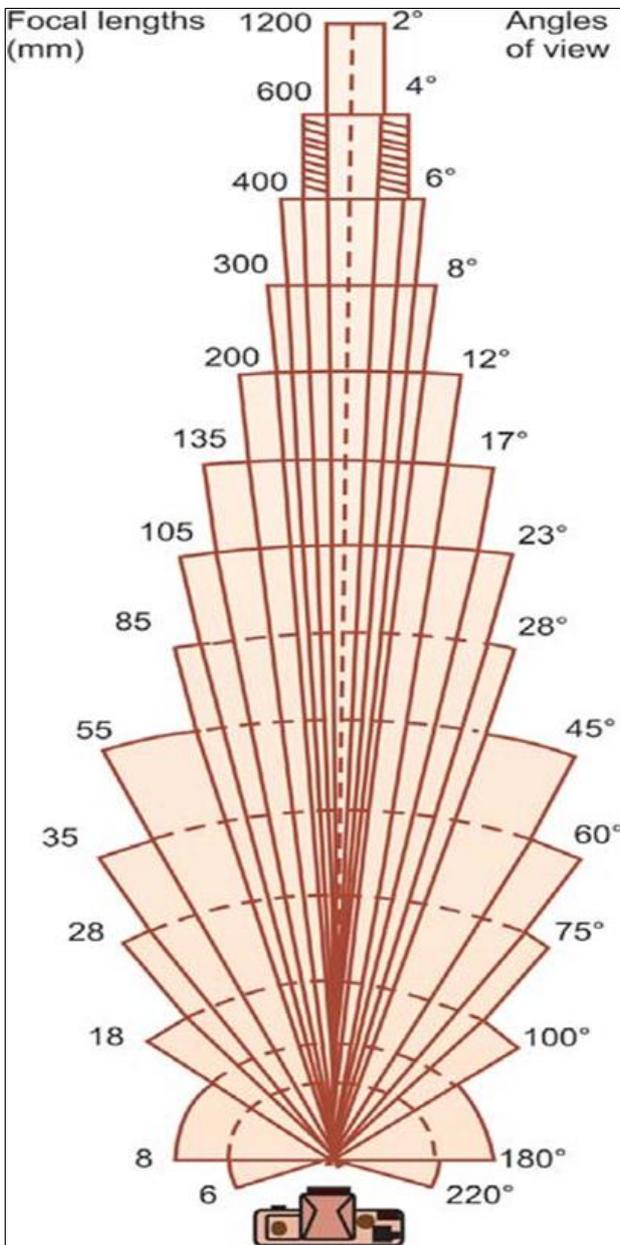


Fig 9: Various focal lengths and their respective Angle of view

ISO Speed

ISO Speed determines how sensitive is the camera’s sensor/film to the incoming light. A lower ISO speed is better for clearer pictures (fig11).

The higher ISO settings can increase the noise in the pictures. In low light conditions however a higher ISO setting is desirable.

Lower ISO number = slower film = need more light = longer exposure required

Higher ISO number = faster film = need less light = shorter exposure required



Fig 11: Illustration of the use of different ISO specifications

Aperture

Aperture is the opening in the lens that lets light pass through to the sensor. It acts just like the pupil for your lens. It dilates to let more light in, and contracts to restrict light when it is bright. Aperture is probably the first thing most photographers think of when they want to adjust the depth of field.

These are series of crescent shaped blades that make a circular opening in the middle of the lens. Moving these blades enlarges or reduces the size of opening. This has an influence on the “depth of field” of the image captured (fig 12).

Aperture is denoted as a 'f' stop number. The smaller the number the larger the size of the aperture and higher the number the smaller the aperture size.

Depth of field -Dof (fig13) is the distance between the closest and farthest objects in a photo that appears acceptably sharp.

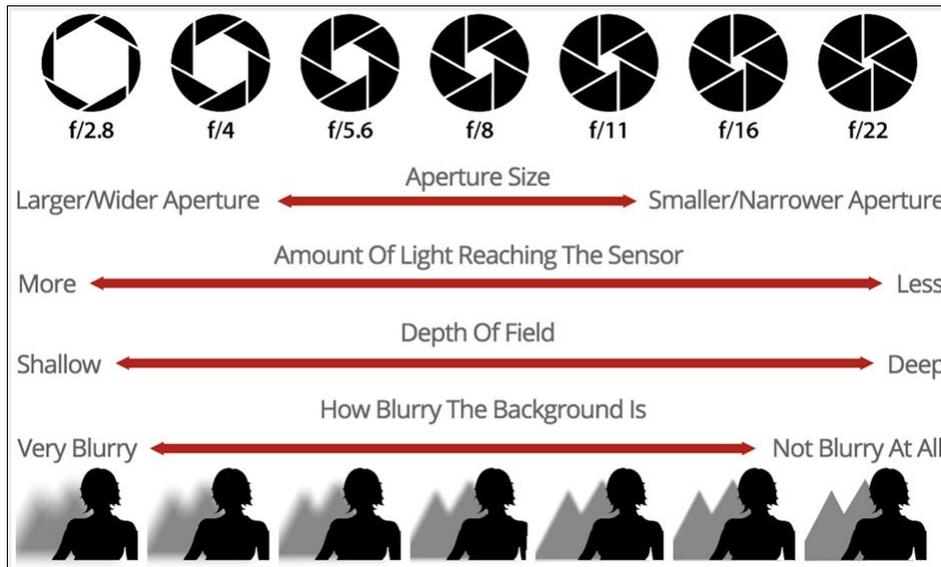


Fig 12: Effect of varying apertures and its effect on Depth of field

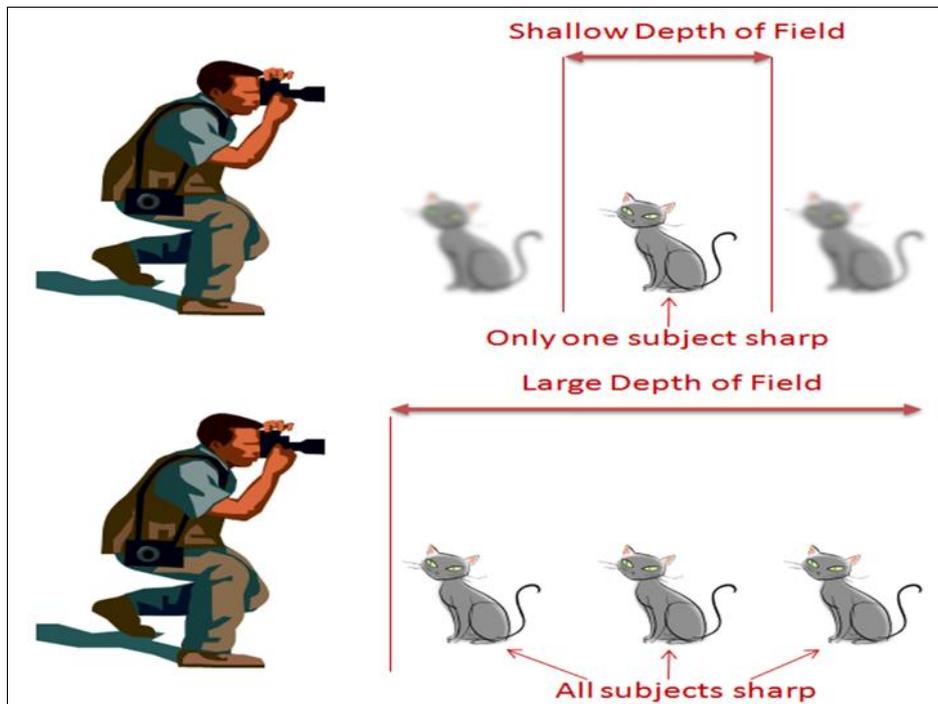


Fig 13: Illustration of different Depth of fields

Shutter Speed

The Shutter speed controls the duration of exposure (1/60 th of a sec, 1/30 of a sec, 1/2 sec, 1 sec, etc.)

Adjusting the shutter speed allows one to capture fast moving objects like birds/sporting action and freeze the motion (fig 14). It can also be used creatively to depict motion or use a slow shutter speed in low light conditions to allow more light to fall onto the camera sensor. The following table -2 gives an insight into the various shutter speed scenarios.



Fig 14: Faster shutter speed used to capture fast moving objects like birds

Table 2: Faster shutter speed used to capture fast moving objects like birds

Shutter speed	Typical scenario
1 second to 30 + seconds	Night and low light conditions, shot on a tripod
2 seconds to ½ second	Give a milky look to the flowing water on a falls shot on a tripod
½ to 1/30 second	Gives a blur to the back ground of moving subject, can be hand held
1/50 to 1/100 second	Normal hand held pics without using zoom
1/250 to 1/500 second	Sports, action, used with telephoto zoom lens
1/1000 to 1/4000 sec	Extreme fast, close up subject like birding, wild life

Basic summary of fundamentals

- ISO – Increase ISO >More Noise –
Decrease ISO >Less Noise
- Aperture– Wide open F – Shallow DoF
Narrow F – Wider DoF
- Shutter Speed – Faster SS > Freeze the action
Slower SS > Blurring action

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In other words, there has to a balance between the three aspects while capturing an image, namely ISA-Aperture & Shutter speed. (Fig 15).

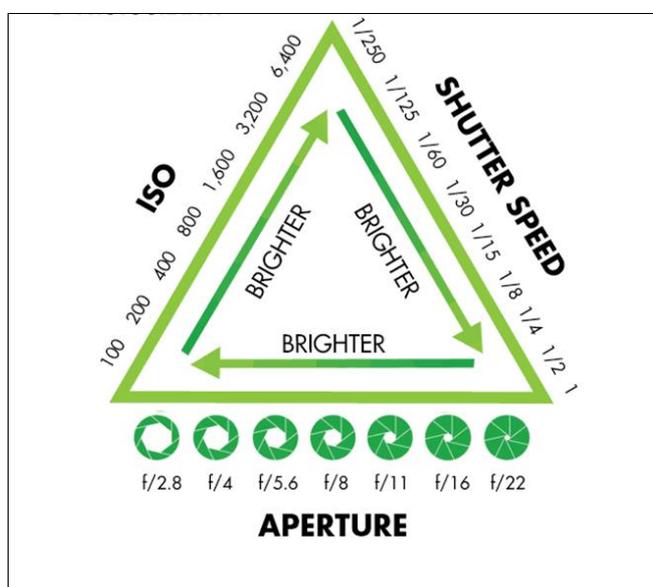


Fig 15: The holy triangle in Photography formed by ISO- Shutter Speed- Aperture

Camera & Lens recommendation for dental photography

Camera: Any DSLR from either Nikon/Canon / Sony etc.
 Lens: A lens with a focal length of 90mm- 105mm macro lens with a capability of reproducing a 1:1 ratio of the image.
 Flash systems: For extra oral photography two studio lights (if possible)
 For intra oral photography- Ring/Twin flash system the second part of the article will be detailing on the camera settings specifications and method of photographing each case in the respective specialties.

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