

## PHOTOGRAPHIC IMPLICATION AND BASIS OF CAMERA LENS

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### ABSTRACT

Our patients expect us to show them what we do, but just making a click is by far not enough to make good intra oral pictures. Being good in photography is an absolute necessity in today's dentistry. Photographs are not used for diagnosis only but also for communication and medicolegal reasons. This article takes a full and clear review of selection of camera, lenses and camera setting for intra and extra oral shots. We know that good quality accurate clinical photography can easily be obtained using correct focusing technique, proper focal length of lens and aperture size. So aim of his article is to take the readers to the basics of camera lens.

**KEY WORDS:** Depth of field , Zoom , shutter speed , SLR, Macro lens , Aperture

### INTRODUCTION

Since prehistoric times the human face has been recorded on various media; ranging from crude representations on cave walls to the modern art of photography. Orthodontics common to the era of photography has like wise recorded the facial appearance of its patient for diagnosis , treatment planning photographic appraisal of patient . The quality of photograph depends on resolution , lens aperture, software used for compression and storage , lens quality ,shutter speed, flash etc<sup>1</sup>. These days digital camera are fully automatic , but keep in mind that camera can easily be fooled and is little slow , which is why manual setting usually produces better picture .Lower end digital camera do not have manual setting , but its true that to produces truly beautiful photograph ,you need to learn about working of lens and few things about manual setting<sup>2</sup>.

### UNDERSTANDING CAMERA FOCUS

The nature of real image depends on how the light travel through the lens .This light path depends on two major factor :

- The angle of the light beams entry into the lens .
- The structure of the lens.

The angle of light entry change according to distance of the object from lens .Light beams enter the lens at a sharper angle when the pencil is closer and more obtuse angle when the pencil is farther away (Fig.1) . It can also be seen that light beams from a closer point converges

away from the lens than the light beams from a point that's farther away. In other word, the real image of a closer object forms farther away from the lens than the real image from a distant object<sup>3</sup>. To focus the image of an object which is farther away or closer, we turn the lens of camera i.e we are moving the lens closer or farther away from the film surface (Fig. 2) . In a lens with flatter shape, light beams converge farther away from the lens. To put it other way, as the distance between the lens and the real image of the object increases, magnification also increases. To put it simple, light beam keeps spreading apart as they travel towards the screen . So as the distance between the screen and the lens is increased ,the image becomes larger. A rounder lens produces real image near to and at reduced magnification . A flatter lens produces real image farther and at increased magnification<sup>4</sup>.

### UNDERSTANDING CAMERA LENS

A camera lens is actually several lenses combined into one unit. A single converging lens could form a real image on the film , but would be warped by number of aberrations. One of the warping factor is that different colors of light bends differently when moving through lens. This chromatic aberration essentially produces an image where the colors are not lined up. Camera compensates for this by using several lenses made of different material .Each lens handle color differently and when they are combined in a certain way, the color are realigned .In a camera , the focal length is defined as the distance between the lens and the real image . The focal length of a lens determine its angle of view and also how much the

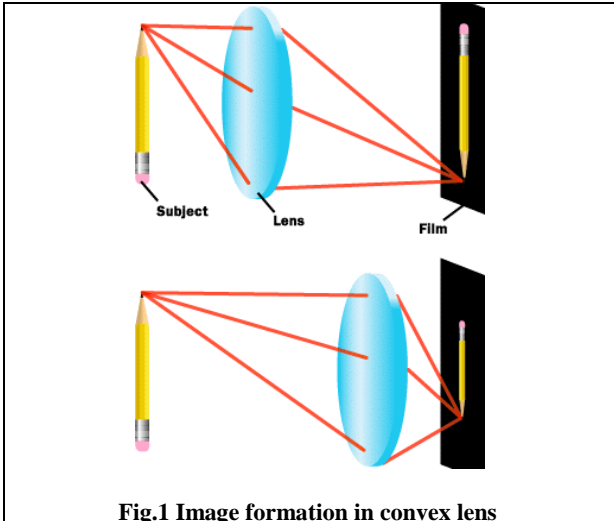


Fig.1 Image formation in convex lens

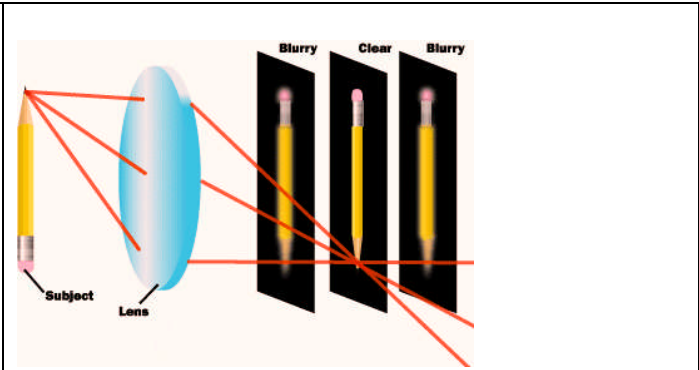


Fig.2 Distance of image from lens

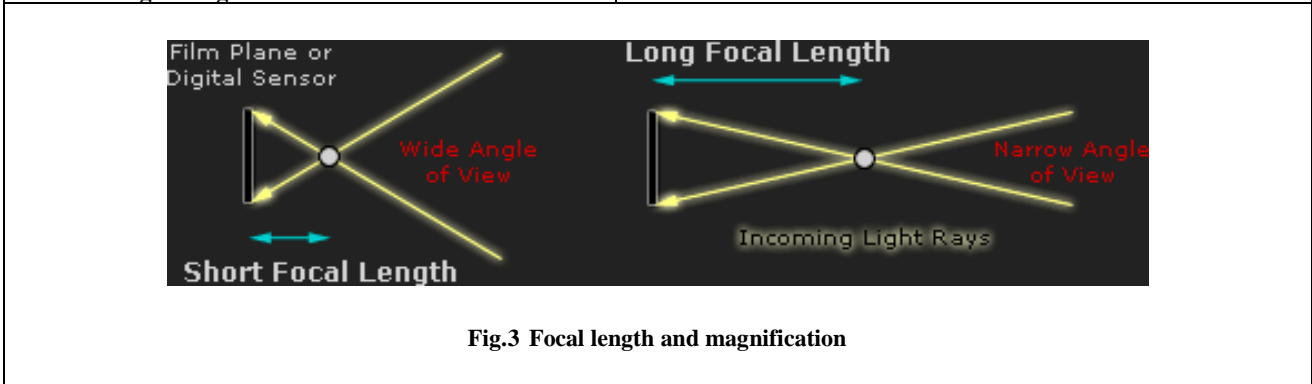


Fig.3 Focal length and magnification

subject will be magnified for a given photographic position. Wide angle lenses have small focal length and wide angle view, while telephoto lenses have large focal length and narrow angle of view. 50mm lens provide normal magnification i.e what our eye sees<sup>5</sup>. A higher focal length indicates greater image magnification and less than 50 mm provides less magnification and have wide angle view (Fig.3) (Table 1). In orthodontics we use focal length near 100 mm to get narrow angle of view also macro lens allows for distortion-free imaging at closer range with high depth of field. A long focal length allows to get a tight photo while a short focal length (wide angle camera) are great for taking large vistas.

**SLR CAMERA VS. POINT AND SHOOT CAMERAS**

The main difference between SLR(Single lens Reflex) Camera and point and shoot camera is how the photographers sees the scene. In point and shoot camera, the view is a simple window through the body of camera. You don't see the real image formed by the camera lens, but you get a rough idea of what is in view. In SLR Camera, you see the actual real image that the film will see (Fig.4). The camera has a slanted mirror positioned between the shutter and the lens. When the shutter is clicked, the camera quickly switches the mirror out of the way, so the image is directed on the exposed film. The mirror is connected to the shutter timer system, so it stays open as long as shutter is open. That is why

the view finder is suddenly blocked out when a picture is taken. Most SLR camera are built with both manual and automatic control and most point and shoot cameras are fully automatic. In automatic mode, central microprocessor receives information from the auto focus system and the light meter, then it activates several small motors which adjust the lens and open or close the aperture. One type of digital camera falls between consumer and professional camera called as prosumer camera<sup>6</sup>.

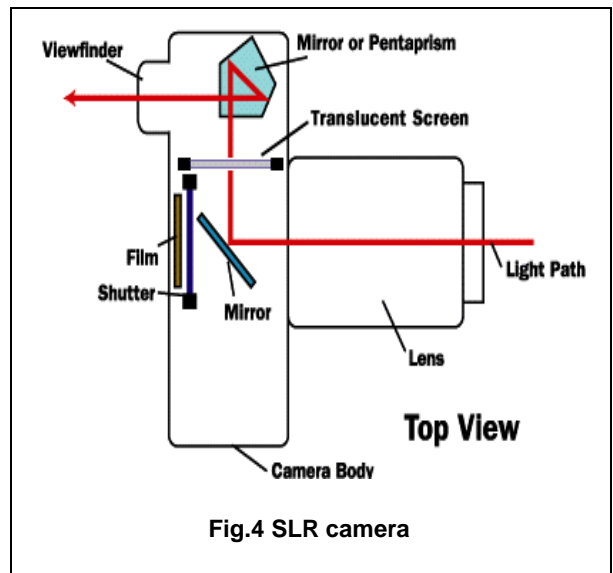


Fig.4 SLR camera

Table.1 Terminology of lens according to focal length

| LENS FOCAL LENGTH | TERMINOLOGY        | TYPICAL PHOTOGRAPHY |
|-------------------|--------------------|---------------------|
| Less than 21 mm   | Extreme wide angle | Architecture        |
| 21-35mm           | Wide angle         | Landscape           |
| 35-70 mm          | Normal             | Documentary         |
| 70-135 mm         | Medium telephoto   | Portraits           |
| 135-300 mm        | Telephoto          | Sports, wildlife    |

Table .2 Relation between f – number and shutter speed

| f Number | Light gathering area (aperture size) | Required shutter speed | Depth of field |
|----------|--------------------------------------|------------------------|----------------|
| Higher   | smaller                              | slower                 | wider          |
| Lower    | larger                               | faster                 | narrower       |

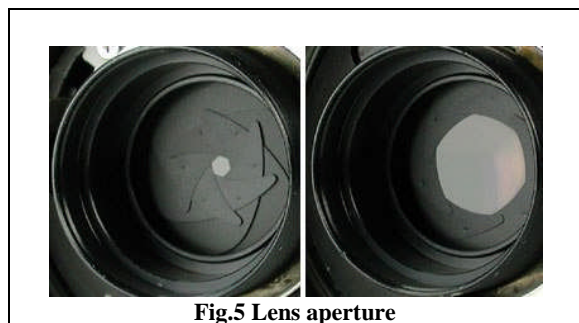


Fig.5 Lens aperture

**CLINICAL IMPLICATION**

Point and shoot camera has very limited shutter speed settings and use of autofocus is slow and is not very effective in low light.SLR has quickest autofocus, greater range of shutter speed setting and greater depth of field.

**UNDERSTANDING ZOOM**

A Zoom lens is one where the photograph can vary the focal length within a pre-defined range , whereas this cannot be changed with a ‘prime’ or fixed focal length lens’. The primary advantage of a zoom lens is that it is easier to achieve a variety of composition or perspective( since lens change are not necessary) . In digital camera, lens listed with 3X,4X and so on refers to ratio between the longest and shortest focal length . 3X means that the longest focal length is 3 times the shortest . Focusing can be a problem in point and shoot camera as auto focus system are frustrating to work when capturing intra –oral photograph .They often take 3-4 attempts to get the system to focus adequately . In SLR a rule of thumb to allow same magnification of photo is to mark the focus for intra and extra oral shots, then moving backward or orward to focus the image to same magnification, allowing direct comparability between photos.

**CLINICAL IMPLICATION**

Optical zoom measures the actual increase in focal length of the lens. By moving the lens farther from the image sensor inside the camera body, the zoom increases because a smaller portion of scene strike the image sensor , resulting in magnification.<sup>7</sup>. Digital zoom is worthless as this technology crop and magnifies the image to create artificial closeup . This process remove pixels and causes image quality degradation. We know that image can always be crop in computer using softwares

**EXPOSURE CONTROL**

When you take a picture , you expose film or sensor to light . Aperture and shutter work together to control light<sup>8</sup>.

**LENS APERTURE**

The aperture range of a lens refers to the amount that the lens can open up or close down to let in more or less light (Fig.5).Apertures are listed in terms of f- number (Fig .6). Lenses with large aperture are also described as being “ faster” because for a given ISO(international standard organization) speed, the shutter speed can be made faster for the same exposure (Table.2). A small aperture means that object can be in focus over a wide range of distance, a concept termed as depth of field .Depth of field is defined as zone of acceptable sharpness and extends in front of and behind the point of focus . For Intra-oral photography a small aperture (large f-number, f/22)gives good depth of field .For extra oral photography we need narrow depth of fields as it isolates the subject from their background so we require large aperture (small f-number , f /5.6)<sup>9</sup> f- number of X may also be displayed as 1:X(instead of f/X).(Fig.7). A 70-200 is zoom range of artistic flexibility in terms of both exposure options and depth of field .The maximum aperture is perhaps the most

important lens aperture specification . This is often listed on the box along with total length (Fig. 8). A range of f/2.0-3.0 means that maximum available aperture gradually changes from f/2.0 to f/3.0 at fullzoom. Many camera have a semi automatic mode that can be set to either aperture priority or shutter priority. Where you can either set the aperture or shutter speed to the desired setting , and the camera calculates the right setting to accommodate the lightning condition . Cameras with zoom often have a range of maximum aperture listed such as f/2.5 –f/4.0 . This means that maximum aperture at most wide angle setting is f/2.5 and maximum aperture at most telephoto setting is f/4.0.

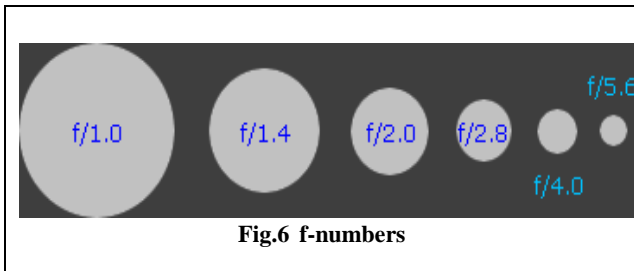


Fig.6 f-numbers

**CLINICAL IMPLICATION**

In dentistry for intra oral shot we need good depth of field i,e if we are focusing front tooth ,we also want that tooth or tissue like molars which are far away from incisor should also be clear and sharp in photograph for good assessment of occlusion and other details. For this reason we keep the aperture small (large f number) i,e 22. For extra oral shots depth of field is not necessary i,e if we have focused the face, background is not a necessity. So we can keep aperture large i,e low f number- 5.6)

**SHUTTER SPEED**

Shutter controls the amount of time , light is allowed to reach the film. Shutter speed is measured in fraction of a second .. 60 means 1/60<sup>th</sup> of a second , Shutter is small plastic sheet that opens or close to allow light onto the film .The shutter is opened when shutter release button is pressed to take a picture. In orthodontics we use macro lenses around 100 mm to get narrow angle view , also macro lenses allow distortion free imaging at closer range with high depth of field . Longer focal length requires shorter exposes time to minimize blurring caused by shaky hands . Imagine , if one is trying to hold laser pointer steady , when shining this pointer at a nearby object , its bright spot ordinarily jumps around less then for objects further away (Fig-9). This is because slight rotational vibrations are magnified greatly with distance .

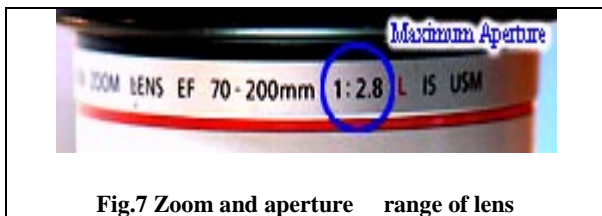


Fig.7 Zoom and aperture range of lens

**CLINICAL IMPLICATION**

A common rule of thumb for estimating how fast the exposure needs to be for a given focal length is one over focal length<sup>9,10</sup>. One – sixty of a second is about as slow a shutter speed as one can use when taking a hand – held shot and not getting any blur. So we can keep the shutter speed at 60(as intra oral cameras uses focal length between 60- 90)



Fig.8 Lens boxes

**FLASH**

Experience has shown that for a high quality intra-oral images , ring flashes are essential to avoid unacceptable shadowing on images . The point flashes are not always powerful enough to allow the photo to be taken at small aperture needed for high “depth of the field”.

**CLINICAL IMPLICATION**

In point and shoot camera the flash is away from lens so it throws light away from area of interest. In SLR ring flash is mounted over the lens so it throws light over the area of interest.

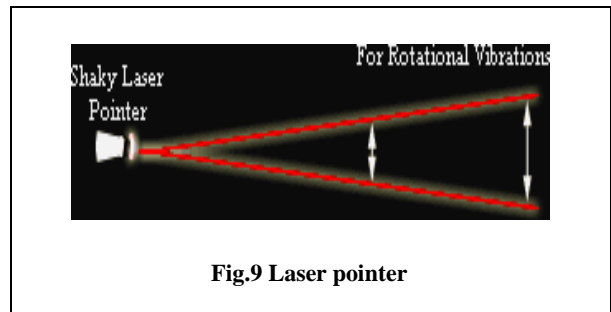


Fig.9 Laser pointer

**CONCLUSION**

In case of digital camera lenses , it pays to read the fine print . Understanding lens makes the most of your digital camera purchase . Don't be fooled as some manufacturers combines optical zoom and digital zoom to show a large combined number on the front of the box

.Digital camera aimed at beginners and intermediate user typically offer a built-in lens . Most digital SLR camera , however can make use of interchangeable lenses . Although there are large numbers of digital camera advertised for use in dental imaging.Only single lens reflex (SLR) cameras consistently fulfill all the parameters. Understanding lens will take you a step ahead for a good photography , however there are other factors like mega pixels of camera, Image compression and storage, printer, photo editing software and skill of the photographer are beyond the scope this article .

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