University of Wisconsin
SCHOOL OF MEDICINE
AND PUBLIC HEALTH

Fundus Photograph Reading Center

Slit Lamp Digital Color Photography (SL-D)

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1. SL-D Overview

This document details the Fundus Photograph Reading Center (FPRC) procedure for photographer certification, provides instruction for digital slit lamp (SL-D) imaging and lists pointers on imaging technique.

Digital systems must be certified for each study separately. See the *Digital System Certification* document for further details.

Further clarification regarding any information included in this document may be obtained by contacting the FPRC Imaging staff at (608) 410-0619 or by sending an email to Imaging_administrators@rc.ophth.wisc.edu.

2. Photographer Certification

2.1. Overview

Photographer certification is specific to each study and photographers taking digital images for studies evaluated by the FPRC must be certified for the relevant procedure(s) before submitting actual subject images. The certification images should be taken on subjects being photographed for clinical purposes. Once a photographer is certified for a specific study, he/she is certified for the duration of that study, provided he/she meets the quality standards set by the FPRC. See section *8 Evaluation of Image Quality*.

2.2. Certification Requirements

Certification consists of:

- Review of the study synopsis/protocol and imaging procedure(s)
- The ability to perform the imaging procedure(s), demonstrated by the submission of images of acceptable quality

2.2.1. Images Required if Previously Certified

The second certification requirement listed above will be waived if all of the following criteria are met:

- The photographer has prior certification at the FPRC using **an identical procedure.**
- The photographer has been actively taking images during the past 12 months.
- The images are judged to be of good quality by the FPRC.

If a photographer thinks these criteria have been met or that he/she has been certified by the FPRC for a similar procedure, submit a certification request (see section *2.3 Submission for Certification*) without sending images.

2.2.2. Images Required if Not Previously Certified

Submit a certification request (see section *2.3 Submission for Certification*) and send color images of four eyes (two right eyes and two left eyes) taken using this procedure (SL-D).

2.3. Submission for Certification

Photographers are encouraged to send complete submissions for each procedure for which they are requesting certification (i.e., if four eyes are required for a certification submission, send image submissions for all four eyes together).

Photographers who meet certification criteria will receive confirmation of certification. Those who do not meet these criteria will receive feedback from the FPRC Imaging consultants and may be required to submit additional sets of images. A plan for improving image quality may be necessary after three complete and unsuccessful certification submissions.

2.4. Uncertified Photographers

2.4.1. Baseline/Screening Visits

Only FPRC-certified photographers are allowed to take baseline (screening visit) photos, unless an exception to this rule is granted (on a case-by-case basis) by the study sponsor. The baseline images for a subject are critical since all follow-up measurements are compared to this point to determine the study outcome.

The sponsor may suspend subject enrollment if the site does not have a certified photographer available to take the baseline images.

2.4.2. Follow-up Visits

On rare occasions during **follow-up** visits ONLY, when a certified photographer is not available, an uncertified photographer familiar with the procedure(s) may take the images. The uncertified photographer should review the imaging procedure(s) before performing photography to be certain he/she understands the procedure and follows the study requirements. Include a comment with the submission or any official documentation indicating that the images were taken by an uncertified photographer and the reason why.

3. Slit Lamp Imaging Equipment

Photo slit lamps manufactured by Topcon, Zeiss, Kowa, Nikon or Haag Streit, generally using 10X magnification will be acceptable for this study. Photo slit lamps other than these may be suitable but will be evaluated on a case-by-case basis. Contact the FPRC if you have questions about the camera you intend to use.

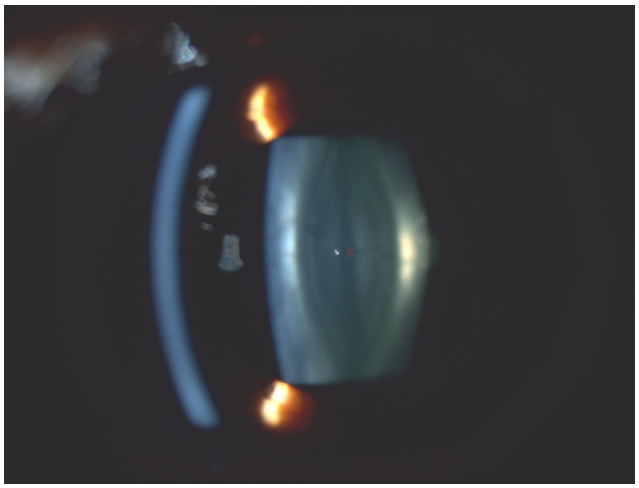
4. Slit Lamp Images Taken Digitally

The SL-D procedure is designed to provide good views of the nucleus of the phakic crystalline lens. In the normal, non-sclerotic lens, the nucleus consists of a central dark section (sulcus), adjacent bean-shaped brighter areas (lentils), one anterior and one posterior to the sulcus, and brighter curved bands (lamellae or nuclear surface bands).

Three slit lamp photographs should be taken of each phakic lens at specified visits following the procedure described below. We ask for three images because obtaining proper focus in the sulcus of the lens can be challenging, and small movements of the eye can result in loss of central lens detail.

We recommend that the slit lamp be positioned carefully, focusing in the sulcus for the first image. The second image is taken focusing the camera on the anterior nuclear surface, and the third image is taken with the plane of focus slightly behind the sulcus near the posterior surface of the nucleus.

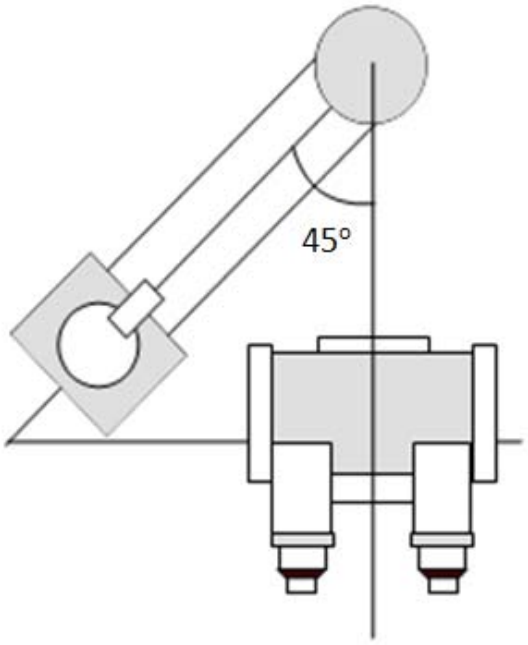
The presence or absence of specific lens changes will be determined based on the grading of the photographs. No part of the lens images should be lost because of interference from lids or lashes.



Example of acceptable slit lamp image

5. Slit Lamp Camera Set-up

The slit beam width is set at 0.3mm, and the full height is used. The beam width may vary by instrument to provide the narrowest slit possible with good illumination of the lens section in the resulting images. The binocular assembly with the magnification changer is placed perpendicular to the cross-slide base. The slit beam projector is placed at an angle of 45 degrees to the optical axis and remains always at the photographer's left for images of both eyes. The magnification changer is placed at 10X magnification or the closest magnification available, and the fill-in illuminator is turned off. The flash power is selected for best exposure of the lens cross section.



Slit Lamp Camera Set-up

The slit lamp microscope consists of a binocular magnification changer typically located behind a single objective lens. Patient fixation placement will vary for each eye. When photographing the right eye, the subject should fixate on a point between the microscope binocular lenses (coincident with the center of the single objective lens). When photographing the left eye, the subject should fixate on a point centered on the left microscope binocular lens (the slit lamp lens of the operator's left eye).

The digital sensor should be placed so it records the image through the right ocular, if possible. The eyepiece with the cross hairs (reticule) should also be placed on the ocular that corresponds with the imaging device view. This will help ensure that the fixation points described will result in the correct patient's gaze.

6. Slit Lamp Photo Technique

The beam should enter either eye from the photographer's left. The slit beam should enter the pupil from approximately 11-12 o'clock to 6-7 o'clock to illuminate the entire lens visible through the dilated pupil. The beam is placed so that the center of the lens is well illuminated. The primary plane of focus will be in the sulcus with the anterior and posterior sutures at equal degrees of focus.

The slit lamp photos should be labeled for each eye—*RE* for the right eye and *LE* for the left eye.

7. Format for Study Images Submitted to the FPRC

Images should be saved using no compression or lossless compression (PNG). For additional information on specific image-handling procedures, see the *Digital System Certification* document.

8. Evaluation of Image Quality

8.1. At the Study Site

The slit lamp photos should be evaluated for quality by the principal investigator and/or photographer (unless prohibited by study protocol) before submission to the FPRC. If quality is not adequate for assessment of key features of the lens (such as extent of opacification) and if no irremediable cause of inadequate quality is present (such as a pupil that will not dilate adequately), the slit lamp photos should be retaken before submission to the FPRC.

8.2. At the FPRC

Slit lamp photos are reviewed and assigned a grade for overall quality. Feedback will be provided to the photographers as needed to help with resolution of any problems. Special attention will be given to photographers having difficulty meeting study photo quality standards. If a certified photographer consistently fails to meet study standards, certification may be suspended.

9. Pointers on Imaging Technique

9.1. General

The most commonly seen problems in slit lamp photos are poor focus, poor beam placement, under-illumination and incorrect beam width. Focus is important for visibility of differences in the opacity of the sulcus and lentils. Poor focus will give an overall hazy affect and blur these lens elements.

Beam placement is important so the center of the lens is photographed. If the beam is too nasal or temporal, the central portion of the lens cannot be evaluated consistently.

Good illumination will allow each structure to be clearly seen. When the photo is too bright or dark there is a loss of detail in fine structures.

Beam width is a balance between the finest beam that shows good structural detail and wide enough for good exposure—but not so wide that lens elements seem to blend together.

9.2. 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 frequently to help keep the cornea clear.

9.3. Photo Sequence

The slit lamp photos should be taken of the right eye first then the left eye, if both eyes are phakic. Otherwise only the phakic eye will be photographed.

9.4. Focus/Clarity

The best image quality is obtained if corneas are not disturbed by prior examination with a diagnostic contact lens.

9.5. Exposure, Gain, and Flash

It is important that photographer adjusts flash, gain, and gamma to obtain optimal exposure, as well as avoiding severe over- or under-exposure. One of the most prevalent problems in the slit lamp photos is under-exposure. Digital camera backs are capable of good quality photos even when using high ISO settings. Generally an ISO of 800 to 1200 should be used for slit lamp photos since these settings will give good exposure with the narrow beam used in this procedure.

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 enhancements are not necessary.

10.References

Age Related Eye Diseases Research Group, Manual of Operations. Chapter 8. Potomac, MD:AREDS Coordinating Center, EMMES Corporation, 11325 Seven Locks Road, Suite 214, Potomac, MD 20854.