

## Side Lighting vs. Central Lighting in Iris Photography

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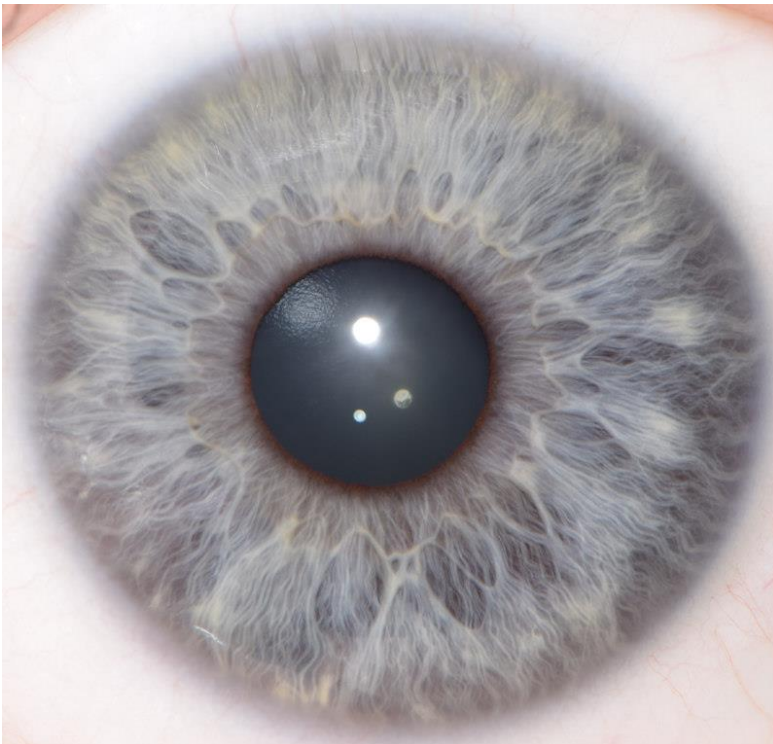
Jon Miles, May 2018

When photographing the iris, **control of the illumination is critical** to getting a high fidelity image. All aspects of iris illumination must be optimized for high-quality iris photography, and a reference illumination configuration **must** be established *and used consistently*, if before-and-after comparisons of the iris are to be made. In other words, if one seeks to **obtain accurate data on iris color**, or to **track changes over time in iris color** (which are typically very subtle), and not be misled by changes in images that are actually due to changes in *illumination* or *camera exposure* factors -- differences in *exposure* or differences in the *response characteristics* of various camera, rather than changes in the *iris* -- one must be meticulous about using the identical *illumination* and *camera settings* for all iris photography.

The color RGB image of the iris includes numerous imaging artifacts that obscure the iris, such as glare and reflections. The iris is brought into alignment with the camera lens by first centering the field of view on the pupil center, and then directing the client to gaze at the focus light reflection seen at the center of the camera lens. To avoid gaze wander, the client is asked to cover the opposite eye with the hand on that side. Correct alignment is when the visual axis is collinear with the camera lens axis.

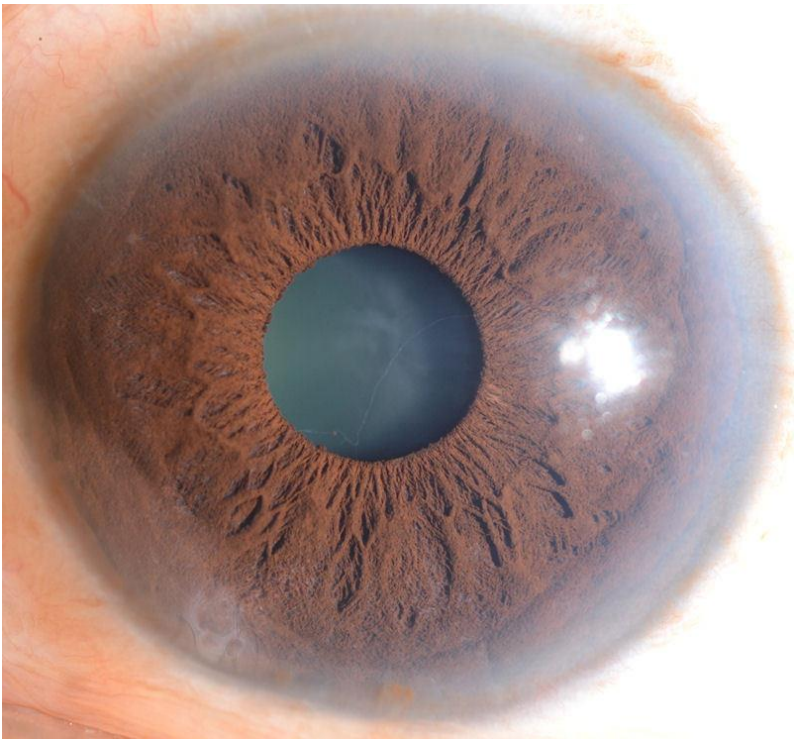
### Angle of Illumination

Various lighting conditions can achieve different effects. This article is focusing on the effect of various angles of illumination, as measured from the lens axis of the camera. For standard biometric imaging, it is normally best to have Central Lighting, so as to have a uniform illumination of the entire iris surface with minimal shadow casting and minimal illumination gradient across the image.



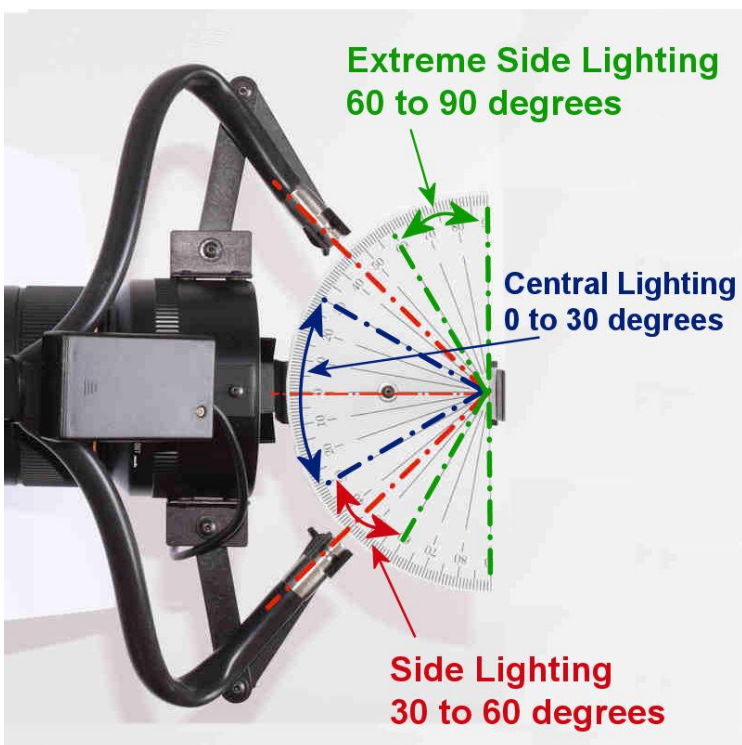
*This iris photo is a good example of a well-illuminated central lighting image*

However, by using Side Lighting illumination, one can get additional information on the iris, because the use of side lighting (sometimes referred to in ophthalmology as “oblique illumination”) is better for illustrating the surface texture of the iris.



*This iris photo is a good example of a well-illuminated side lighting image*

In general, the range of illumination angles can be divided into 3 subranges: Central Lighting (0 to 30 degrees), Side Lighting (30 to 60 degrees), and Extreme Side Lighting (60 to 90 degrees).



Side Lighting can be either Fixed (**Fixed Side Lighting, FSL**), where the angle of illumination is always fixed at the standard reference 45-degree angle and is not changeable *OR* Adjustable (**Adjustable Side Lighting, ASL**), where each side light can be set to any angle between 20 and 90 degrees from the lens axis.

## 2-channel (Side Lighting):

Fixed Side Lighting (FSL)

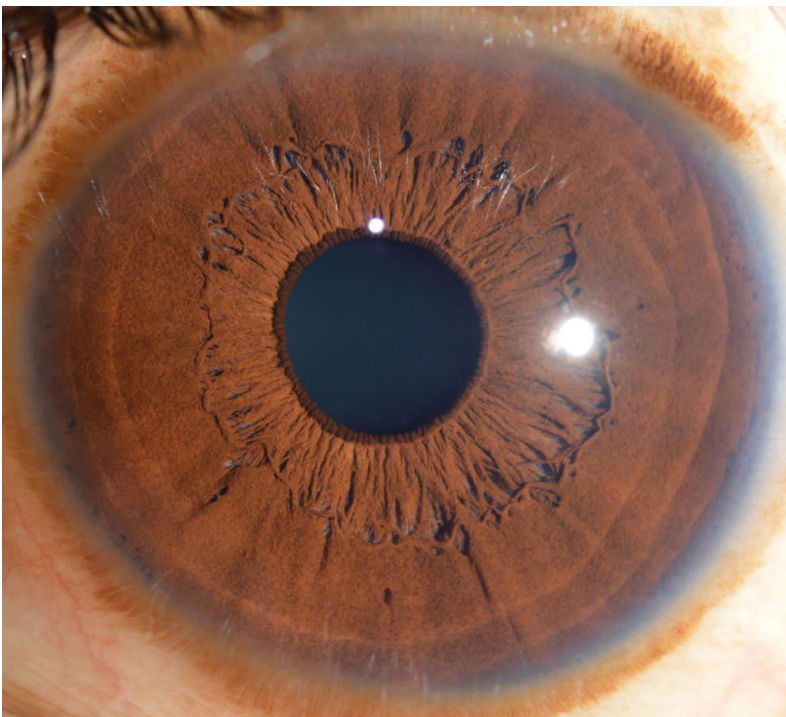


Adjustable Side Lighting (ASL)



The advantage of **Fixed Side Lighting** is that all photos will be taken with identical angle of illumination which facilitates comparison of the iris at different times and standardizes all images.

The advantage of the **Adjustable Side Lighting** is that one can create many different illumination conditions by selecting specific lighting angles to use.



*This iris photo is a good example of a well-illuminated side lighting image*

### **Fixed Side Lighting (FSL) Illumination**

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For bringing out the textural detail of the anterior iris surface, the preferred method is to use the **Reference 45-degree Lateral Side Lighting**, where the lateral light is set to 45 degrees from the lens axis. This is especially useful for getting details of the brown iris surface, since the anterior border layer is either partly or fully pigmented and the underlying radial vasculature is typically obscured from view.



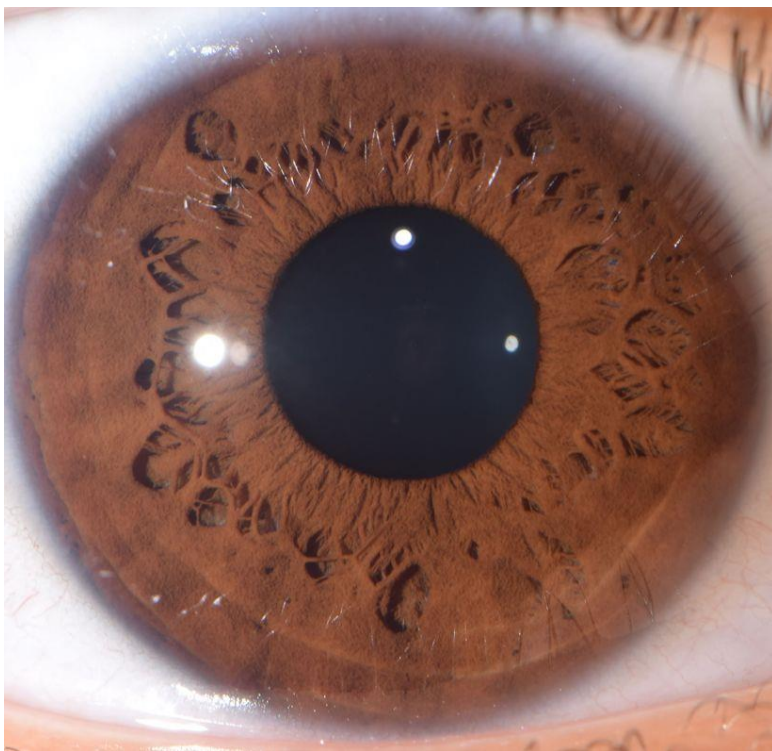


Fixed Side Lighting (FSL)

**FSL**

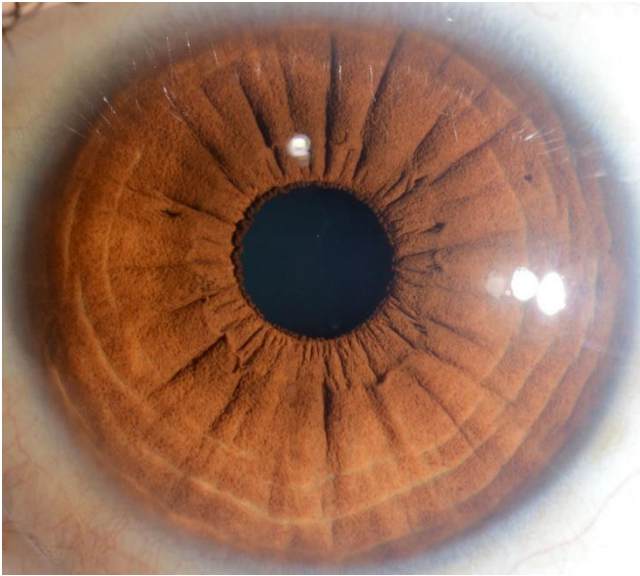


Use of the **Reference 45-degree Lateral Side Lighting** is also helpful to bring out lacunae details since the shadows are cast at a distance equal to the difference in z-position:



## The Adjustable Side Lighting (ASL) Illuminator

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Adjustable Side Lighting (ASL)

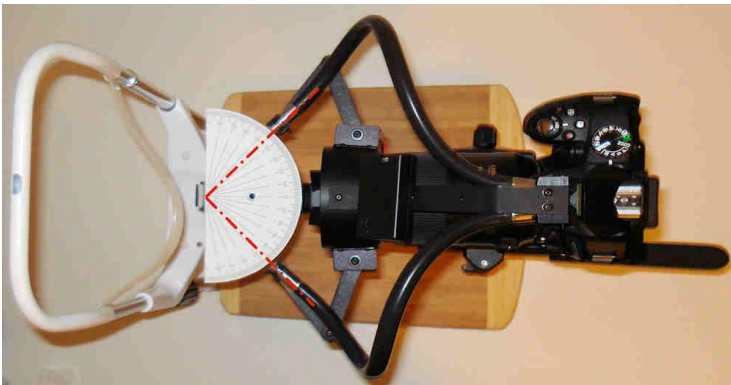
**ASL**



The Adjustable Side Lighting illuminator to specific illumination angles, ranging from 20 to 90 degrees.

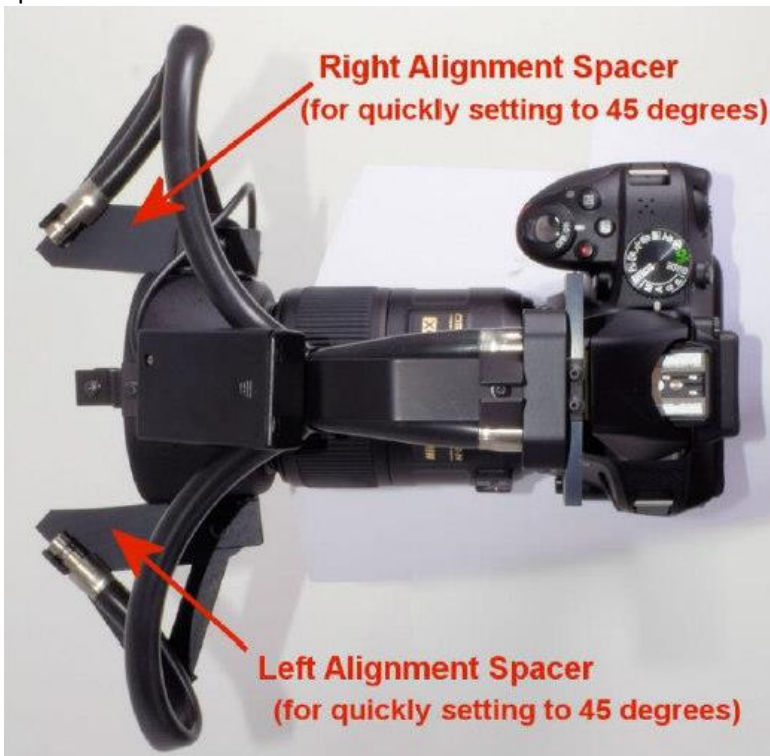
Normally, when the iris is photographed using side lighting, the light is directed at the iris from the lateral side only. With the above configuration, one can switch the light channels on or off, so as to have the light only coming from the lateral or medial direction (or both). If the client has deep-set eyes, the medial light may need to be set to a smaller angle (such as 40 degrees) in order for the light beam to clear the nose and illuminate the entire iris. Some photographers take photos using left, right, and central lighting for all clients.

The standard angle of illumination for side lighting of the iris is 45 degrees:



*The illustration above shows the Alignment Target being used to ensure correct 45-degree angle of lighting.*

With the Adjustable Side Lighting illuminator, the reference angle of 45 degrees can easily be set using the Alignment Spacers:

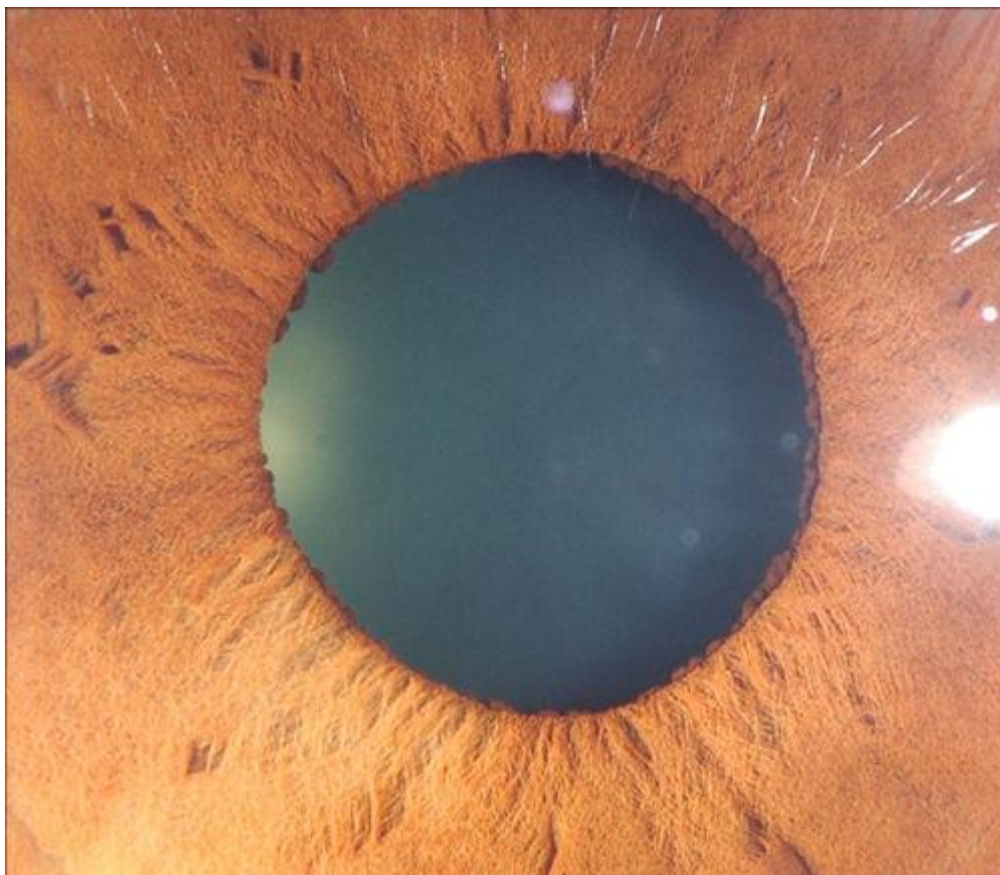


For bringing out the detail in the inner pupil border area, the recommended approach is the **LoRito method of Extreme Side Lighting**, where the lateral light is at 80 to 90 degrees from the axis and the medial light is at about 20 degrees:



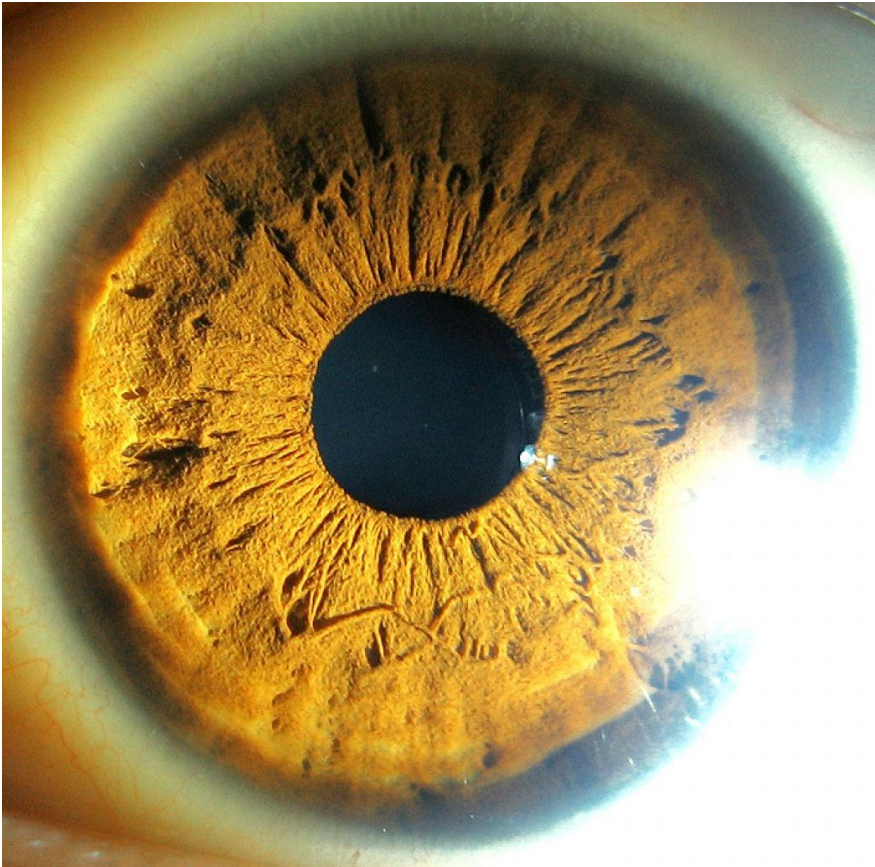


Examples of IPB imaging using the LoRito ESL method:



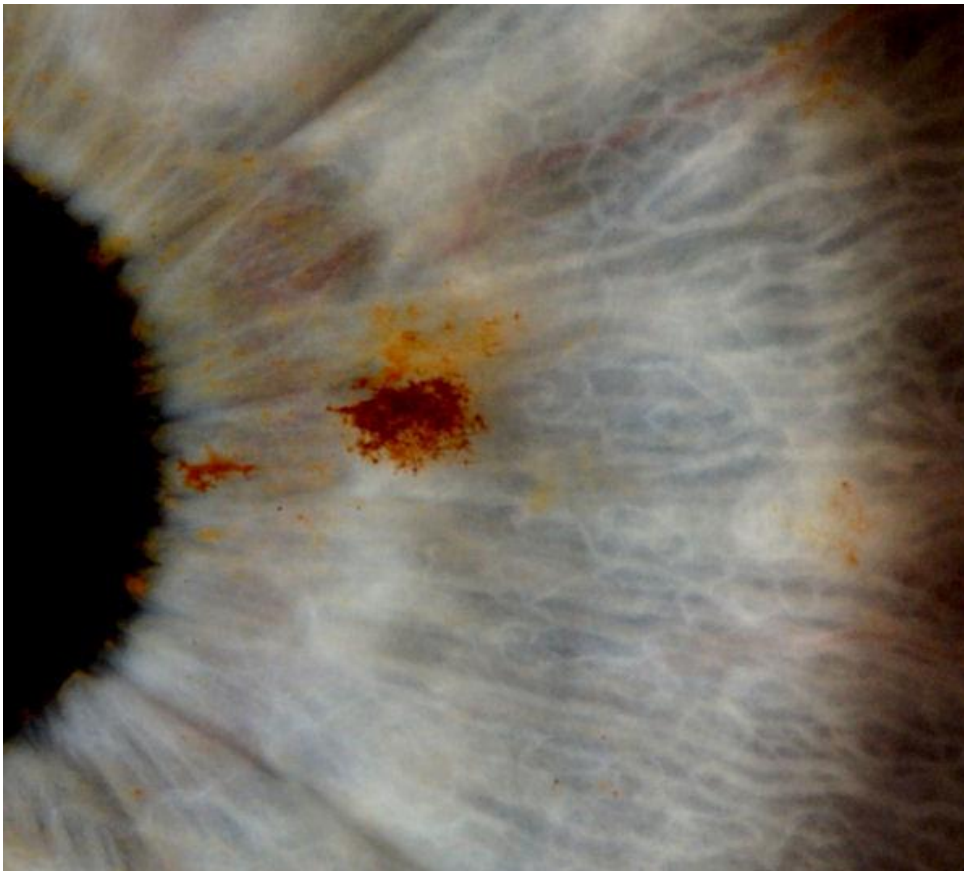
Another type of Extreme Side Lighting is the use of light at an angle of 90 degrees from the lens axis. This will illustrate the arcuate and radial contraction furrows via shadow casting.

Example images using 90-degree ESL:





ESL can also illustrate the elevation of the type of pigment patch that is situated on top of the anterior border layer:

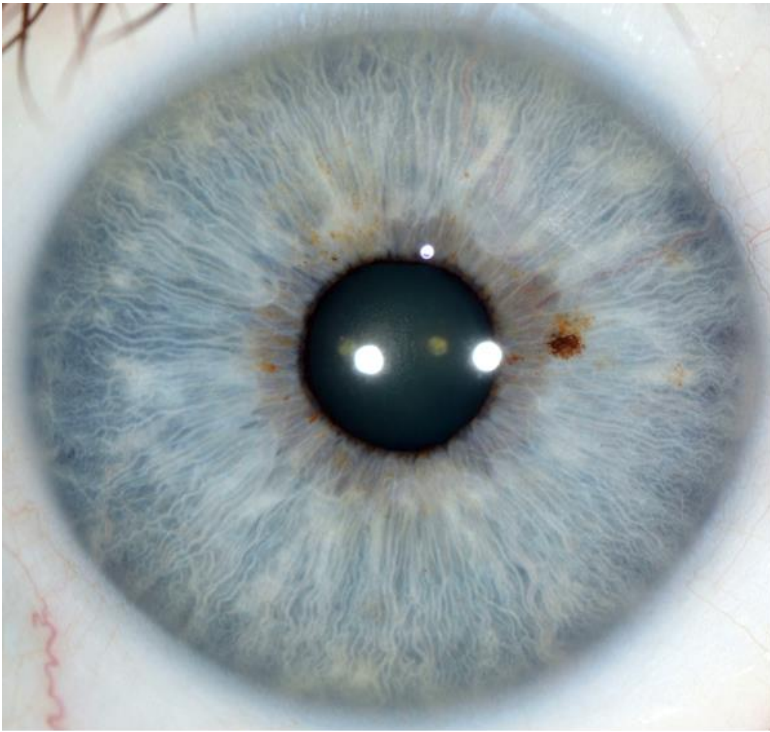


### **Obscuration of the Iris by the Corneal Reflection of the Illuminator (Purkinje 1)**

ANY Side Lighting illumination will block a small portion of the iris from view due to the presence of a reflection off the anterior corneal surface (actually it reflects off the tear fluid layer). Most people just ignore the missing area, however some people who use side lighting often will take photos using both left-only & right-only (and sometimes both as well) illumination so nothing is missing. Many people do not have the time to work with two or three views of each iris, but it is a good idea.

With the adjustable lighting, you can have the reflection anywhere you want, including right near the center, as shown in the example iris photo below, by the reflection on the left side (that light is incoming from the lateral side). Here is the ASL set up for central lighting:

Here is the resulting iris photo:



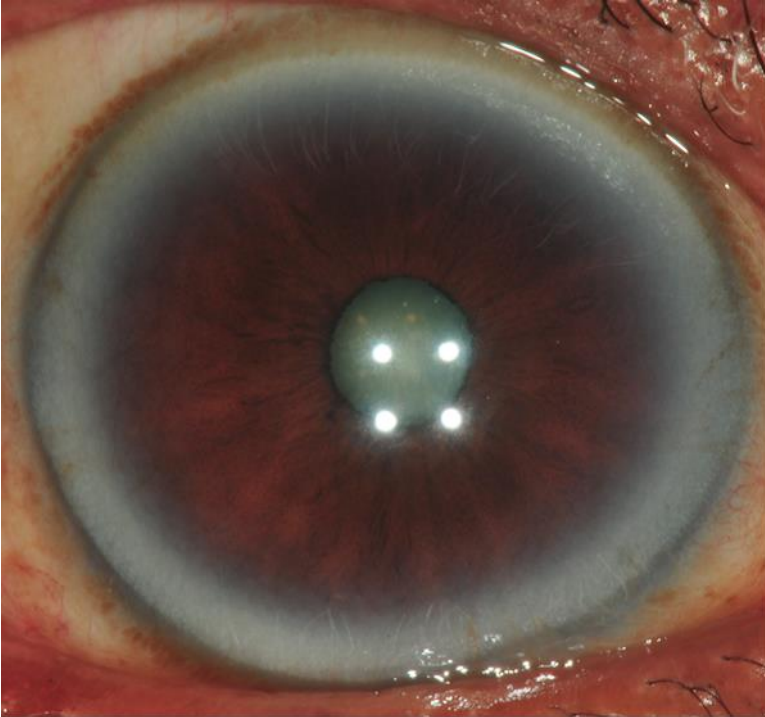
Normally you would not have them both on, just the lateral one, which in the above example (RE) would make only the reflection dot on the left show up.

Notice that even with the smallest light pattern - the **Coaxial Biometric**, that *if the pupil is small* there will be some obscuration of the iris:

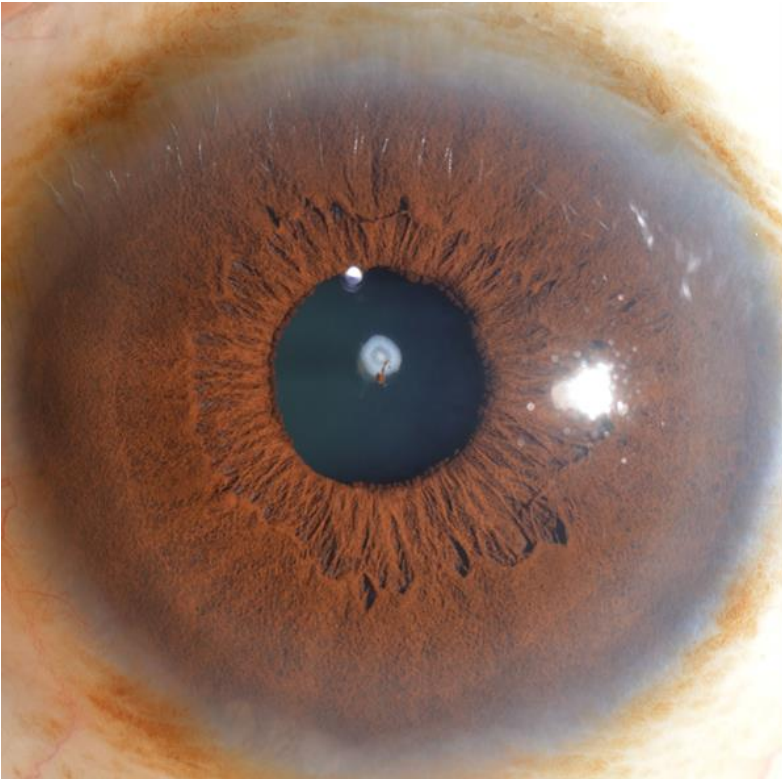


In this case, it is sometimes helpful to switch off the focus light right after taking this photo, then immediately take another before client moves, and then you will get a photo with a larger pupil (due to no focus light).

The main benefit in the use of side lighting is that it can often give a better image of the dark brown iris by illustrating the texture of the brown iris surface (the blue iris does not really have a texture). For example, compare this central lighting photo of an African iris:



to this side lighting photo of an African iris:



In the above photo, it would be quite simple to slide the shutter to the other position for a quick secondary shot of the iris using only the left channel. The standard 45-degree lighting angle will put the reflection dot right over the lateral area - 9:00 Right Eye, and 3:00 Left Eye. But with the brown iris, the top layer is **so pigmented that one cannot see the individual radial fibers** (which are actually blood vessels) underneath



what appears like a brown carpet layer throughout the ciliary zone (outer zone), from collarette to the far periphery of the iris. In the case of this type of pure brown iris, one primarily evaluates the inner zone and the collarette. Since the surface of the true brown iris is opaque, it has a **texture that can be illustrated by lighting at an angle**, unlike the blue iris. The surface of the blue iris in the ciliary zone is like a clear plastic wrap laid on top of the radial fibers (which are collagen-clad capillaries). This is why autofocus works better on the blue iris - the subject has inherently more contrast (all blue iris photos above were done with autofocus).

### Newest Combo Illuminator: the *3-Channel* Central and Side Lighting (CFSL and CASL)

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The **FSL** is recommended for most clinical use, however the newest combo unit (**Central and Fixed Side Lighting**) is also very efficient to operate in a clinical setting because it includes both the Central Lighting and the Side Lighting with the new three-channel shutter which can select between left, center, and right channels. Since the two side lightguides are already in place on each side at the same time, there is no repositioning needed for central lighting.

These are the two new 3-channel CSL models - if your primary imaging uses both central lighting and side lighting, then this is the best choice:

#### 3-channel (Central and Side Lighting):

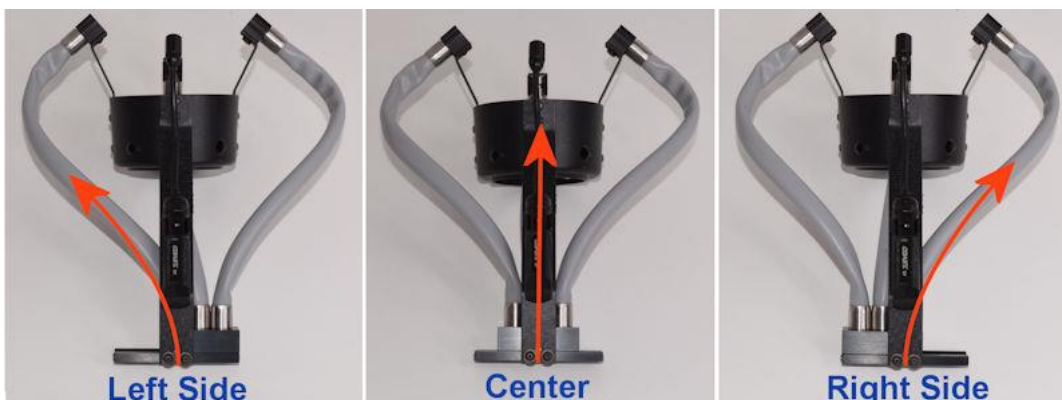
Central & Fixed Side Lighting (CFSL)



Central & Adjustable Side Lighting (CASL)



I prefer to use the 3-channel type of illuminator, such as the Central and Fixed Side Lighting (CFSL) camera, and get central and lateral lighting for all clients, then select the best photo. Usually Side Lighting photos are best for the brown iris and Central Lighting photos are best for blue iris.



The New 3-Channel CSL is priced at \$400 above the 2-Channel Side Lighting model.

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**Current Camera Prices:** [www.milesresearch.com/main/prices.htm](http://www.milesresearch.com/main/prices.htm)

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**Jon Miles You Tube Channel**

<https://www.youtube.com/channel/UCMJN-misCI140V2a3cJu5Rw/video>  
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## Chinrest Options

For a **chinrest** there are two basic models:



CRCSR-UF-TTB - Compact Portable U-Frame Style



CRCS-FH4 – Premium Pro Deluxe

**CRCSR-UF-TTB (\$500)** - breaks down easily (no tools) into a 14x12x8-inch box/bag (or a 12" cube), weighs about 8 lbs.

**CRCS-FH4 (\$1200)** - breaks down easily into a 28x12x6 inch box, weighs about 12 lbs. The FH4 model is the more deluxe, but both are very good and very stable.

### **Chinrest Setup Videos and User Guides**

**How to set up the Compact Chinrest (CRCS-UF)**

<https://www.youtube.com/watch?v=eANGeT-Un7s>

This is the twin-pillar tabletop base model. Note that the horizontal crossbar can alternatively be mounted on a tripod (tabletop or floor-standing). Price is \$500.

CRCS-UF User Guide: <http://milesresearch.com/pdf/Use-of-Chinrest-CRCS-UF-TTB.pdf>

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**How to set up the Premium Chinrest (CRCS-FH4)**

<https://www.youtube.com/watch?v=zKtmqJywiA8>

This is the deluxe professional tabletop base model. Provides excellent head stabilization for all eye photography, and works with all macro cameras. Price is \$1200.

CRCS-FH4 User Guide: <http://milesresearch.com/pdf/Use-of-Chinrest-CRCS-FH4.pdf>

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If a person already has a Nikon DSLR that is available for iris photography, then the Lens-Illuminator Kit is available for \$550 less than the complete kit, and includes everything except the camera body, spare camera battery, and other camera accessories. The Lens-Illuminator Kit includes the Nikon macro lens. If a person already has the 85mm Nikon macro lens (or the 105mm VR Nikon macro lens, then the Illuminator-Only Kit is available for a price that is \$550 lower than the LIK (deduct \$1100 from the full kit for this option). If a softcase is preferred over the airtight/watertight carry case, then deduct \$100.

If you use a Windows computer, then the free software from [www.digicamcontrol.com](http://www.digicamcontrol.com) is recommended - this allows you to see the photo on a computer screen right after taking it. You can also see the live video image from the camera on the monitor before taking the photo. For Apple, you can download the Sofortbild camera control software (free from Apple) or get the \$150 Nikon Camera Control Pro.

The current generation of camera (Nikon D3400) supports both Wi-Fi downloading of images and Bluetooth.

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