CONTINUING EDUCATION

SCLERAL LENSES AND OCULAR PHOTOGRAPHY

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Second in a series of four scleral lens CE activities for 2021

LEARNING METHOD AND MEDIUM

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CONTENT SOURCE

This continuing education (CE) activity captures key statistics and insights from contributing faculty.

ACTIVITY DESCRIPTION

The goal of this article is to better eyecare professionals' understanding of photographing scleral lenses by guiding them through multiple technology options and tips.

TARGET AUDIENCE

This educational activity is intended for optometrists, contact lens specialists, and other eyecare professionals.

ACCREDITATION DESIGNATION STATEMENT

This course is COPE approved for 2 hours of CE credit.

COPE Course ID: 71834-CL

DISCLOSURES

Tom Arnold, OD, has received honorarium from Bausch + Lomb Specialty Vision Products, Blanchard Lab, BostonSight, Eaglet Eye, EyePrint Prosthetics, LensTechs, Oculus USA, PentaVision, and Visioneering Technologies.

Melissa Barnett, OD, has received honorarium from ABB Optical Group, Acculens, Allergan, Azura, Bausch + Lomb, BCLA, Bruder, Contamac, CooperVision, Dompe, EyeEco, Gas Permeable Lens Institute, JVC Vistakon, Mojo Vision, Novartis, Ocusoft, Oyster Point, RVL Pharmaceuticals, Scleral Lens Education Society, Science Based Health, STAPLE program, SynergEyes, Tangible Science, Tarsus, Visioneering Technologies, and Visus Therapeutics.

Chad Rosen, OD, MBA, editor of the continuing education series, reports no conflicts of interest.

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This continuing education activity is supported by unrestricted grants from ABB Optical Group and BostonSight.

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RELEASE DATE: MAY 1, 2021

EXPIRATION DATE: MARCH 30, 2024


SCLERAL LENSES AND OCULAR PHOTOGRAPHY

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Why should we bother photographing a scleral lens? Primarily, because scleral lenses are amazing! Not only do they provide incredible vision and comfort for the most challenging eyes, scleral lenses are also incredibly customized. Not to mention that every scleral lens fit is unique. A photo of each exceptional and personalized scleral lens design is a work of art.

Prior to every scleral lens fitting, a meticulous evaluation of the eye, especially the anterior segment, is essential. A thorough slit lamp examination with details of each area of the anterior segment should be evaluated and recorded. Photodocumentation is vital to record any abnormal findings to aid in monitoring changes over time. Photodocument any findings that could limit scleral lens success, or note pre-existing conditions prior to scleral lens fitting. This documentation is extremely beneficial to patients to help set realistic expectations. Additionally, it is helpful to educate practitioners and their staff. Photodocumentation is useful to examine scleral lens fits over time and to provide information on the health of the ocular surface without a lens. For challenging fits, it is beneficial for communication with laboratory consultants, who have a wealth of knowledge and are helpful with scleral lens designs. Accurate information is required to design a lens appropriately.

Photodocumentation is also advantageous to build your scleral lens practice, obtain referrals for scleral lens fitting, and consult with other practitioners. Images obtained may be used for lectures, case reports, and/or posters.

TIPS FOR PHOTOGRAPHING SCLERAL LENSES

What is so different about photographing scleral lenses as opposed to other types of lenses? One of the first things that practitioners look for in fitting a scleral lens is the central clearance or vault. Opinions vary as to what constitutes an appropriate fluid reservoir depth, but all agree that touching the cornea should be avoided. Documenting this clearance with photography is of great benefit when reviewing the case later and especially when communicating with laboratory consultants. To do this, it is critical that a bright beam of razor thinness is brought into sharp focus. This is very important when viewing the fluid reservoir without fluorescein (Figure 1).

The magnification settings are different on various slit lamps; however, settings of 10x to 16x are appropriate for most cases. If there is too little magnification, the image will be too remote. Magnifications higher than 16x will not have the best field of view and will be difficult to focus. Start with the light source angled approximately 45° to the side,[1] then slowly move the slit lamp horizontally while varying the angle. In this way, clearance will be evaluated across the entire corneal surface. Snap photos at several locations and angles. By knowing the central thickness of a scleral lens, you can compare the apparent depth of the fluid reservoir to this value. In addition, it is especially important to ensure that you have adequate limbal clearance.

A photo of each exceptional and personalized scleral lens design is a work of art.

When evaluating a diagnostic lens, many practitioners will instill sodium fluorescein (NaFl) into the lens bowl. Next, the fluid reservoir is still evaluated in white

light. This makes the evaluation of the reservoir thickness even easier. When captured with a sharp image, precise measurements can be made with a variety of image processing tools.

These, too, may be recorded for documentation and analysis. After the optic section is captured, change from white light to cobalt blue, which excites the fluorescein and makes it fluoresce; then open up the aperture on the light source to the full width and set the magnification to 8x to 10x.[2] A Wratten #12 filter blocks the cobalt light, producing a bright, fluorescent-green image (Figure 2).

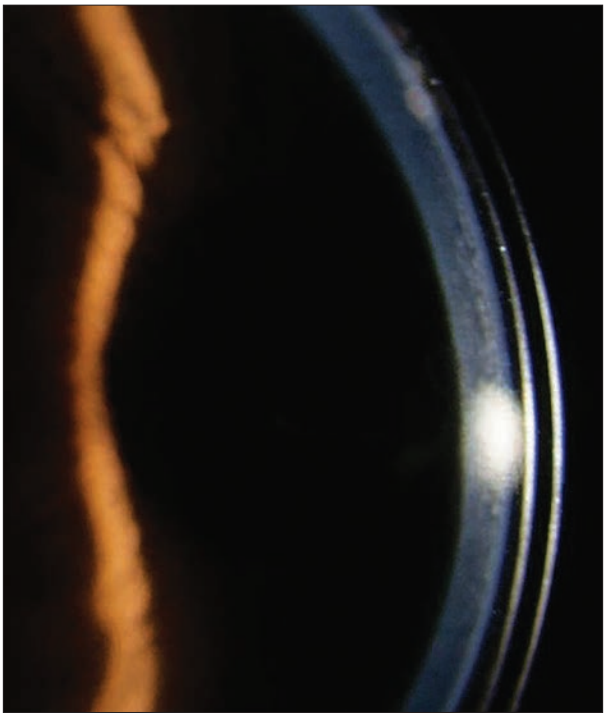

Figure 1. Fluid reservoir without NaFl.

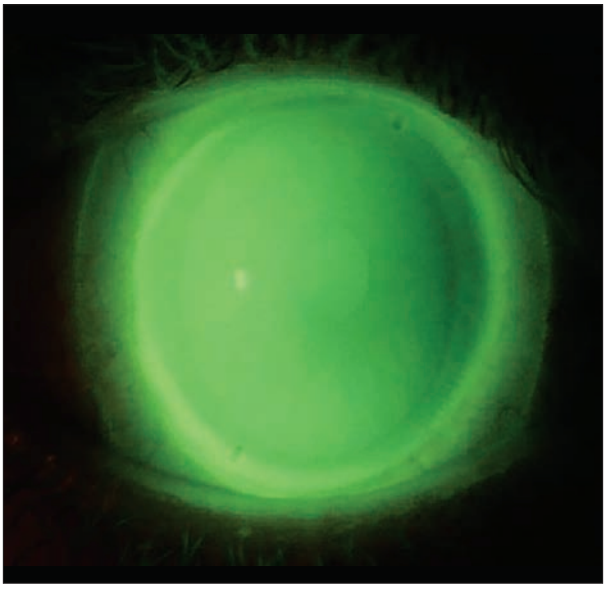

Figure 2. A Wratten #12 filter will block the cobalt light, producing a bright, flourescent-green image.

Generally, the oculars will be centered, with the light source just a few degrees off-center or in-line with the oculars. In the latter case, make sure that the light source does not cast a shadow on the image. This wide-angle view of the entire lens is useful in assessing areas of minimal clearance or touch. One caveat to keep in mind: the human eye is not able to perceive fluorescein if the clearance is about 20 microns or less.[3] Therefore, these areas may be dark, leading to the incorrect conclusion that there is touch.[1] An anterior segment optical coherence tomographer (OCT), if available, can be used to evaluate these areas. If the lens has been on the eye for some time, remove it and instill fluorescein to look for punctate staining on the cornea and for staining on the conjunctiva.

After evaluating the eye with the blue light, change back to white light with a wide aperture and reduce the light intensity so as to not wash out the image. In addition, it is advisable to use a diffuse light source. Photo slit lamps usually have a diffuser built in. However, you can easily make one. A neat trick is to take a plastic cup like the ones included with children's cough syrup and simply place it over the light source like a hat (Figure 3). Alternatively, you can either make a diffuser

Figure 3. Using a plastic cup to create a DIY diffuser.

out of an empty daily disposable lens pack secured with a paper clip or by placing a piece of frosted transparent tape over the mirror. For the latter, try not to get the glue on the surface of the mirror. By diffusing the light, a nice image is obtained of the entire lens. This is very useful when evaluating the lens edge for signs of impingement.

ADAPTERS: SMARTPHONES, HOLDERS, ETC.

Precise clinical observations are required for scleral lens design. There are various methods and types of equipment available for photographing the anterior segment. A basic and cost-effective option is an adapter that attaches a camera or cell phone to the ocular on the slit lamp (Figure 4).

Obtaining high-quality images does take practice. It is important to allocate sufficient time for optimal patient positioning and fixation. Refining the amount of lighting and magnification is essential. Another tip is to begin focusing with a low magnification, then increase magnification as needed, keeping in mind that more light is needed with increased magnification. A diffusing filter softens the slit lamp beam to improve visualization of the conjunctival vessels when evaluating scleral lens landing zones (Figure 5). Diffusers help obtain images in low magnification for a complete view of the scleral lens.

Figure 4. A basic and cost-effective option is an adapter that attaches a cell phone to the ocular on the slit lamp.

There are many different adapters available on the market, including:

- An adapter that consists of a phone dock with customized silicone jaws to fit on any microscope. The jaws expand and lock down like a clamp with a one-button clamp release, and the light dock provides portable illumination for slit lamp photography.
- One that uses 4K cameras to offer high-definition slit lamp imaging without the high cost of traditional imaging. The device is custom fit to a provider's slit lamp and mobile device.
- One that obtains slit lamp photographs. A specific adapter is manufactured for different types of slit lamps (Figure 6).

SLIT LAMP ATTACHMENT: PLACIDO TOPOGRAPHERS WITH CAMERA

One unique device inserts a smartphone adapter in between the oculars and the objective of the slit lamp (Figure 7). A toggle switch on the side changes the image beam from the oculars to the camera itself. This arrangement is very secure and can remain permanently affixed to be used as desired. As all smartphones today come equipped with Bluetooth, the image can be shared with any other compatible device. This is especially useful for patient education in which the image(s) can be shared with a nearby computer or Bluetooth-enabled flat screen television in the exam room.

The next time that you are in the market for a topographer, consider one with a camera on board.[4] Although these will not create an optic section, they are excellent for an overall view. Cobalt blue light may be utilized as well as white light. Video recording is also available, which is an excellent way to evaluate a corneal lens fit, as the lens moves with the blink. Many employ reticules that may be used to evaluate the various angles of rotation in the case of toric contact lenses (Figure 8). Another very useful feature of having a camera incorporated in a topographer is the evaluation of lens decentration.

Images of the lens in situ are taken in which the difference between the line-of-sight and the lens center can be measured. This is valuable information, especially when fitting multifocal contact lenses. Angle kappa can be measured to a high degree of accuracy.[5]

The correction of higher-order aberrations (HOAs) is of special interest to scleral lens practitioners, as a number of laboratories are creating lens designs to address this. Typically, a diagnostic HOA lens will have special markings so that lens rotation and decentration can be measured precisely. A camera image captured with the lens on the eye can be evaluated with measuring tools using software available on the device shown in Figure 9. These measurements are critical because, for HOA correction to be successful, the lens must be extremely stable with almost no movement.

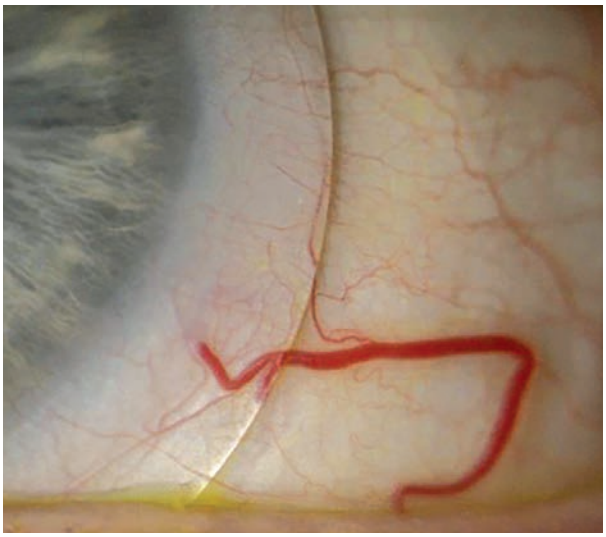

Figure 5. A diffusing filter improves the visibility of conjunctival vessels in the scleral landing zone.

Figure 6. An attached tablet for taking photos. Specific adapters are manufactured for different types of slit lamps.

Figure 7. A unique option inserts a smartphone adapter in between the oculars and the objective of the slip lamp.

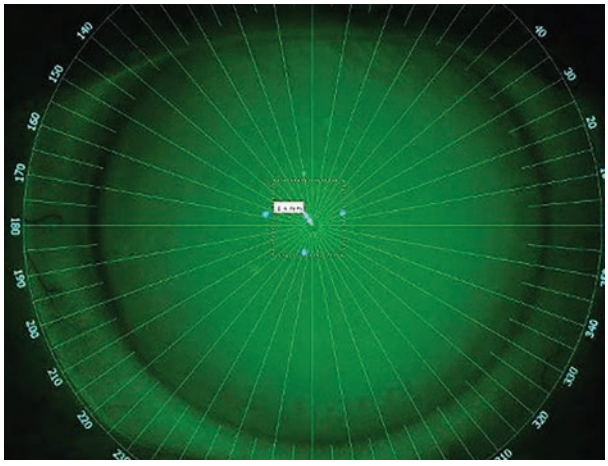

Figure 8. Many topographers employ reticules that may be used to evaluate the angles of rotation in toric lenses.

For ease of use in scleral lens photography, it is difficult to surpass a dedicated photo slit lamp. This would be a microscope with the camera built in. Many models are available. In some cases, existing slit lamps may be retrofitted depending on the model. Numerous advantages of slit lamp cameras include exceptional image quality and stability, a wide range of magnification, the ability to easily switch between still photos and video, and ease of capturing images with a click of a button on the joystick or foot pedal. Videos are especially easy with a built-in camera. However, it is best to keep videos short, no more than 10-to-15 seconds.[6] Any longer and the file size becomes too large, which makes uploading and sharing difficult.

Typically, these camera systems are connected to a computer via USB cable. Image capture is immediate, without having to wait for a wi-fi network. Images are viewed directly on the computer as they are captured. Those that are out-of-focus or of poor quality can be immediately discarded. Connection to a flat-screen television via an HDMI cable will provide an excellent image for reference as well as for patient education.

Another option is to directly attach a camera body to the slit lamp. This is accomplished via attachments that can switch the image from the oculars to the camera itself (Figure 10). With this configuration, all of the features of the more advanced camera may be utilized.

MACRO PHOTOGRAPHY

Do you ever wonder how eyecare professionals get

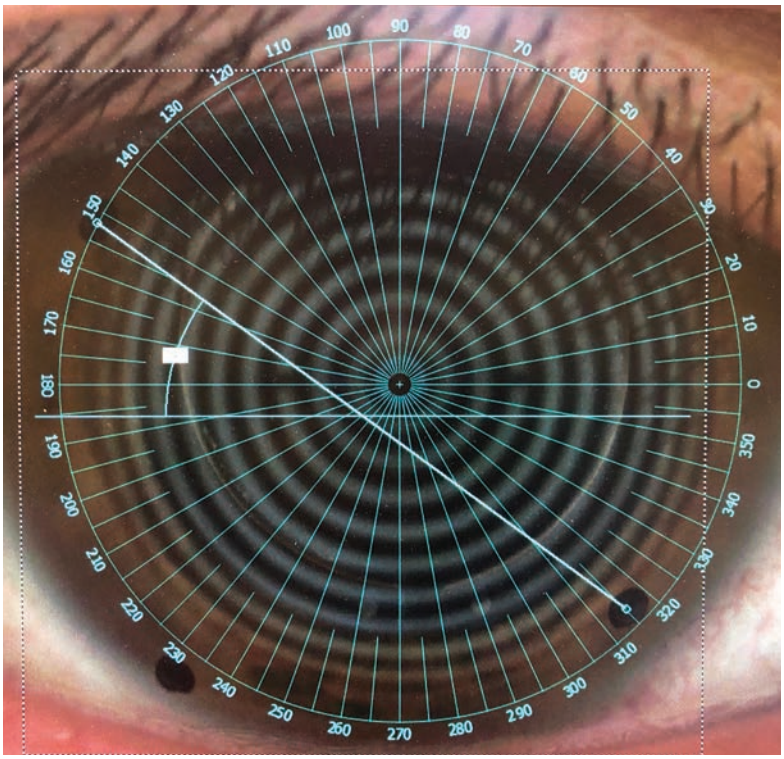

Figure 9. Higher-order aberrations rotation measurement.

Image courtesy of Daddi Fadel, OD.

Figure 10. DSLR-camera attachment.

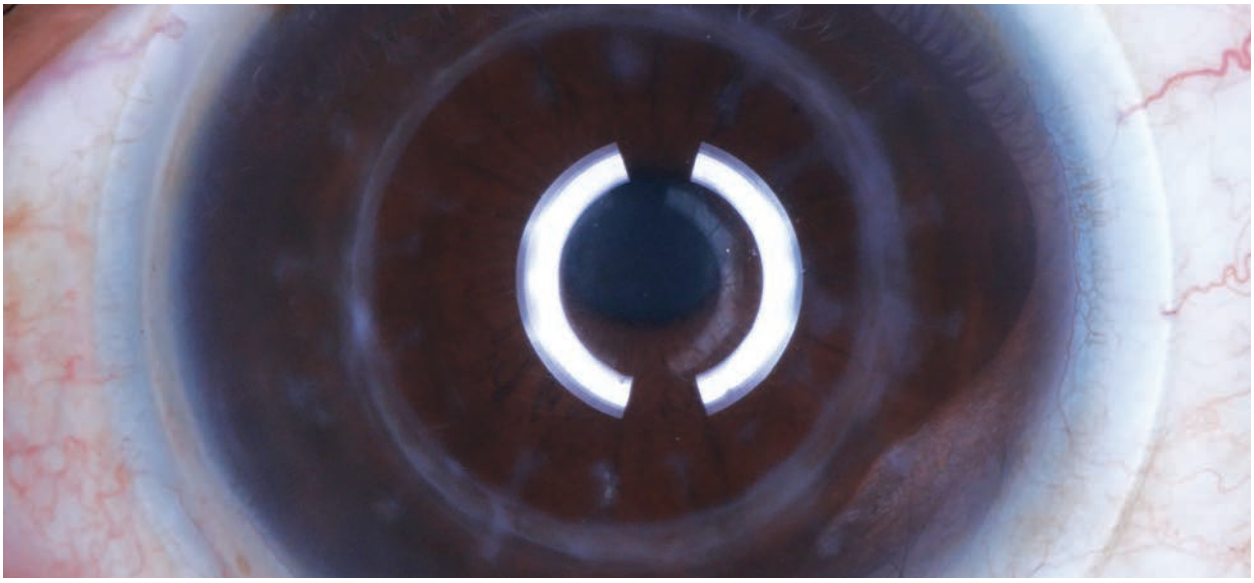

Figure 11. Ring flash on the eye.

those amazing close-up pictures, not only of scleral lenses but of all of the various eye conditions commonly encountered in practice?

To obtain "magazine-quality" images close up, photographing with a true "macro" camera lens attached to a digital single-lens reflex (DSLR) camera body is required. While it is possible to increase the magnification of a lens used for general photography with the addition of lens extenders, for quality photos at a very close range, a macro lens with a focal length of 90mm to 105mm is preferred. With this focal length, the photographer can be 6 inches to 3 feet away from the subject. If you or your patients feel uncomfortable with the camera that close, macro lenses with a focal length of

150mm to 200mm enable you to be farther away and still obtain a sharp image.

Look for a magnification ratio of 1:1. This means that the camera image will be "life size."[7] In other words, the image captured will be the same size as the actual image. A ratio of 1:2 would indicate that the image size would be only 50%.

Another thing to consider is that the depth of field when focusing the lens on the eye is very limited.

> Photodocumentation is vital to record any abnormal findings to aid in monitoring changes over time.

Therefore, a small aperture is required to get everything from the lids to the corneal apex, the conjunctiva, and even the iris in sharp focus. Look for a lens that can stop down to f/32. In essence, this is a pinhole, so that all elements of the photograph can be brought into sharp relief.

A desirable feature in a macro lens is "image stabilization."[7] Because of the need to be in close proximity to the eye, most photos are taken while holding the camera "free hand." Image stabilization helps to prevent image jitters that could spoil the photograph.

We also recommend using manual focus. Set the lens magnification to maximum and then move in toward the patient until the image is in sharp focus. Many cameras have an alert setting in which the camera will beep and the black reticules turn red, indicating that the image is in focus. Depress the shutter at that point.

> Image focus or sharpness cannot be improved in post-production.

The final element is the addition of a flash. This is necessary, as much of the ambient light is blocked by the need for close proximity to the patient. Ambient light may also result in unwanted reflections. The best flashes are those that attach directly to the end of the lens. These may be connected to the camera body via cables or wirelessly via Bluetooth. Avoid "ring" flashes, which are popular for macro photography, as they create unwanted reflections right in the middle of the photo at the apex of the cornea[9] (Figure 11). Thus, many fine details are washed out. Flashes that are a few inches away from the end of the lens but on the same plane are the best. It is always a good idea to demonstrate the flash to the patient prior to taking the picture—while not directly pointing at the patient—so as not to startle them when the actual image is taken.

Typical camera settings to start with are noted in Figure 12. Adjust as needed for your particular camera and lens.

CAMERA SETTINGS

1. Save all as "Custom"
2. Aperture f/32 (or highest available)
3. ISO 400
4. "Portrait" mode
5. Manual focus
6. Exposure compensation "0" (may set to –1 to –2 for light eyes; +1 to +2 for dark eyes)
7. Average White Balance (AWB)
8. "Spot" metering
9. Image size – "RAW"

Figure 12. Typical camera settings with which to start.

IMAGE PROCESSING

Whatever device or system you choose for image capture, it is important to save the picture as a "raw" file.[10] This is the full file size without any compression or processing by the camera. Now that disk storage is very inexpensive, multiple large files can be stored. This is important for editing and processing the image with other applications after the fact. Some tweaks commonly employed are cropping the image, adjusting the exposure, adjusting skin tones, changing the white balance (tungsten versus fluorescent), and color temperature. One thing to always keep in mind is that image focus or sharpness cannot be improved afterward in post-production. When taking photos, pay particular attention to obtaining a sharp, well-focused image.

Post-production of the image can be accomplished using any of a number of applications; some are free of charge, and others may be purchased. The professional photography standard has long been Adobe, with its full-featured software that many professional photographers use. Its origins go all the way back to 1990. While a very powerful program, it has many more features than a casual photographer requires, and it is expensive. The company also offers a less complicated and less expensive application that still provides everything needed and more. That being said, there are also many free applications that are quite sufficient for the needs of ocular photography.

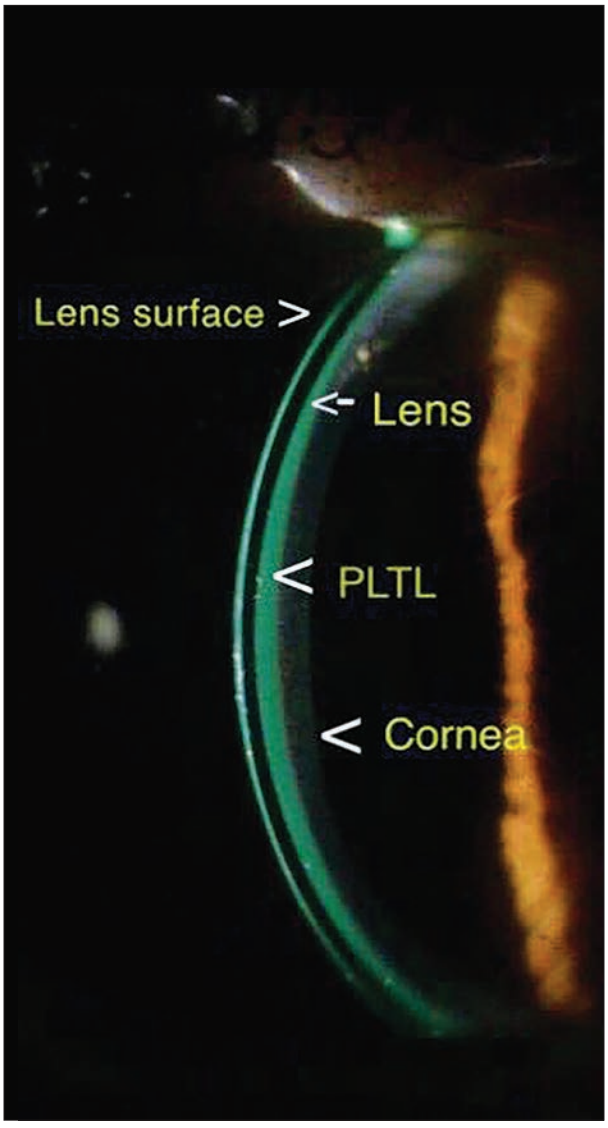

Figure 13. "Rule of Thirds."

In addition to improving image quality, these applications allow you to make notations, add descriptions, and draw illustrations directly on the image. They will also format the photo for posting to the various social media platforms.

The iconic American photographer Ansel Adams (1902-1984) once remarked, "There are no rules for good photographs, there are only good photographs."[11]

> There are no rules for good photographs, there are only good photographs.

That said, two things that will help improve any photo are eliminating any vignetting and obeying the "Rule of Thirds"[12] (Figure 13). Vignetting is when there is a black ring around the image. This occurs most commonly when taking pictures through the oculars of the slit lamp. Much of this can be reduced or even removed when taking the photo. Increase the magnification on the device (not on the slit lamp) so that the entire image fills the screen without any black borders.

The "Rule of Thirds" refers to cropping the photo. Think of dividing the picture into three equal zones. The object of regard can be placed to the right, in the middle, or to the left—whatever is the best fit. The result will be a photo that is balanced and attractive. **CLS**

For references, please visit www.clspectrum.com/references and click on document #306.

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