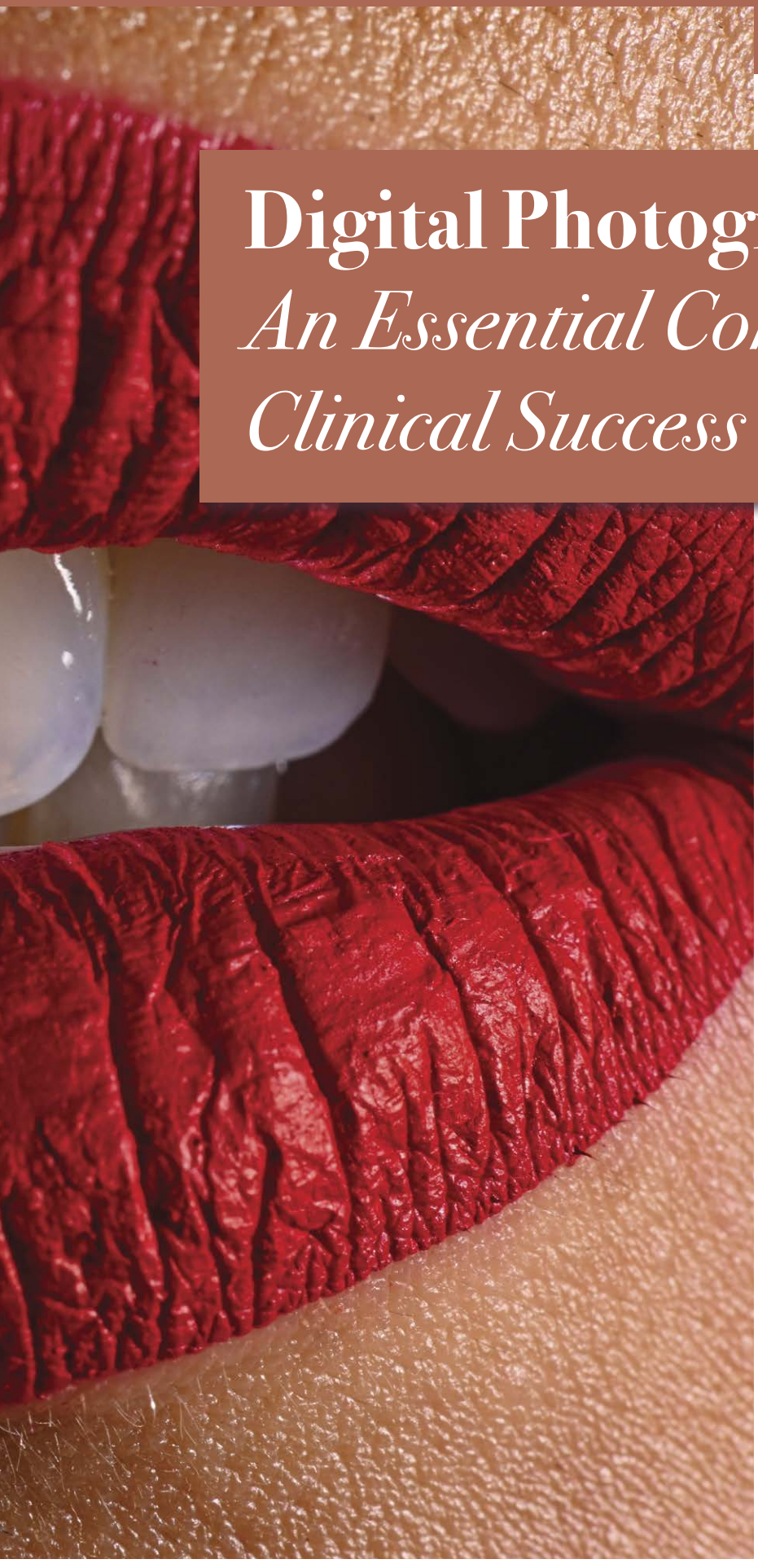

Digital Photography
An Essential Component of Clinical Success

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Abstract
There are a variety of cameras on the market today, and new practitioners can be overwhelmed when trying to choose the one that is best suited to their needs. This article describes how to document a case utilizing high-quality dental photographs for optimal treatment planning, documentation, and self-evaluation. It outlines the fundamental principles to understand when using a camera for dental photography and provides information about camera setups and accessory options.

Key Words: Dental photography, camera setup, camera body and lens, camera settings, light source, photo guidelines, shade communication

Bonus content!

This article has a CE course on AACD CEntral. To view, go to AACD.com/central

Introduction

The rise of social media and technological advances have exposed us to a side of dentistry that was never imagined. Our profession has evolved and expanded to a global network of colleagues who share their work with peers and patients alike. Many find themselves on Instagram scrolling through beautiful case photos asking, "How do I even begin taking a picture like that?" In some cases, this exponential increase in exposure to our colleagues' work can push us to improve, but it also can cause us to feel inferior, or even defeated. Dental photography, while not part of the core dental education, is essential not only to creating beautiful smiles but also for self-evaluation, case documentation, patient education, and marketing.[1] Fortunately, learning the skill is within reach provided one has the will to learn.

Lessons

Demystifying the Camera Setup

The setup that most practitioners gravitate toward is a digital single-lens reflex (D-SLR) camera.[2] This type of camera must be viewed as a system rather than a product. Components of the system are purchased individually but work in tandem to create stunning images. The three main components of a DSLR camera are the lens, body, and flash.

Lens: The lens is the camera's "eye," and as it is primarily responsible for the quality of the images, it is the most important investment. Since we are capturing the minute features of the oral cavity, we want a lens that can focus up close while maintaining the highest level of detail. A macro lens has the optics for preserving this detail. Because our photos must be standardized (i.e., we will be documenting in a way that is consistent, the same distance from the subject) we should use a fixed lens. This means that the focal length cannot be adjusted (i.e., the level of "zoom" cannot be changed). To achieve the appropriate "zoom," we must move closer or farther from the subject, rather than adjusting the zoom on the lens.[3,4]

"By using a fixed macro lens, we are able to standardize our photography by maintaining a consistent distance from the patient, light source, and position."

When first diving into dental photography, it is wise to invest in the lens first. Buying a high-quality lens that you can use as you upgrade your camera body is key to investing long term in a dental setup that will grow as your photography skills improve. You eventually may consider upgrading the camera body for one with more features, and as long as you have a high-quality lens you will not sacrifice the image quality.

Light source: A light source often is an overlooked investment. Lighting systems come in all shapes and sizes, but ultimately provide us with the same goal: illuminating the dark and wet oral cavity. The most common options are ring lights and dual flash setups. Depending on the type of dentistry you hope to capture, the type of light source will differ. If your practice is more surgery based, you may want to consider having a ring flash as it will position light posteriorly in the oral cavity. If your practice is more cosmetic based and you do a lot of shade matching, having a dual (twin) flash option is preferable because it allows you to position the light more laterally on the teeth, enabling the camera to capture more information about light scatter, texture, depth of shade, opacity and translucency of the teeth, while avoiding shadows.[3,5,6]

Mirrorless cameras: Many practitioners ask about these cameras, and with good reason. The main difference between a DSLR camera and a mirrorless camera is the way the image is captured and displayed. In a DSLR camera, the image bounces from a mirror to the viewfinder. In a mirrorless camera, the image is displayed directly into the sensor. Why is this important? The lack of a physical mirror reduces the size and weight of the camera body and provides features such as improved video recording and improved autofocus. Currently, dental photography is not significantly impacted by the advances found in mirrorless cameras, but they will certainly become the standard in the next decade. One last thing to consider before buying a mirrorless camera is that they have different lens mounts. This means the lens selection is much more limited compared to DSLR lenses. Adaptors exist to retrofit a traditional lens to a mirrorless camera, so careful consideration is recommended before choosing a mirrorless camera.

Choosing a Camera Body and Lens

Brands: Before delving into the inner workings of a camera, it should be noted that there is a distinction between brands. The two major digital camera manufacturers today are Canon and Nikon. Each has its own proprietary complement of lenses and flash systems that accompany the camera body. Components of Canon and Nikon systems are not interchangeable but there are several other lens and light system brands that can act as alternatives to the name brand lens and lights, including SIGMA, Cameron, and Tokina. Each of these brands makes a lens for both the Nikon and Canon camera system.

The body of the DSLR camera is the camera's "brain." The lens projects the image on the sensor of the camera body, where it is then displayed on the screen and stored on the SD card. You will interact with the body by adjusting the functions of the camera such as the f-stop, the ISO, the white balance, and the

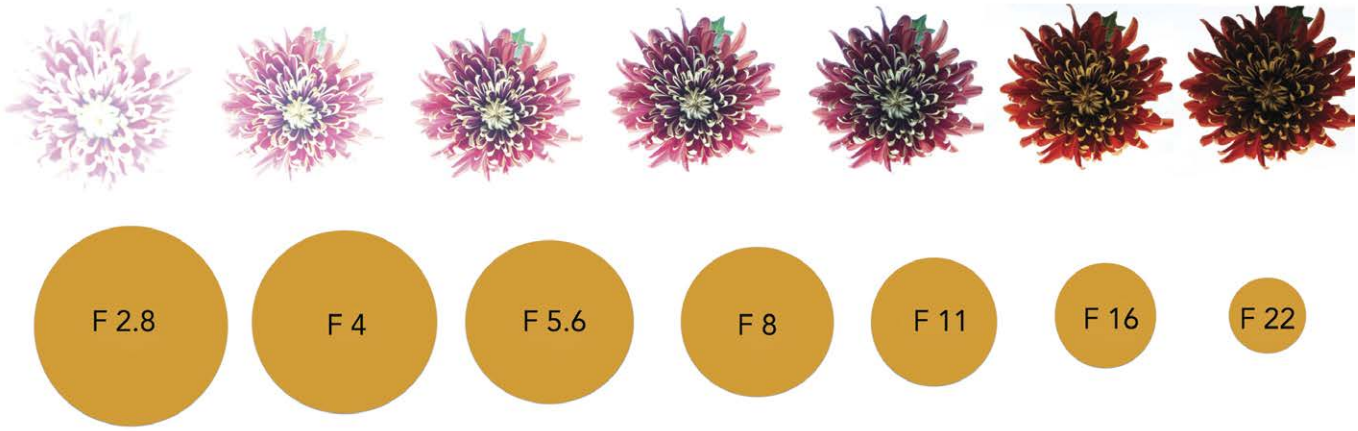


Figure 1: A small aperture (larger number) is beneficial because it gives us a large "depth of field."

shutter speed. Camera bodies range in price from $200 to $6000 U.S. dollars, depending on the internal features and quality of the camera's internal sensor, which is what captures the image projected from the lens. Think of it as a reusable piece of film that captures each image on a digital format.[3,4]

Sensors: Each camera body has a different sensor, some of which are larger than others. The larger the sensor, the better the image quality. Most affordable options have what is called a "crop sensor," seen on spec sheets as APS-C. This simply means that the sensor is smaller. The more expensive options typically have full-frame sensors. The difference between crop and full-frame sensors and how it impacts dental photography is important because for a camera with a crop sensor you would have to move farther away from a patient to capture the same image that a full-frame sensor would capture at a closer distance. Typically, when starting out in dental photography it is ideal to start with a more affordable camera body and spend the bulk of your budget on the lens and light source. Once you are comfortable taking high-quality dental photographs you can update and upgrade your camera body to one with more features as your passion for dental photography grows.

Fixed macro lens: As mentioned previously, it is important to use a macro lens that has a fixed focal distance. The focal length of a lens is defined as the distance in millimeters from the optical center of the lens to the focal point on the sensor. This is important in dental photography because by using a fixed macro lens, we can standardize our photography by maintaining a consistent distance from the patient, light source, and position. The alternative to a fixed lens is a zoom lens. While a zoom lens provides versatility in focal lengths, it is not ideal for the dental office setting. Fixed lenses provide much more accurate photos, whereas zoom lenses' moving components can cause distortion.

Macro lenses are available in different focal lengths. Nikon has both 105-mm and 85-mm macro lenses. Canon has a 100-mm and a 60-mm macro lens. These lenses are all capable of providing high-quality images; however, lenses with smaller focal lengths will require a lesser distance between the lens and the patient. A good rule of thumb sticks close to 100-mm focal length (i.e., 105-mm and 85-mm lenses are similar, but a 60-mm lens will likely prove uncomfortable for intraoral photographs).

Many macro lenses include an adjustable dial for the focus ratio. These ratios relate to a fixed distance from the optical center of the camera to the patient. Setting this ratio will also create images that are cropped similarly from before to after treatment. For example, if you are taking a full-face image, the ratio set on the lens would be 1:10 for a full-frame sensor (or 1:15 for a crop sensor). This equates to shooting the image 7 to 10 feet away from the patient depending on the size of the sensor. Setting the ratio each time before taking a photograph and using your body to move in and out allows the image to come into focus and will allow you to take consistent images each time.

Settings: Aperture, Shutter Speed, ISO

The body of the camera controls three main features that directly impact the images we capture. These three features are the aperture (f-stop), ISO, and shutter speed. Adjusting these settings allows for some flexibility, but in order to adjust them, they must first be understood.[5,7]

Aperture: The lens aperture is the opening where light travels to the camera sensor. The size of this opening can be changed, where it directly affects the image. A large aperture has a smaller number, and vice versa. The larger the aperture, the bigger the opening, the more light that is being let in. A larger aperture is desirable in certain contexts, but our setup has a flash, so we do not need a large aperture to let in light. A small aperture provides a large depth of field (DOF) **(Fig 1)**, the area of the image that is in focus. For intraoral photos, we want all teeth in focus, not just the anterior dentition. Therefore, a small aperture is beneficial.

When taking extraoral full-face photographs we must be approximately 7 to 10 feet from the subject to have the image in focus. The camera and the light source are far from the subject

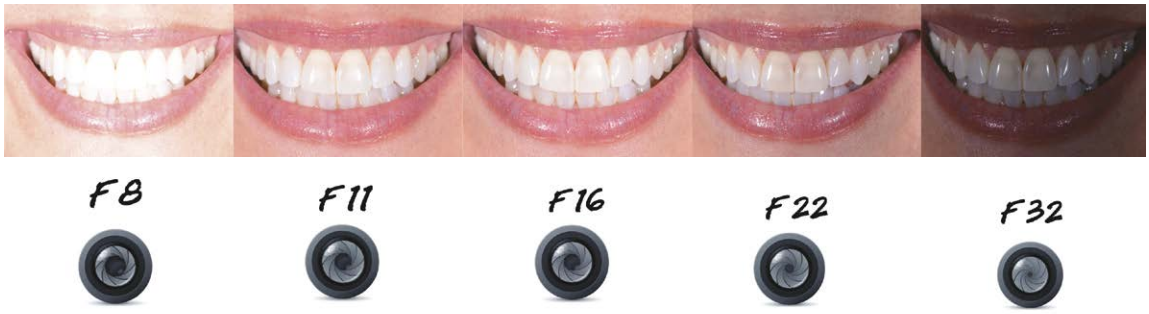


Figure 2: Increasing the number from f/8–f/11 to f/22–f/25 will allow the flash to properly illuminate the subject as well as capture the details with increased depth of field.

Figure 3: A longer shutter speed lets in larger amounts of light for extended periods of time; this is great in low-light situations for nondental photography.

and because of this we want to open up the f-stop (f/8 to f/11), allowing more light to pass into the sensor to capture the image properly illuminated and framed. When moving to extraoral and intraoral close-up photos, the camera body as well as the light source are closer to the subject. It is important to close down the f-stop, increasing the number from f/8–f/11 to f/22–f/25. This will properly illuminate the subject as well as capture the details with increased DOF **(Fig 2)**.

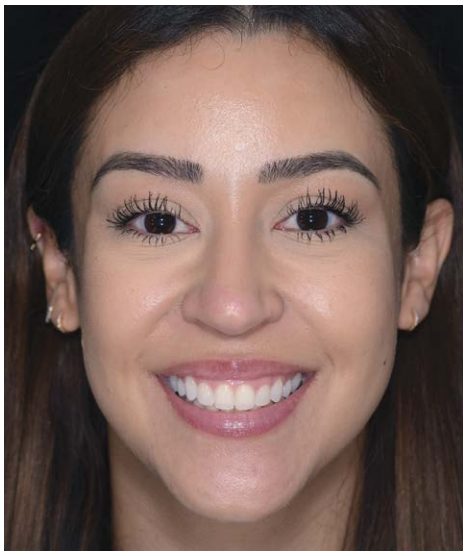
Shutter speed and ISO: While aperture adjusts the amount of light being let through the opening of the lens, shutter speed is the amount of time the camera spends allowing light into the sensor. The shutter speed could be as fast as 1/8000 of a second or as long as 30 seconds. A longer shutter speed would let in larger amounts of light for extended periods of time; this is great in low-light situations for nondental photography **(Fig 3)**. It is important to note that the longer the shutter speed, the higher likelihood a blurry image will be captured. Many times, when fluctuating the shutter speed most photographers set up a tripod to stabilize the camera so that a blurry image is not produced. In dental photography, we want to allow the shutter speed to be fast enough to get a properly exposed image. Changing the shutter speed can have an effect on the exposure as well. However, it is more predictable since we are not using a tripod to capture dental photos that we limit the amount of time the shutter is opened and use the f-stop to change exposure predictably. Typically, we will set the shutter speed to 1/125 of a second for dental photographs.[3,4,8]

It is important to note that ISO technically is not part of the image exposure, but it has a major impact on the result of the image. The higher the ISO, the more sensitive the camera is to light. If you turn the ISO value all the way up, the images will be extremely bright. This is helpful if you are taking pictures in a dark environment. Since our setup has a light source, we do not need to rely on ISO to brighten our images. For this reason, we typically set the ISO for all dental photographs to 125 and instead change the amount of light by adjusting the aperture.[6]

Light Sources

There are two types of flash systems: on-camera and off-camera. The latter includes any lights that wirelessly connect to the camera, similar to what is used at graduation photo studios.

On-camera flashes—ring flash, dual (twin) flash: On-camera flashes are more convenient for dental photography. These flash systems are physically tethered to the camera and provide light in close proximity to the lens. A ring flash falls into this category and is a great option for capturing surgical procedures and posterior areas of the mouth because the light is projected parallel to the lens. The downside to this light system, however, is that it creates a washed-out image that lacks texture and may not capture information that is important when shade-matching teeth. A dual (twin) flash system comprises two lights that are set to either side of the lens. This type of lighting system is excellent for relaying detailed information on color, texture, and translucency. The ability to adjust the



flashes away from the lens allows more flexibility when it comes to the types of images you want to capture. When photographing the anterior region for esthetic dentistry it is crucial to have a twin flash system.

The benefit of twin flashes is even greater when using an adjustable bracket, which enables flexibility of the flash position. Companies such as PhotoMed have bracket systems for both Nikon and Canon cameras that mount the twin flashes to a bracket, away from the lens. This allows you to position the flash for intraoral views or separate them further apart for anterior esthetic views and lab communication.

Recommended Photo Views

The American Academy of Cosmetic Dentistry suggests a specific set of photos that should be taken prior to beginning any dental treatment.[9] Remember, there is only one chance to take a "before" photo. Many practitioners wish they had taken better photos prior to treatment. With that said, it is recommended to take many pretreatment photos prior to starting any treatment on a patient **(Fig 4)**.

Figure 4: The AACD's 12 recommended photos that should be taken prior to any dental treatment.

Table 1. Tips for Capturing Ideal Images

Type of Photo	F - Stop	Lens Ratio Full-frame | Crop	Tips
Natural full face	f/8 to f/11	1:10 | 1:15	The image should be framed including the top of the head and a bit below the chin. The patient should show a full smile utilizing the interpupillary line and vertical midline to orient the face so that it is not tilted left or right, up or down. Position the patient so there are no shadows on the background.
Natural full smile	f/22 to f/28	1:2 | 1:3	The image should show a full natural smile revealing the maximum number of teeth that the patient displays. The incisal plane of the teeth should be reflected in this image. If there is a cant present, be sure to capture this in the close-up photo as it appears in the full face. Focus on the centrals. The lips should not be cropped out of the image.
Right & left lateral smile	f/22 to f/28	1:2 | 1:3	The focus should be the lateral incisor. You want to see a bit of the contralateral lateral and canine.
Retracted teeth slightly parted front, right, & left	f/22 to f/28	1:2 | 1:3	Upper and lower teeth should be slightly parted so the incised edges are visible. Minimize the appearance of lips and retractors and position.
Maxillary anterior sextant front, right & left	f/22 to f/28	1:1 | 1:1.5	No retractors should be visible and only 4 to 6 teeth should be in the frame.
Maxillary & mandibular occlusals	f/22 to f/28	1:2 | 1:3	Draw a line down the incisal edge of the central incisors showing equal parts of the buccal and lingual of the incisors. Take the image 45 degrees to the mirror. Positioning for these images is key. When taking the maxillary occlusal photo, I have my assistant hold the mirror and have the patient lie down completely on their back, tilt their head back and place retractors in their mouth, then shoot down from behind the patient. For the mandibular occlusal shot, I have my patient tip their chin up all the way, have my assistant hold the mirror, stand on the front side of the patient, then shoot upwards to take the photo.

Table 1 gives an overview of each type of photo in detail. The following settings should not change: ISO 125, shutter speed 1/125. F-stop will vary depending on the shot you want to capture.

Common Errors

Incorrect exposure: Some of the most common errors in dental photography can be corrected by recognizing them early and adjusting accordingly. An error many doctors struggle with is capturing an image at the wrong exposure. A dark photo is the "preferred" mistake because the information is still preserved in the digital file. The photo can be edited on the computer to brighten the image while maintaining the integrity of the shot. However, an overexposed photo lacks information. A shot that looks "blown out" that is overly white cannot be salvaged. That brightness should be viewed as lack of information, whereas darkness in an image can be brightened.[4,8]

Improper angle: Another common issue are images taken from an improper angle **(Fig 5)**. Unfortunately, this mistake cannot be corrected after the fact. It is crucial when taking each photo that you position yourself properly to obtain the perfect shot each time. Angulation and positioning are critical elements to achieving a diagnostic photo. When taking extraoral and intraoral photos, be mindful of the spatial relationship between the camera and the patient. Note the height of the patient relative to the camera, as well as the angle at which the camera is facing. It becomes easier with time, but do not be afraid to adjust the patient's position to achieve a quality photograph.[8]

Improperly sized retractors: Retractor size and shape are very important. Using improperly sized retractors can yield photos that have the lips curled over the retractors, making it more diffcult to capture perfect images. Improper sized retractors positioned in the wrong way can lead to shadows in the

Figure 5: Views showing improper angles.

"Dental photography, while not part of the core dental education, is essential not only to creating beautiful smiles but also for self-evaluation, case documentation, patient education, and marketing."

posterior. When taking retracted photos, it is important to position yourself so that as little of the retractor as possible shows in the image, creating a clean esthetic.[10,8]

Depending on what you hope to capture with each photo, it is important to set your camera ratio keeping in mind how far you should be from the subject for each shot. Setting these ratios and moving your body in and out to come into focus will allow you to be the same distance from the subject, creating repeatable and consistent images every time.

Shade Communication

Perhaps one of the most important reasons we take dental photographs is to communicate shade-matching information to our lab technicians. Proper exposure and a variety of photographs are key to shade mapping as well as relaying specific details like color, translucency, and texture.[10]

There are many different tips and tricks to facilitate accurate shade matching. Beyond the 12 recommended photos prior to treatment, I like to take two additional photos for shade matching. One is retracted, slightly opened with three shade tabs in the same plane as the teeth to be matched, about 2 mm from the incisal edge **(Fig 6)**. Selecting the shade you think is the best match along with one slightly brighter and one slightly darker will give the ceramist extra information that will help when trying to consistently achieve a perfect shade match. This photo should be taken with the correct exposure. The second photo should be slightly under exposed so any translucency can be captured in detail as well. The underlying idea is to provide the laboratory with an excess of information, rather than too little.[10]

Tips

Beginner

- It is critical to fully understand how to operate the camera you are thinking of buying/have chosen. Reading the camera's user manual, utilizing YouTube tutorials, and taking CE courses will help you learn how to adjust your camera's settings. Practice as much as possible to become more comfortable with taking a full set of dental photos quickly and effciently.

Intermediate

- Do not get too complacent; there are always "tweaks" that can be made to elevate your photography. Evaluate your photos: Are they at the proper angulation? Is the exposure consistent? Are there shadows? These are issues we all face, but fortunately, they are easily corrected with minor adjustments and practice.

Advanced

- After becoming comfortable operating your camera and maintaining a consistent photography protocol in your office workflow, what is next? Experiment with providing the laboratory with underexposed photos in addition to your standard shade match photos. You also may consider upgrading some components of your camera. (e.g., at this stage, it would be reasonable to upgrade from a crop sensor camera to a full-frame camera body). In addition, it would be wise to invest in some light modifiers and experiment with how a bouncer or an adjustable bracket will allow you to achieve dramatic and altered lighting effects.

Figure 6: This shade-matching image should be captured prior to any treatment being completed. Use a retractor and three shade tabs: one tab slightly darker than the ideal shade, one slightly lighter than the ideal shade, and one of the shade you hope to match. It is important to take this image with the three shade tabs in the same plane as the teeth you hope to match, approximately 1 to 2 mm from the incisal edge.

Summary

To provide the best care for our patients we must practice self-evaluation at the highest level. While social media propels us to put our best out into the world, it is important to realize that we must walk before we can run. Picking up a camera and starting to take photos can be intimidating for many reasons, so recognize and accept that becoming a dental photographer is a lifelong journey. Taking and sharing our high-quality photos with patients can be a critical part of their education, helping them to understand the rationale for different treatment modalities and giving them an idea of what the results will look like over time. Creating a portfolio of cases also can be very helpful to us in determining which types of treatment have been successful long term.

"Perhaps one of the most important reasons we take dental photographs is to communicate shade-matching information to our lab technicians."

References

1. Christensen GJ. Important clinical uses for digital photography. J Am Dent Assoc. 2005 Jan;136(1):77-9.

2. Desai V, Bumb D. Digital dental photography: a contemporary revolution. Int J Clin Pediatr Dent. 2013 Sept-Dec; 6(3):193-6.

3. Casaglia A, De Dominicis P, Arcuri L, Gargari M, Ottria L. Dental photography today. Part 1: basic concepts. Oral Implantol (Rome). 2015 Oct-Dec;8(4):122-9.

4. Lowe E. Digital photography. [Internet]. 2012. Available from: http://www.hdiqdental.com/digital-photography-ed-lowe.html

5. Liu F. Dental digital photography: from dental clinical photography to digital smile design. [Internet]. Singapore: Springer; 2019. Available from: https://link.springer.com/book/10.1007/978-981-13-1622-7#editorsandaffiliations

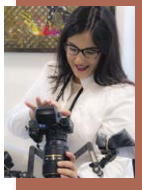
6. Sincar DC, Decuseara M, Popa GV, Rudnic I, al-Shukeir A, Pepelea G. The role of digital photography in dental medicine. Romanian J Med Dent Educ. 2019;8(9):33-8.

7. Shagam J, Kleiman A. Technological updates in dental photography. Dent Clin North Am. 2011 Jul;55(3):627-33.

8. Bengel W. Mastering digital dental photography. 1st ed. Hanover Park (IL): Quintessence Pub.; 2006.

9. American Academy of Cosmetic Dentistry (AACD). Photographic documentation and evaluation in cosmetic dentistry: a guide to Accreditation photography. Madison (WI):AACD; 2015.

10. Griffin JD Jr. Excellence in photography: heightening dentist-ceramist communication. Dent Today. 2009 Jul;28(7):124-7. **jCD**



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