

1. Pointers on Imaging Technique

1.1. General

When shooting the fields digitally, shoot the study eye images first, followed by fellow eye. Stereo pairs should be taken shooting the left member of the pair first, followed by the right member of the pair. All digital images should be reviewed for quality at the time of photography and the photographer should select the best stereo pairs for each field, deleting extra, unnecessary images.

1.2. Patient Cooperation

Photography of the photophobic subject can be challenging for the photographer and uncomfortable for the subject. Minimizing the number of flashes and the length of time the eye is exposed to a bright viewing lamp are two things that can help make the photography procedure more comfortable. Additionally, keeping the view lamp as low as possible (maybe even dimming the room lights) can help make the photography procedure more tolerable. Patients should be asked to blink to help keep the cornea clear.

If the subject has great difficulty tolerating the screening visit photography procedure and the photographer thinks this will lead to a problem at follow-up visits, the situation should be discussed with the principal investigator and/or coordinator, and consideration should be given to not enrolling the subject in the study.

1.3. Field Definition

When the modified 7-standard stereo fields are taken, the following sequence is recommended: disc (Field 1M), macula (Field 2), temporal to macula (Field 3M), superior temporal (Field 4), superior nasal (Field 6), inferior temporal (Field 5), inferior nasal (Field 7). Fields 1M, 2, and 3M may be taken on the same horizontal plane.

The following technique may be used for attaining proper definition of Field 4: (1) move the camera from the center of the disc upwards until the upper edge of the disc meets the bottom of the photographic field, (2) take note of some landmark at the intersection of the cross hairs (e.g., a small vessel or microaneurysms), (3) swing the camera temporally until this landmark is at the nasal border of the photographic field (at this point, the lower edge of the field will fall on the same plane as the upper edge of the disc). This is the proper position for Field 4.

To locate Field 6 rotate the camera nasally until the landmark is at the temporal edge of the field. A similar approach can be used to obtain Fields 5 and 7.

1.4. Focus/Clarity

Remember that the best image quality can be acquired if corneas are not disturbed by prior examination with a diagnostic contact lens.

In a properly aligned digital system, the cross hairs and the retina are in focus at the same time. In these instances, constant attention must be paid to keeping the cross hairs in the camera ocular in focus when focusing on the retinal vessels. However, some digital systems are not par focal with the eyepiece; in these cases, it is important to confirm that image on the monitor is as sharp as possible. Proper camera-to-eye distance should be maintained to avoid haziness and artifacts.

If it is not possible to get the entire photographic field in crisp focus, the photographer should concentrate on getting the center of the field in focus, sacrificing a bit on the periphery if necessary. This is especially important in Fields 1M and 2.

When the photographer moves to Field 2, having just taken Field 1M, **he/she should refocus on retinal vessels near the center of the field.** *Failure to do so results in images that show the foveal area to be slightly out of focus while the periphery is in focus.*

A common problem is focusing below the surface of the retina. Images that include the optic nerve (Fields 1M and often Field 2) sometimes show clear focus on the bottom of the cup, while the retina is slightly out of focus. Some photographers use the lamina cribrosa (at the bottom of the cup), the disc margin, or the granular pattern of the pigment epithelium for focusing. Instead, it is preferable to focus on fine retinal vessels. Since the depth of focus is greater posterior to the plane of absolute focus than anterior to it, it makes sense to err on the side of focusing slightly above the retina rather than too deep. This should keep both the anterior surface of the retina and the pigment epithelial background in focus. Such a strategy is of special importance when macular edema is present.

1.5. Stereoscopic Effect

Dilation of the pupil to at least 6mm is important to permit good quality stereo photography. If the pupils cannot be dilated to at least 4mm for the screening visit, the subject should not be entered into the study.

The technique described by Allen¹ is used for taking non-simultaneous stereo fundus images. The camera **should not be rotated or pivoted**; instead, it should be moved laterally from left to right with the joystick (or by sliding the camera base on its table, if preferred). About 2mm is the minimum separation between members of the stereo pair to be aimed for when moving the joystick or sliding the camera.

Stereo pairs should be taken shooting the left member of the pair first, followed by the right member of the pair. When obtaining stereo pairs, care should be taken that at least one member of the pair is of good technical quality with crisp focus. In many cases, it will be possible to obtain good quality in both members of the pair, but if this is not the case, *the aim should be to obtain good quality in one member and **some** stereo separation between the members, accepting **somewhat** poorer quality in the second member of the pair, if necessary.*

¹ Allen L. Ocular fundus photography. *Am J Ophthalmol* 1964; 57:13-28.

1.6. Exposure, Gain and Flash

It is important that photographers use flash, gain, and gamma changes to obtain optimal exposure, as well as to avoid severe over or under exposure to avoid loss of image detail. We recommend that photographers become familiar with using the camera and software controls available to ensure optimal exposure and good color balance. The FPRC Imaging staff is available to assist in recommending acceptable settings.

Most digital systems have a wide variety of image enhancement tools to adjust image contrast, brightness or sharpness after image capture. Enhancement tools should not be used at the clinical site to adjust image quality. Pay careful attention to obtaining optimum exposure and image sharpness so that enhancements are not necessary. For more information on color balance for retinal images, read the Color Balance Paper at our website <http://eyephoto.opth.wisc.edu/Photographers.html>.