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Digital dental photography – The tool of necessity

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ABSTRACT

Photography in dentistry has revolutionized the diagnosis, treatment planning, marketing, and communication between the patient, dentist, and dental laboratory technicians. With the advancements digital photography has implied in dentistry, the craftsmanship of the practitioners is touching new grounds for education, self-improvement, and documentation. This article tries to solve the enigma of choosing the camera and its lens, the accessories that necessitate achieving professional-like results and also seeking the same results with the next big leap in accessible photography, the smartphone camera. This article intends to broaden the knowledge of the technicality behind digital photography and how the same can be used in dentistry to make a standpoint for the practitioners in their field.

Keywords: Dental photography, Dentistry, Smartphone photography, Smartphone dental photography, Dental photography techniques, Dental photography light, Dental photography camera

INTRODUCTION

"We look with our eyes, but see with our mind." One can look at a photograph, but it is the mind that needs to see; the possibilities hidden in an otherwise normal visual field. Photography is defined in Greek as "the creation with light."[1] Light rays are captured on a light-sensitive medium when a visual image is recorded. From the cameras obscure and daguerreotypes to the DSLRs and mirrorless cameras today, this process has advanced to perfection and become more user-friendly.

When early dentistry started with drawings and visual representations to describe dental conditions and treatment procedures, photography created a portal of possibilities. The American Journal of Dental Sciences initiated printing as the world's first dental journal. The first pre-operative and post-operative photographs got published by Ide and Thompson.[2] Clinical dental photography is a paradigm shift in diagnosis, treatment planning, and education.

WHY DIGITAL DENTAL PHOTOGRAPHY (DDP)?

Although legal documentation, education, publication, patient/team/laboratory communication, and marketing share the need for DDP, accurate recording of the oral details holds the primary requirement. Recording the stages and steps of the treatment help in follow-up and avoiding misunderstandings with the patient. It can be an educational tool for students and patients. It can also be used while referring to a specialist or a dental technician.[3] Projecting and enlarging these images help a dentist in self-evaluation and training.

ADVANTAGES OF DIGITAL DENTAL PHOTOGRAPHY

- Images are immediately available and easy to share.
- No expense for film processing.
- No chemical development is required.
- Higher reproducibility.
- Metadata of the images can be produced.
- Image lighting can be adjusted in real-time.

DISADVANTAGES OF DIGITAL DENTAL PHOTOGRAPHY

- Steep learning curve.
- Planning and proactive management of the files for accessibility.
- Possibility of fakery.

ARMAMENTARIUM

Camera

A perfect camera does not exist! The camera is an aid. One must first decide the subject and composition. A single-lens reflex and mirrorless system are recommended.[4,5] Spending on the lenses and lighting is advocated rather than on the camera body.

Camera accessories

- An *eyecup* that prevents the undesirable light from reaching the viewfinder.[5]
- A *right-angle finder* if the camera is to be mounted very low on a tripod.
- The *dioptric adjustment lenses*.[5]
- A *tripod* ensures no-touch protocols with precise focusing and framing.
- *The bracke*t supports the flashes on the camera.
- A *stage* is used in extra-oral bench photographs to focus without touching the lens.
- A *copy stand* ensures uniform lighting and stability to shoot radiographs.
- For cross-infection control, use a *remote release cable*, and operated through foot control or wireless
- An *18% color grey card* helps in white balance and dental shade guide.[6]

Lens

This is the image quality negotiator! Dentistry is more about macro photography; hence, the use of a macro lens is recommended for portraits and to obtain a life-size reproduction ratio of 1:1.[2] Some of the suggested lenses are Canon* 60mm f2.8 and 100mm f2.8, Nikon* 60mm f2.8 and 105mm f2.8, Tamron* 90mm f2.8, and Tokina* 100mm f2.8.

Lens accessories

- *Close-up lenses*: Attachments on the lens (like filters) to focus more closely on the subject. More than one close-up lens will reduce the image sharpness.
- *Reversing rings*: Accessory to mount the lens in a reverse direction to take extreme close-ups.
- *Extension tube and Bellow's unit*: Metal tubes between lens and camera, fitted to achieve greater magnification.

Light source

A ring flash and twin flashes are ideal as it provides even illumination, canceling shadows by lighting from all directions.[5] They are attached in front of the lens.

Background

Light neutral color background such as grey, blue, and beige is recommended for standardizing portrait photographs.

Importance of the background-color

This depends on the subject's color and the purpose of the photograph. A uniform color helps in post-editing processes. Each color is designated for a particular reason.[2,5,7]

- *White:* Used for dark subjects. Easy to reproduce in printing.
- *Black:* Black eliminates shadows and produces a pseudo-three-dimensional reproduction giving the object a floating appearance. Also increases the luminous power of the color of the object. However, black color can lead to over-exposure of the object when metered the average by the digital camera setup. In such cases use spot metering or minus correction of exposure. Do a plus correction if the subject is a large white object.
- *Grey*: Universal background color. Grey does not hamper the exposure or the color of the subject. It makes post-editing color correction easier. However, subject isolation will be poor if the image is to be printed in black and white.
- *Colored backgrounds*: Background and object color should be harmonious like red on black, blue, and yellow. The background color should be available visually but should not dominate. Red is the least recommended; blue is near ideal. Non-harmonic combinations such as green-magenta and cyan-red can be omitted.

Dental armamentarium

- *Cheek retractors* help in retracting cheeks and lips. Bilateral type for anterior teeth and unilateral for

posterior teeth. Plastic pliable is suggested over the metallic for patient comfort.[8]
    - For shooting occlusal mirror and buccal retracted view use of *modified retractor* advised.
    - For retracting the front of the mouth use of a *full crescent retractor* is recommended.
    - For both the above shots if the mouth size is small, a *wire retractor* can be used.
- A *front-coated intraoral mirror* to shoot various aspects of the dentition.[8] *Occlusal mirrors with handle, bullet-shaped mirror on an angled handle* (buccal retracted view), and *lingual cut mirror* (posterior sextant) are available.[8]
- A *contraster* gives smooth black background when placed behind the teeth.[2]
- For neutralizing colors for precise color communication a *pensler shield* can be used.
- *Cotton rolls, saliva ejector, and rubber dams*: Moisture control.
- Storage media and computer: Ideally, a minimum 512MB memory card is necessary for clinical purposes.[1]

BASICS OF PHOTOGRAPHY

A photograph is a delicate balance of *shutter speed, aperture, and ISO* that creates the style and esthetics funded by creativity. This exposure trinity should be prioritized in a way that best presents your subject.

Shutter speed

The measured time is between the opening and closing of the camera shutter. A fast shutter speed is needed to freeze action. A low or slow shutter speed will give motion blur. Shutter speed, say, 1/60 s will allow half the light as its preceding 1/30 s but twice the succeeding 1/125 s.[2,5]

Aperture

The size of the hole lets light into the camera. It is denoted by "f number." Smaller the f number wider will be the hole and vice versa. A wider aperture lets more exposure, giving a very narrow area of focus. The larger the f stop, the smaller the depth of field. The smaller the aperture, the more overall focus on the image.

Exposure/ISO

The amount of light allowed to pass through the lens to reach the sensor. If the subject is well lit, then a brief exposure will give a crisp result. Longer exposure is necessary for low light conditions. Modern cameras have a built-in meter to calibrate the correct exposure using special photoelectric cells that measure the light reflected from the subject.[5] Unfortunately, in clinical conditions in dentistry with a deep oral cavity, this metering is biased by low light.[2,5] A first-hand knowledge of the right exposure settings will help in such situations.

Composition

Framing an image by attending to the subject, its position with respect to other objects in the image, and how well the subject matter is expressed is the essence of the composition of a photograph. A good composition is visually pleasing and stimulating to look at. A poor composition distracts the viewers' attention. Image composing can be learned by familiarizing with the rules and by practicing them judiciously.

The composition can be improved by eliminating the background and foreground until only the most obvious choice is left. The same subject shot from different *perspectives* can render a different meaning to each shot. Focusing on the subject of interest grabs the viewers' attention, thereby also providing a sense of scale. As per the *rule of thirds*, if one divides the frame into nine grids forming four intersections, and the subject is placed at any of these intersections, it adds to a pleasing effect.[1,6,7] Use landscape (horizontal) and portrait (vertical) when necessary so that frame is filled with the subject. The negative/empty space if present in an image can be used wisely to obtain amazing results. The thumb rule is to use the negative space in front of the subject.[2]

IMPORTANCE OF LIGHT IN DENTAL PHOTOGRAPHY

Dental photography is bound by the space, color, and time for a visual experience. When *time* decides the movement, sparkle, flicker, glitter, and fluctuation; the hue, value, and Chroma define the *color*. Transparency, depth, texture, size, and form are described by the *space*. By eliminating Chroma and hue you achieve a black and white image called chrominance.[5,9]

Light can be incident or backlighting. The reflection of a single light source can cause an unwanted reflection called halation/hot spot.[2] This eliminates the details below the reflecting layer (dentine structure beneath the reflecting enamel). Thus, two light sources are used on both sides of the camera at 45' in the horizontal plane. The angle of incidence of one light equals the angle of reflectance of the other.[2]

The light that travels only in a straight line needs to be manipulated to achieve desired details. A ring flash gives a 360' naked uniform illumination. The use of flags and opaque objects can block the light to present a shadow on a plaster cast (blocking). Materials such as linen cloth or Perspex with a range of opacities when in front of light can reduce the output contrast with smoother lighting (diffusion).

To eliminate unwanted hot spots and highlight the areas opposite the light source, a reflective surface can be used against the light (reflection).

A subject receives less light as the light source is moved further away. The larger the light source, relative to your subject size, the softer the light. For example, a softbox is a larger light source when kept near the subject. However, it becomes a smaller light source when it is moved further apart. This is explained by the inverse square law.[2,9]

Types of lighting

- Daylight/North light: The daylight from the geographic North direction diffused by a drawing paper can achieve professional images on zero budget.[2,5]
- Artificial light: Used when the daylight dependency becomes demanding. It is of two types – flash lighting (ring flash/twin flash) and continuous lighting (softbox).[2,9]

CAMERA SETUP FOR DENTAL PHOTOGRAPHY

Whether it is a Canon or Nikon camera, the following settings [Table 1] will be optimum for dental photography.

For the portrait photography position, your subject is at 6 feet (2 m) from the camera and shoots by holding the camera vertically. Make sure to stabilize the camera with a tripod or hand support while shooting any image. And keep flash in manual mode.

Photographing small objects in dentistry

The aim is to attain maximum details, filling the frame with a highly perceptible image for documentation. A *macro lens* with 50 mm or 60 mm is used with a circular *polarizing filter* on a camera with a *lens hood*, operated with a *wireless device* or self-timer. Polarizer removes reflections on shiny surfaces like glass. Place the object perpendicular to the optical axis in a way that the object axis is parallel to the lower and upper edge of the photograph. For better perception of a three-dimensional object, shoot from a top oblique view.

The camera must be stabilized with a tripod or copy stand while the object has to be stabilized with an adhesive, soft wax, silicon impression materials, alligator clips, and rod sets (Novoflex). A shooting table such as Novoflex macroscopy stand or Magic studio or Top-table (Kaiser) helps in isolating and shooting the object. For isolating an object, in a horizontal level shoot, place the object far from the background and illuminate it in such a way that the shadows of the object are outside the viewing field. For, "from-the-top" shots, use a glass plate 15–20 cm from the base to keep the object. One can also place the object on a black glass plate or tile, even on the case of your smartphone to get a dramatic reflection.[5]

Table 1: Camera adjustment parameters

ISO	Shutter speed	Aperture	White Balance	Focus
100–200 (>200 causes grainy image)	1/125 s	For intraoral: f22 For portraits: f5.6 or less	5500K flash	Single point autofocus (S-AF)

Photographing a radiograph

For a diagnostic quality photograph, we need a 100 mm macro lens on a smaller aperture mounted on a camera with a tripod. The X-ray film was cello-taped on the x-ray viewer. Orient the viewer vertically, perpendicular to the floor. Shoot after switching off all lights except that of the X-ray viewer at larger f-number like f/11 or f/16.[2]

SMARTPHONE DENTAL PHOTOGRAPHY

With accessibility turning the cards, smartphone photography is picking up pace. With technology, the latest smartphones are capable of producing professional standard photographs but they might need color correction using spectrophotometry to attain the exact value.[10] The smartphone lens due to the difference in focal point can distort the edges of the lens and may not be appreciated in macro photography.[10] The smartphone flash can sometimes wash out the surface textures of the enamel or ceramic prosthesis. There are attachable lenses available easily in the market that when mounted in front of the camera lens, yield the desired effect. For lighting the subject, USB ring flashes and point flashes can be mounted. Smile MDP frame is an affordable luxury in smartphone lighting.

Intraoral smartphone photography

1. Retract the lips and cheek.
2. Disinfect the smartphone. Place it at 45°.
3. Use the chair light to illuminate the scene. For diffused lighting loosely cover the light using a white cloth or tracing paper. To get more texture in the image, place the lamp on the patient at about 90°. You can also use a ring flash on the mobile.
4. Focus on the area of interest. "Lock-focus" if there is an option. Shoot!

Extraoral smartphone photography

- Ask the patient to smile naturally. Judiciously use facial asymmetries.
- Eliminate plaque and. excess restorations before the shoot.

- Centre the nose to the image.
- Use a white or black background
- Place the patient about 50–60 cm in front of the fundus to reduce the shadow.[11]
- Place the mobile phone at the level of the patient's eyes

CONCLUSION

Photography in dentistry is revolutionizing diagnosis, treatment planning, marketing, and patient-dental team communication and relations. Constant integration of knowledge and technology in digital dental photography can help a normal dental practitioner to mutate his practice to stand ahead of the market. It also favors a niche for self-evaluation and learning; segregating materials for training and publications. If channeled well, the dentist can develop an exciting hobby as well.[12,13]

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