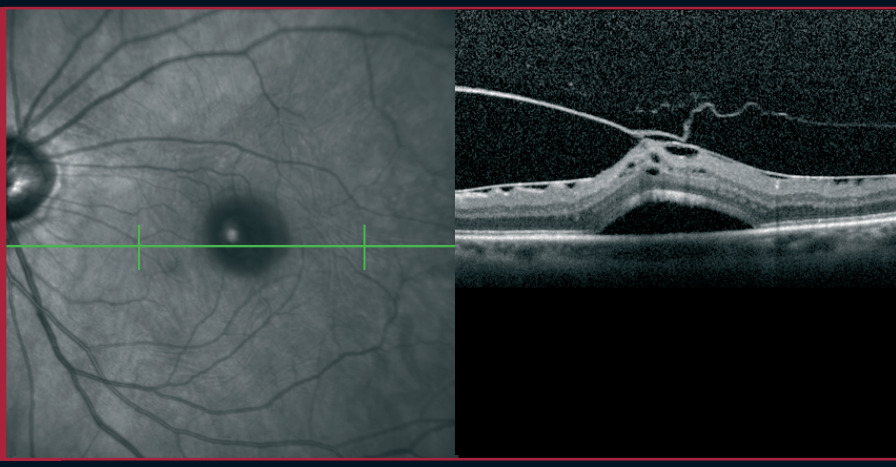
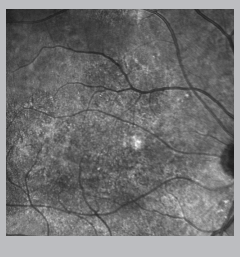
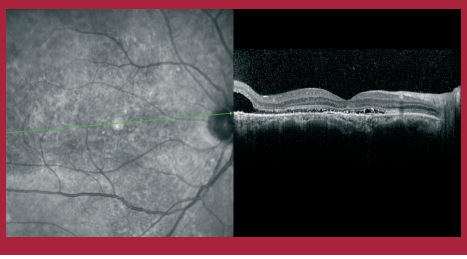
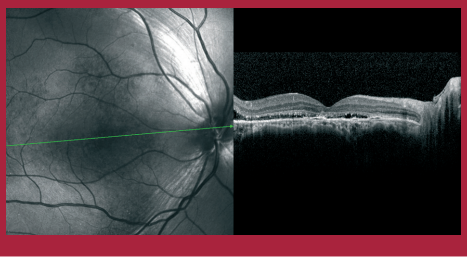
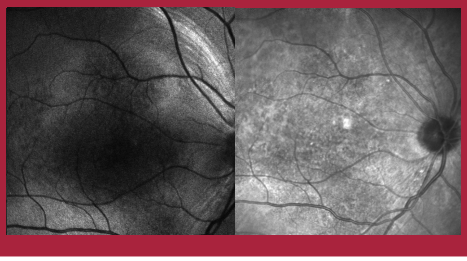
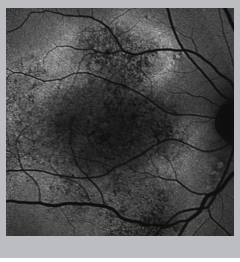
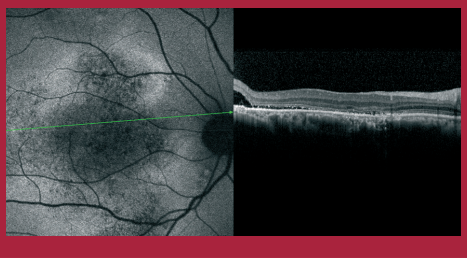
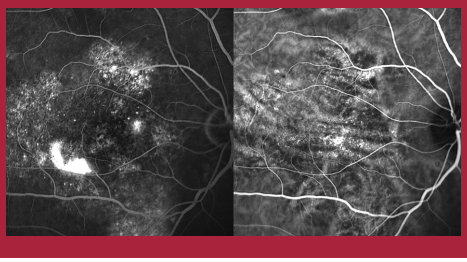
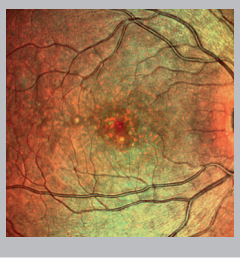
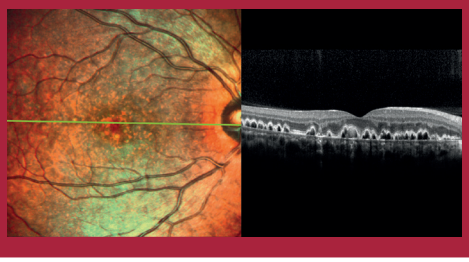
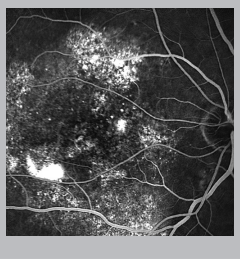
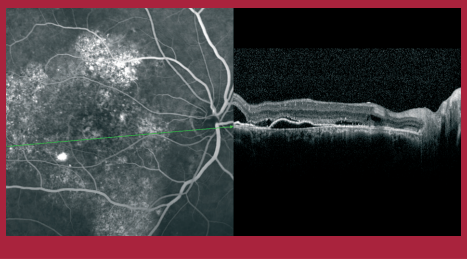
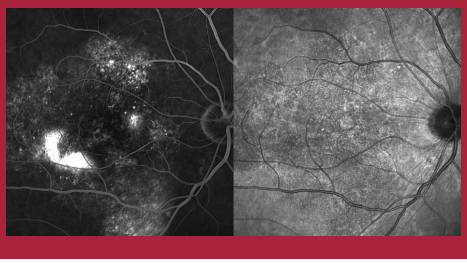
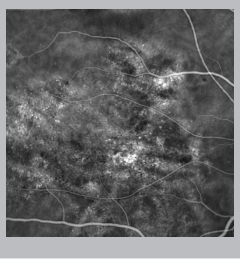
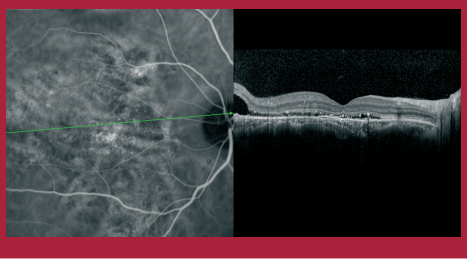
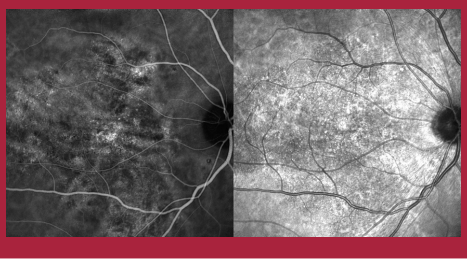
How to Acquire the Perfect Image

HRA+OCT SPECTRALIS

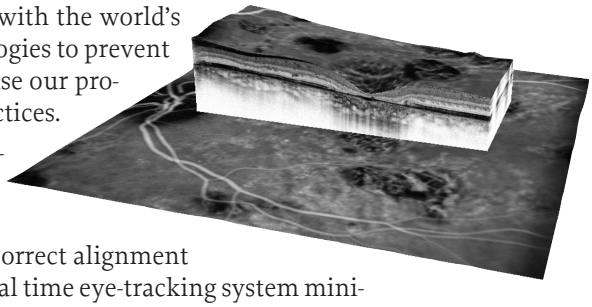


HEIDELBERG ENGINEERING ACADEMY

SPECTRALIS Acquisition Modes

Single Modes	Combined Modes	
IR 	IR+ OCT 	
BR	BR+OCT 	BR+IR 
BAF 	BAF+OCT 	FA+ICGA 
MultiColor 	MultiColor+OCT 	
FA 	FA+OCT 	FA+IR 
ICGA 	ICGA+OCT 	ICGA+IR 

The Technology of Fusion



Heidelberg Engineering has spent many years working closely with the world's leading doctors and imaging specialists developing new technologies to prevent sight loss. Most major research centers and teaching hospitals use our products, as well as a large number of general clinics and private practices.

The Heidelberg SPECTRALIS HRA+OCT provides a unique combination of retinal angiography and optical coherence tomography.

The ability of the SPECTRALIS HRA+OCT to automatically maintain the OCT scan at the selected location guarantees the correct alignment between OCT scan and its position on the fundus. The built in real time eye-tracking system minimizes the influence of eye-movement artifacts and allows highly reproducible follow up examinations. Because of TruTrack alignment technology, the instrument has a high degree of reproducibility, as low as 1 micron[1].

Simultaneous digital Fluorescein angiography (FA) and Indocyanine green angiography (ICGA) images improve the diagnosis of retinal and choroidal pathologies such as diabetic retinopathy and AMD. High Speed ICG imaging can identify feeder vessels and retinal choroidal anastomoses for more effective treatment of CNV.

BluePeak blue laser autofluorescence imaging and fundus reflectance imaging with infrared and blue reflectance light contain additional information for identifying various manifestations of retinal disease. SPECTRALIS HRA+OCT enables accurate diagnosis and monitoring of patients. The low light levels used in the SPECTRALIS scanning laser and OCT technology result in examinations which are comfortable and safe for patients.

By offering you this guide on "How to acquire the perfect image", we hope to give you an easy start with the SPECTRALIS HRA+OCT.

[1]Wolf-Schnurrbusch UE et al. Macular Thickness Measurements in Healthy Eyes Using Six Different Optical Coherence Tomography Instruments. Invest Ophthalmol Vis Sci. 2009;50:3432-3437.

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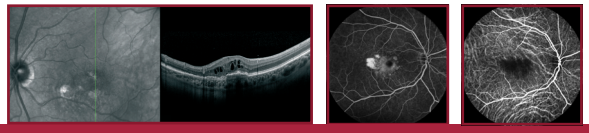
Acquisition Protocol
SPECTRALIS HRA+OCT



General Workflow

- ✓ Create „New Patient“ database entry or choose existing patient for re-examination.
- ✓ Move the camera to the farthest back position.
- ✓ Clean camera chinrest and forehead rest - preferably when patient can see you doing so.
- ✓ Check that lens is clean
- ✓ Adjust table height and chinrest for the patient.
- ✓ Turn camera on.
- ✓ Select acqusition mode using the filter wheel (R=Reflectance modes, A=Angiography modes, P=Polarization mode) on the touch panel.
- ✓ Ask patient to place the chin on the chinrest and to lean the forehead against the forehead rest.
- ✓ Make sure red line on chinrest pole is at canthus level.
- ✓ Align camera with pupil and move camera forward.
- ✓ Acquire images.
- ✓ Move camera backwards and then over to the fellow eye.
- ✓ Acquire images of the fellow eye.
- ✓ Exit acquisition window. Images are automatically saved.
- ✓ Select and delete any low quality or duplicate images.

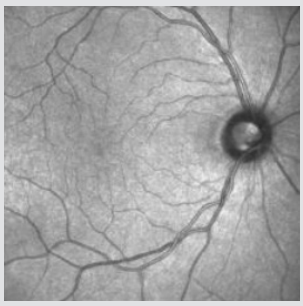
Specific Acquisition Modes

1. Infrared reflectance (IR)

The first acquisition is usually done in IR mode. These images are taken before ICGA or FA image capture. As with all images, aim for even illumination, minimal artifacts and centering of the macula, unless otherwise indicated. In the case of IR, it is possible to have too much illumination. Overexposed images are a sign of excessive light. In this case reduce the IR laser intensity on the touch panel as needed. Slight overexposure can be reduced by turning the ART / Sensitivity knob (Fig. 4).

IR

Fig.1: Overexposed image



IR

Fig. 2: Improved image quality

Note: In case of overexposure first reduce the laser intensitiy, then reduce the sensitivity!

Fig. 3: IR intensity at 25 % at touch panel

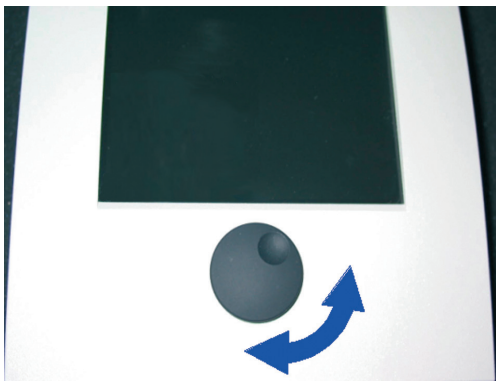


Fig. 4: ART / Sensitivity-knob

2. Blue reflectance (BR)

Blue reflectance images are taken as a control image set before FA and ICGA. BR acquisition mode is activated by moving the filter wheel from position „A“ to position „R“. In order to minimize the amount of visible light exposure to the patient's eye, set the image in IR mode and then switch to BR for acquisition. For a high quality Blue reflectance image, the sensitivity should be subsequently increased and the focus adjusted, so that the focus of the IR image varies by approx. -0.5 D.

BR

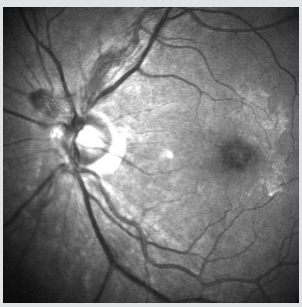


Fig. 5

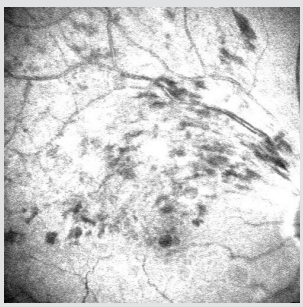


Fig. 6

3. BluePeak blue laser autofluorescence (BAF)

The high quality of SPECTRALIS HRA+OCT BluePeak blue laser autofluorescence imaging offers information beyond conventional fundus images or Fluorescein angiography. BAF is used for a variety of purposes, from outlining optic nerve head drusen (previously the standard use of BAF in fundus cameras), to studying various manifestations of the age-related macular diseases and hereditary retinal disorders without the injection of fluorescein dye.

Align the camera as outlined above, using the IR acquisition mode. Once you see a sharp, well-focused image, change to the BAF illumination. Adjust the focus as recommended for BR-imaging. The image will now be considerably darker, however, increasing sensitivity will outline the retinal blood vessels (Fig. 7, 8).

Quick Tips: BAF

- ✓ Increase sensitivity until retinal vessels are seen.
- ✓ Activate the ART Mean function and acquire the image.
- ✓ Dilating the pupils can increase image quality.
- ✓ Images must be aquired before starting FA.

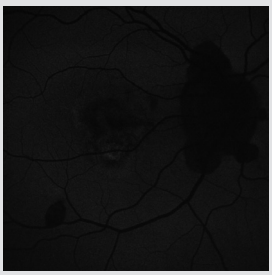


Fig. 7

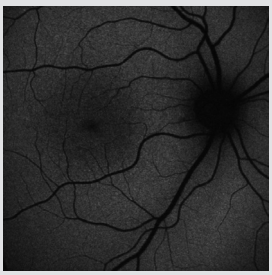


Fig. 8

BAF

To receive a BAF image with good quality, at least 6-24 single scans must be acquired and averaged. The following methods are available:

1. **Recommended method: By pressing the ART / Sensitivity knob on the Touch Panel you can activate the ART (Automatic Real Time) Mean function to generate a live Mean BluePeak blue laser autofluorescence image online and view it as it is created.**
2. Multiple single images
3. Short movie

Following the acquisition, methods 2 and 3 only, use the „Compute Mean" function in the HEYEX (Fig. 9). Compute mean images for all the BAF images you have taken (Fig. 10, 11), before proceeding with the FA.

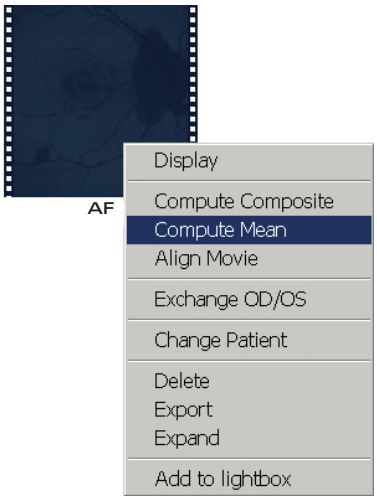


Fig. 9: „Compute Mean" function

Fig. 10

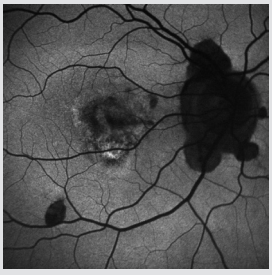


Fig. 11

BAF (Mean)

Note: After the injection of fluorescein dye, it will be impossible to perform BAF imaging.

When using method 2 or 3, evaluate the resultant mean images, and if necessary, repeat. Small eye movements, which were potentially invisible during acquisition may lead to unclean image calculation. When eye movements result in poor mean images, it is possible to either use the „Compute Composite" mode (Fig. 13), to delete the images from within the mean series showing eye movement then recalculate the mean. You may also re-acquire the series.

BAF (Mean)

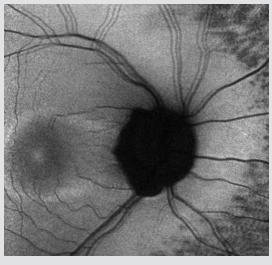


Fig. 12

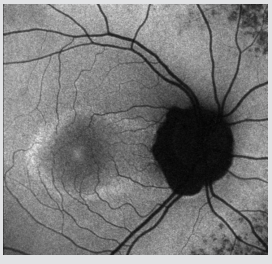


Fig. 13

BAF (Composite)

4. MultiColor

The MultiColor acquisition consists of three simultaneously acquired, color-selective laser images. The individual laser colors highlight the structural details of various retinal layers (Fig. 14-17).

MultiColor images deliver sharp and detailed fundus images even under difficult circumstances, such as patient's suffering from cataract and nystagmus.

Quick Tips: MultiColor

- ✓ Position filter wheel to „R".
- ✓ Adjust the focus in BR mode until small retinal blood vessels are clearly visible.
- ✓ Activate the ART Mean function and acquire image.
- ✓ Dilation may improve image quality..

MC

Fig. 14: MultiColor image

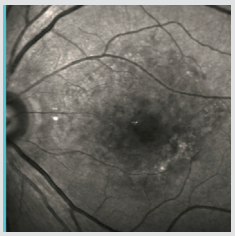


Fig. 15: Blue reflectance

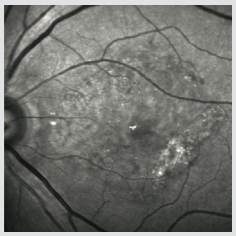


Fig. 16: Green reflectance

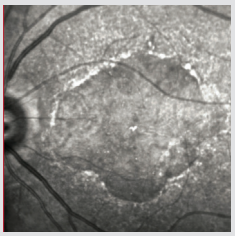


Fig. 17: Infrared-reflectance

Checkbox for perfect MultiColor Images

- ✓ To prepare MultiColor acquisition, turn SPECTRALIS HRA + OCT filter wheel to position „R".
- ✓ To avoid disturbing the patient's eyes, illuminate and focus the fundus in IR mode correctly.
- ✓ To acquire an image of the macular area, optimize the focus by looking at small blood vessels while in BR mode.
- ✓ Select the function „More" on the touch panel. To start MultiColor acquisition mode, select „MColor" (Fig.18).
- ✓ Always activate the ART Mean function during MultiColor acquisition.

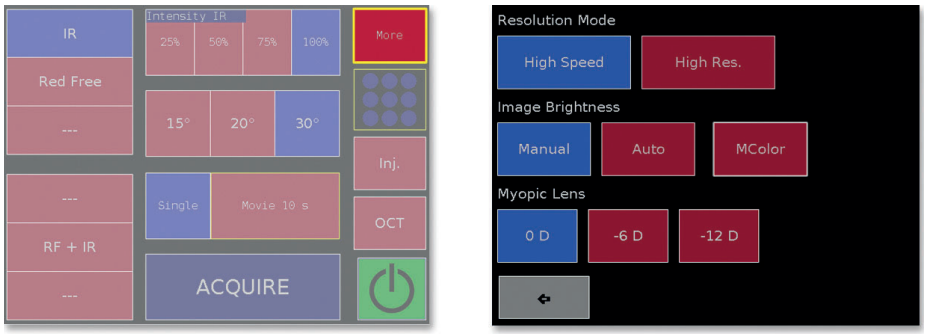


Fig. 18: Activation of the MultiColor acquisition mode

Note:
Varying the image focus changes the depth scanning information in the MultiColor image.
Focus in BR-mode: image is focused on inner retinal layer, retinal nerve fibre layer, internal limiting membrane, retinal blood vessels.
Focus in IR-mode: image is focused on outer retinal layer, retinal pigment epithelium, choroid.

Avoiding image artifacts

- ✓ The most common cause of image artifacts is a weak or an unevenly illuminated image during acquisition (Fig. 19).
- ✓ An incorrectly focused MultiColor image also leads to appearance reflection at artifacts in image acquisition (Fig. 20).
- ✓ Do not perform any examinations that disturb the tear film before MultiColor acquisition; use artificial tears in patients with dry eyes (Fig. 21).

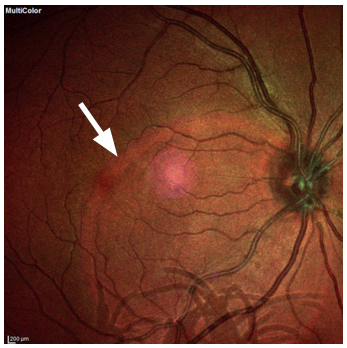


Fig. 19: Artifact due to poor image illumination

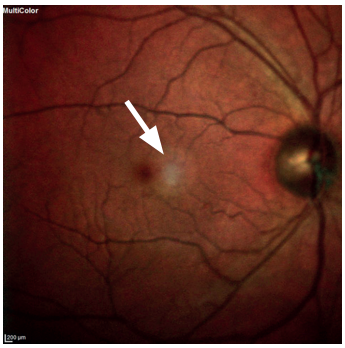


Fig. 20: Artifact due to poor focus

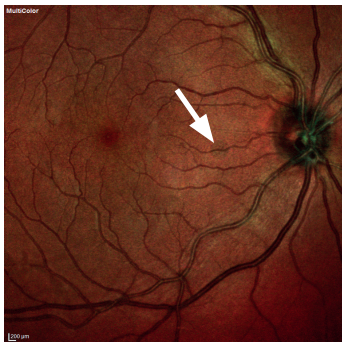


Fig. 21: Artifact due to dry eyes

Note:
- MultiColor images are not fundus photos and can vary from clinical view.
- MultiColor images can only be acquired in High Speed mode (HS).
- Stereo images cannot be acquired in MultiColor acquisition mode.

5. Fluorescein angiography (FA)

FA images are taken after the fluorescein dye has been injected. The location of the vein (arm / hand) usually has bearing on the time it takes the dye to reach the eye. While taking images of the early stages it is important to adjust the brightness of the images as necessary by turning the ART / Sensitivity knob (Fig. 22-24).

Quick Tips: FA

- ✓ During the early stage pay special attention to the brightness adjustment.
- ✓ Acquire movies of early stages, then delete if not needed.
- ✓ Use ART Mean function for late / dark images.

FA

18 seconds

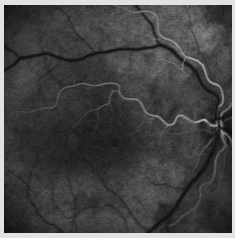


Fig. 22

20 seconds

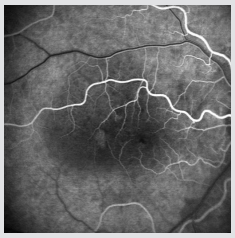


Fig. 23

25 seconds

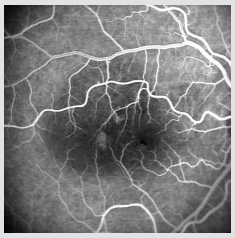


Fig. 24

Taking FA photos is essentially not much different from recording non-angiography images. Knowledge and understanding of the pathology to be documented are essential for the area to be documented and the correct level of illumination to be used.

In cases where the angiography images are too dark, e.g. extremely narrow pupils, or in some late stages where there is a very low level of fluorescence, the use of the ART Mean function will allow you to generate excellent images.

The following (Fig. 25-29) is a general flow-chart for the acquisition of FA images. Actual time intervals vary depending on pathology. This does not include peripheral images which demand more time. It is possible to withhold a small amount of the dye at the initial stage and inject it when you are ready to document the periphery, which will result in higher quality images. The earliest images are taken either as a movie or in rapid succession, one every 1-4 seconds, during the dye-arrival stages, until the veins are full.

FA

20 seconds	1 minute	3 minutes	4 minutes	8 minutes

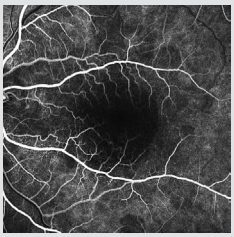
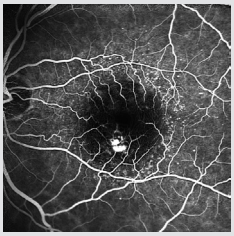

	

Fig. 25	Fig. 26	Fig. 27	Fig. 28	Fig. 29

Angiograms can unsually be recorded up to 12-15 minutes with fundus cameras, but the SPECTRALIS HRA+OCT can also record excellent images at much later stages. Currently there are only few diagnosis that require very late images, after 20-30 minutes, such as in cases of suspected optic nerve head edema or suspected tumors.

Stereo images can be taken during fluorescein angiography. They are most instructive in cases of e. g. edema, ICCS, PED.

6. Indocyanine green angiography (ICGA)

Acquiring ICG angiography images is similar to fluorescein angiography technique.

Note: Acquisition of the early and late ICGA images might require special attention.

During the early stages of the dye arrival in ICGA, the images tend to be extremly bright, unless the illumination is reduced accordingly. In the case of ICGA, it is strongly recommended that the laser intensitiy is reduced to 25 % (Fig. 30) before the dye is injected. Remember to return the intensity to 100 % after 2-3- minutes.

Quick Tips: ICGA

- ✓ During the early stage pay special attention to the brightness adjustment.
- ✓ Acquire movies of early stages, then delete if not needed
- ✓ Reduce laser intensity to 25-50% to acquire the early stages and return it to 100 % after ca. 2-3- minutes.
- ✓ Use ART Mean function for late / dark images.

As in FA, the early stages of the dye arrival are both crucial and difficult to acquire. There are many applications, where a movie of the early stage is used as standard application. This demands a close attention to the illumination aspects of the image. There are many protocols for acquiring the ICGA images all according to the instistution and the diagnosis. The following is a rough guide, but it is always best to review the patient chart and ask for guidance when in doubt.

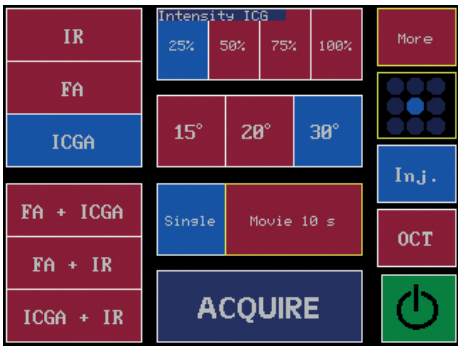


Fig. 30: ICG intensitiy reduced to 25 %

ICGA

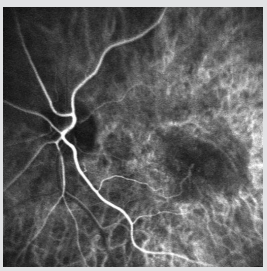


Fig. 31

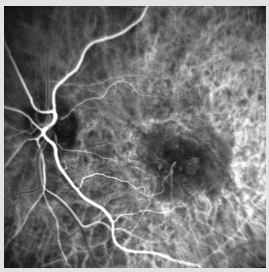


Fig. 32

Movie mode allows obtaining earliest possible angiography images.

3-5 minutes

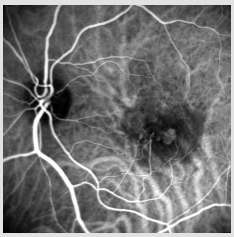


Fig. 33

7-10 minutes

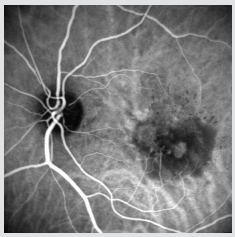


Fig. 34

14-17 minutes

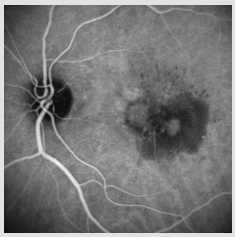


Fig. 35

20-22 minutes

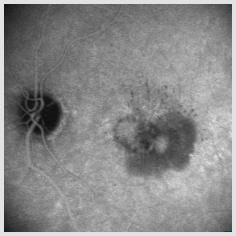


Fig. 36

25-plus minutes

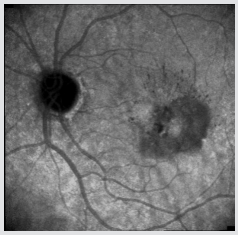


Fig. 37

ICGA

In case where the late stage images seem to be dark or lacking in information, use the ART Mean function (see chapter Mean Images). Stereo images may be acquired at any stage (see chapter Stereo Imaging).

7. Optical Coherence Tomography (OCT)

An OCT scan with SPECTRALIS HRA+OCT is always combined with a reflectance or angiography image. The following modes are available in combination with OCT:

	IR	BAF	BR	MColor	FA	ICGA	MEAN	Movie	Stereo	Tomo	Comp	WFO	UWF
OCT	✔	✔	✔	✔	✔	✔	✔	✘	✘	✘	✘	✘	✘

WFO = Wide Filed Lens / UWF = Ultra-Widefield Angiography Module

Checkbox for perfect OCT images

- ✓ Keep the patient's forehead leaned against the forehead support.
- ✓ Patient should blink regularly, since maintaining a good tear film is important for OCT image quality. In cases where the patient suffers from dry eye, or when the cornea cannot be kept moist enough by blinking alone, artificial tears may be administered.
- ✓ Try to maintain an evenly-illuminated, well-focused fundus image, as well as a high-quality OCT scan. Sometimes the fundus image quality needs to be compromised to some extend, if it provides a better OCT scan.
- ✓ OCT image shows maximum contrast and quality if placed in the Sweet Spot (Fig. 38-40).
- ✓ Select the scan pattern and place it at the desired position.
- ✓ Always activate ART Mean function when performing an OCT scan.

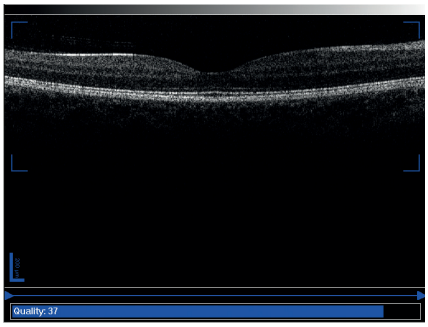


Fig. 38: OCT scan within the Sweet Spot

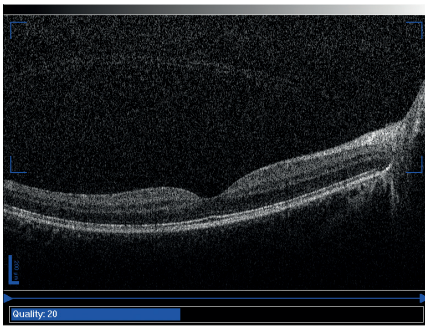


Fig. 39: OCT scan below the Sweet Spot - camera too far away from the patient's eye

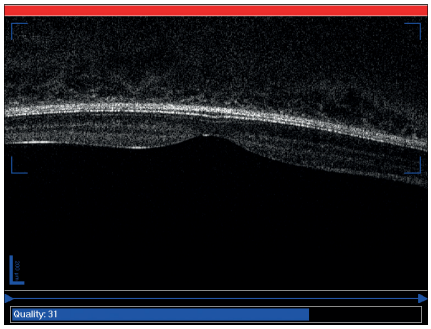


Fig. 40: OCT scan upside down - camera too close to the patient's eye

Note: The larger the volume scan and the higher the densitiy of the scan, the more time it takes to scan. Adjusting the size of the volume scan to the circumference of the pathology saves time and data storage. For a higher resolution with more details, such as macular pathologies, the volume scan should be reduced to the size of the pathology and the density increased in order to obtain the maximum amount of information over a short scan period.

Note: Depending on the resolution mode (High Resolution oder High Speed) the streching in y-direction ranges from ~1.5 to ~ 3.0 times the original size.

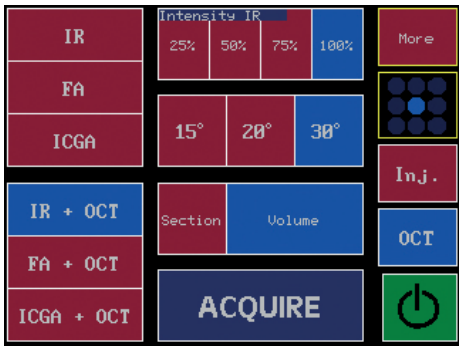


Fig. 41: Touch panel enabled OCT volume scan

Tips und tricks for acquisition of myopic eyes

- In cases of myopic, long eyes, or deep set eyes, a good fundus image might be visible, but no OCT scan appears in the OCT acquisition window. This can be compensated by using the corresponding eye-length button in the acquisition window.
- If the OCT scan is tilted, move the joystick slightly left / right (horizontal scan) or up / down (vertical scan).
- Reducing the scan-length helps to avoid imaging the tilted or curved parts of the scan.
- Patients with more than -12 D should wear contact lenses during the examination.

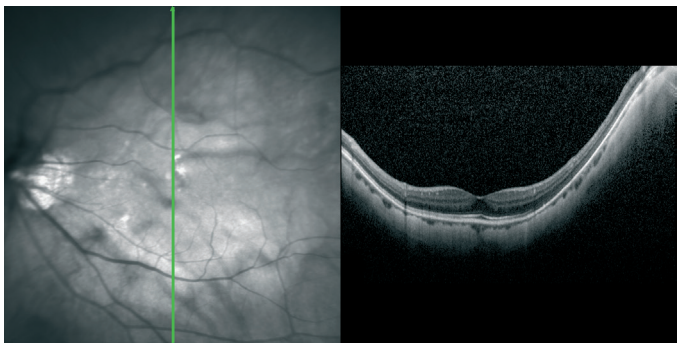


Fig. 42: Curved OCT scan as result of high myopia

Note: Myopic Lens function is not available for OCT imaging. It is especially important for eyes with more than -12 D myopia to use contact lenses (see chapter High Myopia Compensation).

Tips und tricks for acquisition of astigmatism eyes

- In astigmatic eyes often good scans can only be achieved by turning the scan at a particular angle.
- In these cases change the angle of the scans into the optimal direction.

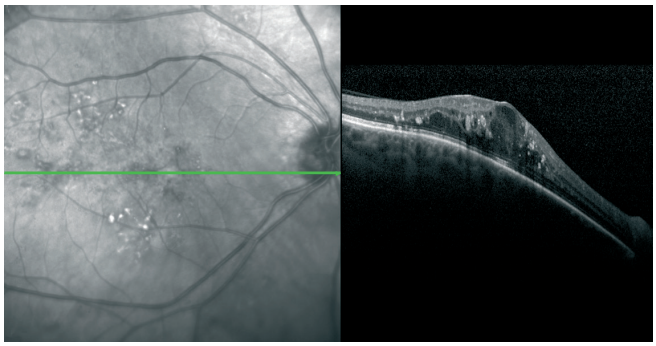


Fig. 43: Tilted OCT scan as a result of high astigmatism

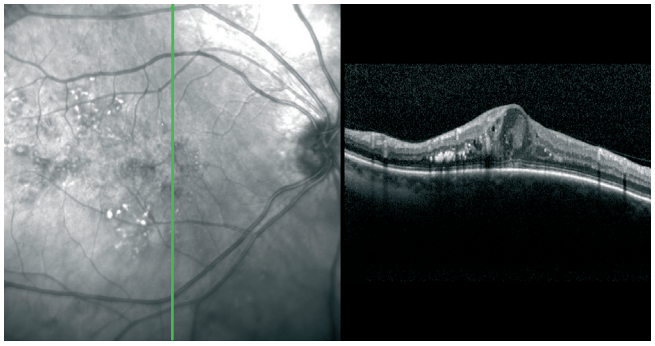


Fig. 44: Straight OCT scan by changing scan direction

Enhanced Depth Imaging (EDI) - OCT

EDI is an imaging module which allows deeper lying structures to be displayed more clearly in the OCT scan.
The contrast of the follwing structures is optimized with EDI-OCT: outer retinal layers, choroid, lamina cribrosa.
EDI is available for all scan pattern.

Checkbox for perfect EDI-OCT images

- ✓ Keep the patient's forehead leaned against the forehead support.
- ✓ Patient should blink regularly, since maintaining a good tear film is important for OCT image quality. In cases where the patient suffers from dry eye, or when the cornea cannot be kept moist enough by blinking alone, artificial tears may be administered.
- ✓ Try to maintain an evenly-illuminated, well-focused fundus image, as well as a high-quality OCT scan. Sometimes the fundus image quality needs to be compromised to some extend, if it provides a better OCT scan.
- ✓ OCT image shows maximum contrast and quality if placed in the Sweet Spot (Fig. 45).
- ✓ Select the scan pattern and place at the desired position.
- ✓ Always activate ART Mean function when performing an OCT scan.

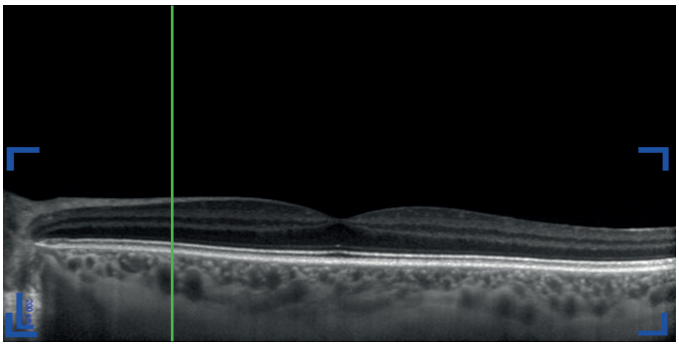


Fig. 45: EDI-OCT image

OCT Follow-Up Examination

OCT images can be repeated on exactly the same location of the fundus via the AutoRescan™ function. To do a follow up examination, an OCT thumbnail must be right clicked with the mouse and „Progression“ and “Set Reference“ must be selected to define the image as baseline image. To place the scan new on the same position of the fundus, the scan must be selected via „Follow-Up“ button in the acquisition window. Follow-up examinations can be executed on various devices in different modes. All OCT scan pattern can be specified as a reference for follow- up examinations. It is possible to combine all OCT acquisition modes as an automatically aligned base and follow up examination for software versions 5.1 and up, such as FA + OCT or a BAF + OCT defined as a baseline examination and the follow-up exam executed in IR + OCT mode.

Quick Tips: Follow-Up examination

- ✓ Define reference exam.
- ✓ Fundus image evenly-illuminated and focused.
- ✓ Selecting scan via „Follow-Up“-function

Checkbox for perfect Follow-Up Examinations

- ✓ The green frame on the fundus image shows the position of the patients head relative to the initial examination.
- ✓ The green frame can be adjusted by having the patient slightly moving his eyes or head.
- ✓ As soon as the reference image is selected (Fig. 39), the active eye tracking automatically starts and the tracking time begins. Due to the fact that there is a limit on how long each eye can be tracked, it is recommended that the fundus image first be evenly-illuminated and then the reference image could be selected to perform a follow up examination.

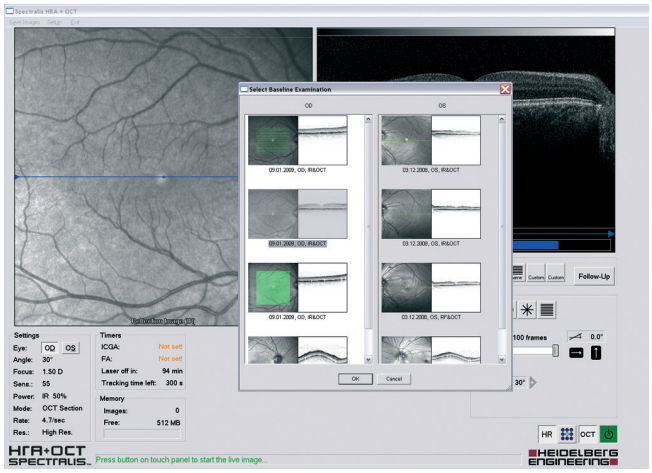


Fig. 46: Select reference image

Fig. 47: Tilted follow-up examination

Scan Planning Tool

The Scan Planning Tool allows to define locations in a cSLO image where an OCT scan should be taken at a later time and to preselect a requested fundus image mode. The selected scan location and pattern is saved to the database. Each Spectralis system can now automatically perform an OCT scan as planned in the cSLO image.

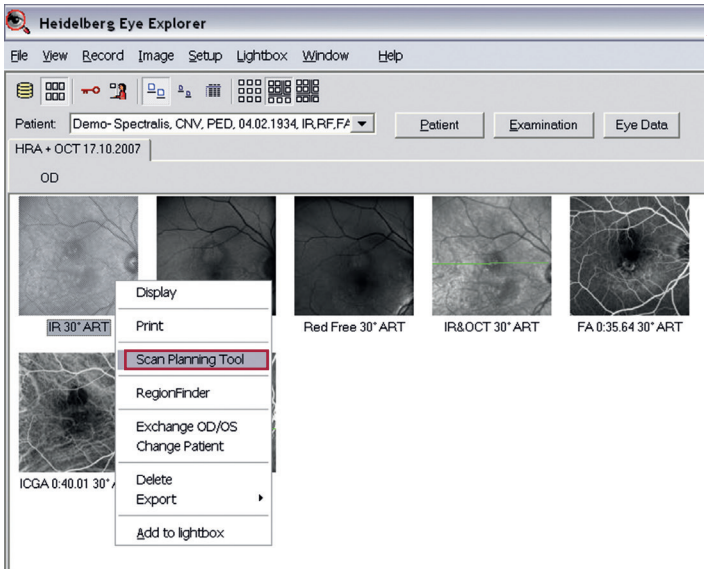


Fig. 48: Open Scan Planning Tool

Note: The software „Scan Planning Tool“ is no component of the standard delivery of the SPECTRALIS HRA+OCT and must be bought seperatly.

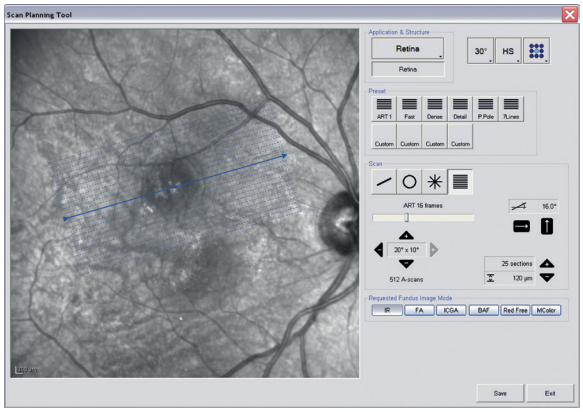


Fig. 49: Scan Planning Tool

Steps how to use the Scan Planning Tool

- ✓ Right click on the cSLO image and select Scan Planning Tool (Fig. 48).
- ✓ Plan the OCT scan and the requested Fundus Image Mode (Fig. 49).
- ✓ Save your selection.
- ✓ The planned scan pattern appears as a yellow overlay on the preview icon (Fig. 50).
- ✓ Perform the OCT scan by selecting the cSLO image from the follow-up window in acquisition mode (Fig. 51).

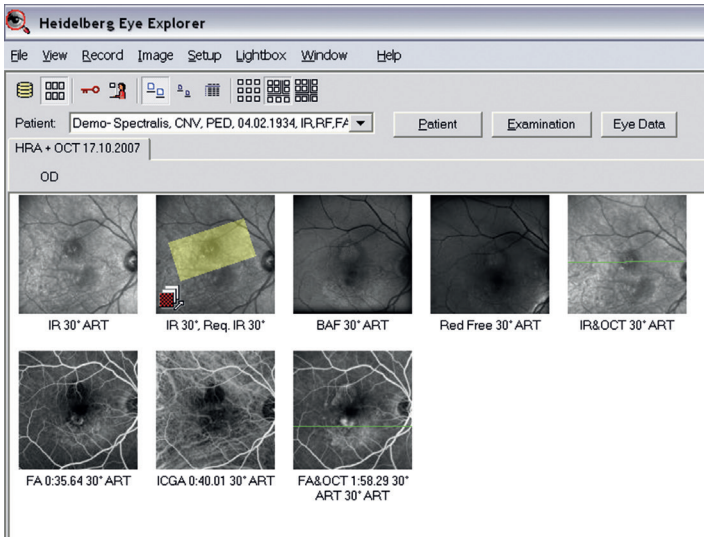


Fig. 50: Yellow scan pattern overlay on the preview icon

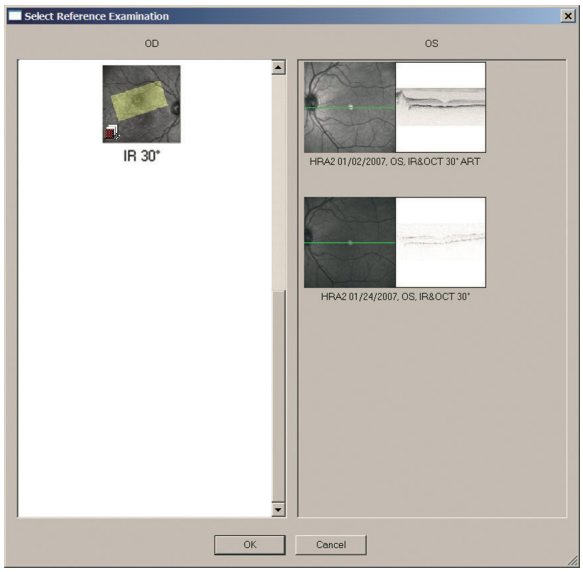


Fig. 51: Select reference examination out of follow-up window

8. High Magnification

It is possible and advisable to take high magnification images (15°) in the various acquisition modes, but they are most impressive in angiography modes. The images are particularly significant in the early stages when there is no obscuring leakage in FA (Fig. 52-54) and the contrast is highest in ICGA. High magnification is used especially in ICGA when trying to locate a feeder vessel.

Note: When selecting high magnification, use High Resolution (HR) mode.

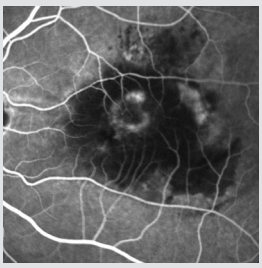


Fig. 52: 30°

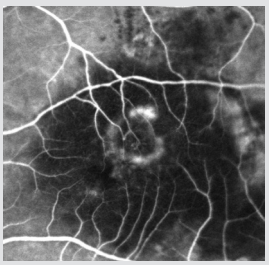


Fig. 53: 20°

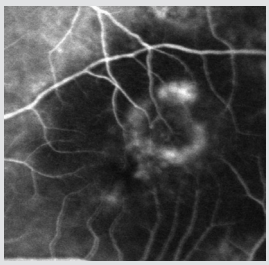


Fig. 54: 15°

9. Wide Field Images (Composite, Wide Field Lens, Ultra-Widefield Lens)

Composite Images

Composite images are made up of multiple single 30-degree images (Fig. 55-58), resulting in mosaic, large-field image of the retina (Fig. 59). Their final size depends on the total area covered by the original single images and the software's ability to automatically create the final composite. Following the acquisition of the individual images, highlight those to be included in the composite and select „Compute Composite" from the drop-down menu.

Quick Tips: Manual Composite

- ✓ Use either single images, movie option or 3x3 Composite.
- ✓ Acquire overlapping images.
- ✓ Check for double vessels in final image.

Quick Tips: Real-time Composite

- ✓ Select „Composite" on touch panel
- ✓ Use external fixation light only!
- ✓ Activate ART Mean function in the composite mode.
- ✓ Move camera head around and keep live fundus image evenly-illuminated.
- ✓ Save images with „Acquire"

FA

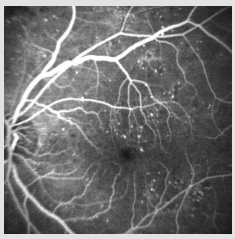


Fig. 55

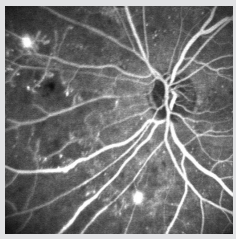


Fig. 56

FA

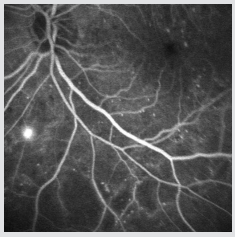
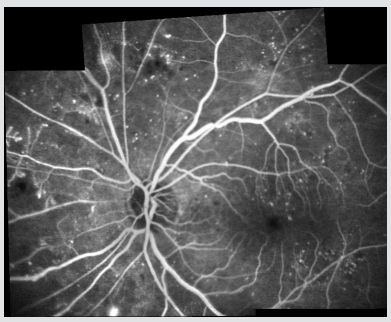


Fig. 57

Fig. 58



FA

Fig. 59

Composite images can be created through three various methods:

1. **The easiest method to create a composite image is by using the „3x3 Composite“. After selecting this function on the touch panel, images with all internal fixation points will be generated one after the other. After succesfull generation, all images are automatically combined. The outer periphery cannot be acquired with this method.**

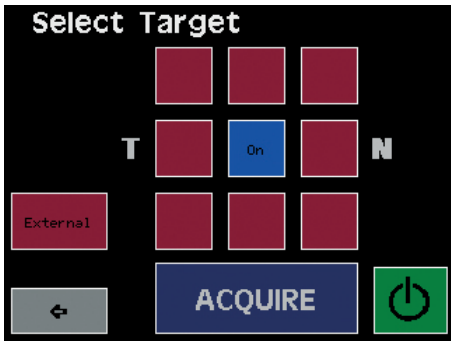


Fig. 60: Selecting fixation target

2. **The real-time composite image is started by selecting „Composite“ on the touch panel and pressing the ART / Sensitivity knob. By moving or pivoting the camera head, the composite image is created and by pressing „Acquire“ afterwards the image is saved (Fig. 61 and 62)**

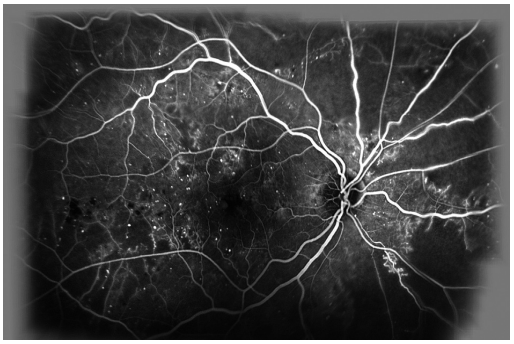


Fig. 61: ART composite with 30° Standard lens

Fig. 62: ART composite with Wide Field Lens

3. After acquiring individual images or a movie, the picture or movie is marked and selected with a right-click of „Compute Composite“. If peripheral regions of the retina are acquired through pivoting of the camera head, it is often necessary to adjust the brightness and the focus. Even under the best conditions and the selection of excellent images, the software is sometimes unable to create the anticipated proper image. In this case, the procedure should be repeated with several other images, for example, newly acquired images. When images from the outer area of the periphery are needed, ask the patient to look in a certain direction or offer a fixed point with help from an external fixation and pivot the camera in the desired direction.

Wide Field Images

With the SPECTRALIS HRA+OCT, it is possible to acquire a single wide field image, using the 55° Wide Field Lens. This lens is mounted on the camera in place of the standard 30° lens. The acquisitions are executed in a similar manner, however it shows a larger area of the fundus (Fig 63). Important to note is that the working distance is much shorter than with the 30° standard lens. In addition, OCT and MultiColor images are not available with the Wide Field Lens.

Note:
- **Check the focus after mounting the Wide Field Lens.**
- **OCT acquisition an MultiColor images are not available.**
- **The working distance is much smaller than with the 30° Standard Lens.**

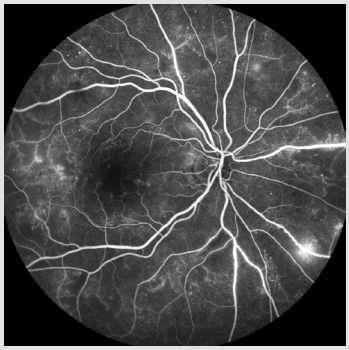


Fig. 63

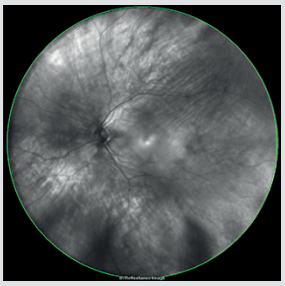
Ultra-Widefield Angiography Module (UWF-Module)

The UWF-Module allows to acquire evenly-illuminated, accurate and contrast-rich images even in the outer periphery. The UWF-Module is easily attached to every SPECTRALIS oder HRA 2 camera head. Crosspolarized Infrared reflectance images (IR(XP)) and BluePeak blue laser autofluorescence (BAF) images as well as fluorescein- and ICG angiographies can be acquired with the UWF-Module.

To attach the UWF lens, set the focus from the Standard 30° lens to +45 D.

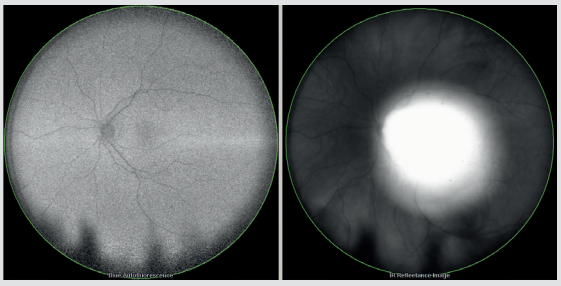
Checkbox for perfect IR(XP) and BAF images

- ✓ Set the filter wheel to position „P“ and select IR acqusition mode. There is only a weak reflex in this acquisition mode.
- ✓ The goal is an evenly-illuminated, well-focused IR(XP) fundus image. (Fig. 64).
- ✓ For BAF images, place the filter wheel at position „A“ and select the acquisition mode IR+FA (Abb. 65). For a high quality image, increase the sensitivity and if necessary adjust the focus afterwards.
- ✓ Always acquire images by using the ART Mean function.



IR(XP)

Fig. 64: Crosspolarized IR (IR(XP)) image



IR + BAF

Fig. 65: left BAF; right IR with large central image artifact

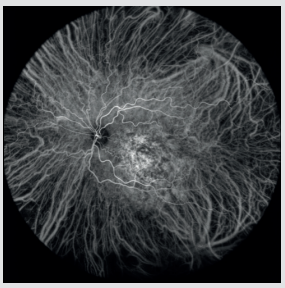
Note: IR(XP) appear darker than IR reflectance images and can exhibit a circular shaped polarized artifact. Typcial polarization effects can occur in the area of the macula through the birefringent properties of the Henle fibers, as well as diffuse, induced through the calculation properties of the retinal nerve fiber layer.

Checkbox for perfect UWF-Angiography

- ✓ To adjust camera need for even illumination and focus use IR(XP) with filter wheel in position „P“.
- ✓ To start the angiography, put the filter wheel in position „A“ and select the desired acqusition mode. Fluorescein- and ICG angiograpies as well as simultaneous images (read more in chapter 12) are possible with UWF.
- ✓ When the images appear dark or lose contrast in the late phase, the ART Mean function allows contrast enhancement.

FA

Fig. 66



ICGA

Fig. 67

10. Mean Images

The mean process dramatically improves the quality of the information in the images, without introducing an alteration to the original image or adding any distracting electronic 'noise'. It also does not change the inherent relative contrast or brightness of the original image, even though the averaged image is obviously brighter.

Quick Tips: Mean

- ✓ Excellent for BAF, BR, improving late images, improving dark images and images generally lacking in detail.
- ✓ Can be created in several ways (see text).
- ✓ After mean image is generated, multiple originals can be deleted, saving space.

Mean images can be created in three ways:

1. **Recommended method: By pressing the Sensitivity / ART knob on the touch panel you can activate the ART Mean function to generate a live mean image online and view it as it is created. Once you are satisfied with the results, you may save the image (Fig. 68 and 69).**
2. Select the „Mean" function from the touch panel. Once the raw images have been saved and you opt to leave the acquisition window, the Heyex will ask if you wish to compute the mean images at this time, or leave them to be computed later.
3. Acquire several single images and select them all. Afterwards point to one of them and rightclick on one of them to select the „Compute Mean" function.

   If a mean image generated with method two or three does not appear sharp or shows double vessels, then try to use the „Composite" function (see chapter Wide Field Imaging) instead.

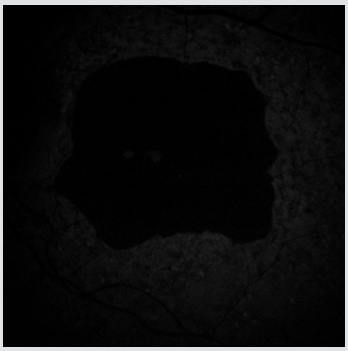


Fig. 68: Single BAF image, no retinal details

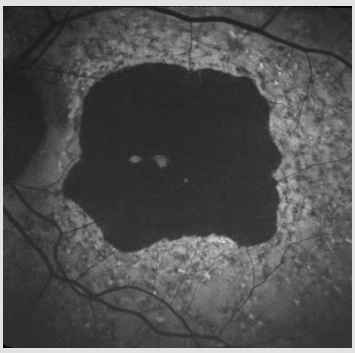


Fig. 69: ART Mean made up of 15 single images

BAF

By default, all averaged fundus images are normalized when displayed. Normalization adjusts the grey scale values between the brightest and the darkest pixel within the individual image (Fig.70).

In order to achieve comparable results in studies where grey values are quantitatively measured, this option has to be disabled.

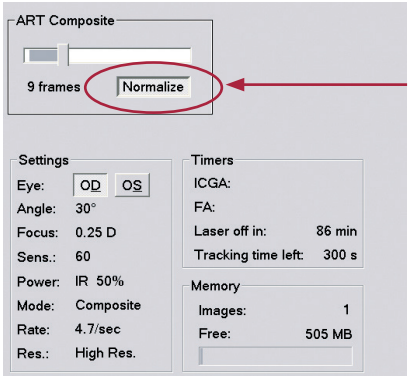


Fig. 70: Enable / Disable normalization

Mean images are most impressive when used to demonstrate the information collected in the BAF mode by creating bright autofluorescence images from dark raw images (Fig. 68 and 69). The average is useful to improve the quality of fluorescein and ICG angiographic late phase images, images with poor contrast, images with narrow pupils and OCT scans (Fig. 71 and 72).

Fig. 71: Single image

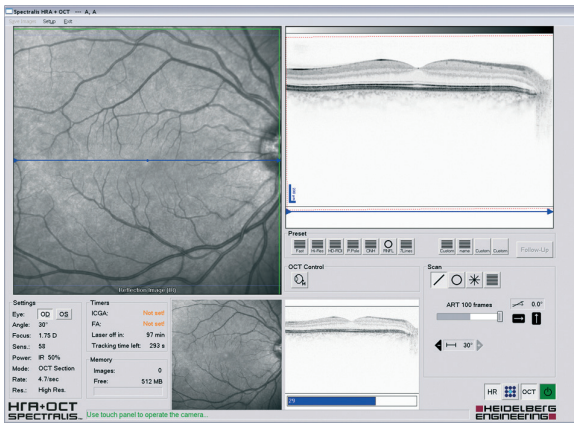


Fig. 72: ART Mean image, improved quality

11. Stereo Images

Clicking „Stereo Pair“ on the touch panel (Fig 65) activates the acquisition of stereo images. To take the image, move the camera slightly to the left or to the right with the help of a joystick and acquire two images in the same area with different acquisition angles.

Quick Tips: Stereo

- ✓ Select „Stereo Pair“ on touch panel.
- ✓ Sequential Left-Right images.
- ✓ Adds to diagnosis and treatment.
- ✓ Special viewing stereoscope needed (see text).

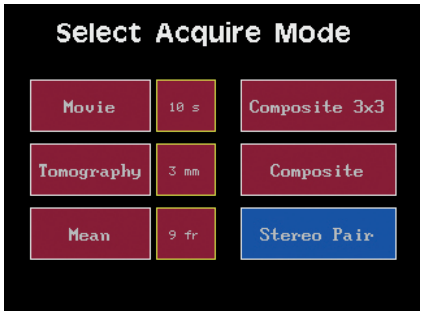


Fig. 73: Stereo function is activated

When viewing stereo images using special stereo viewing glasses, one can appreciate the topography of the imaged area. The stereo images, when selected for viewing, come up as a matched pair ready for viewing (Fig. 74).

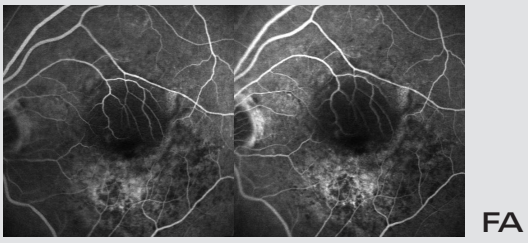


Fig. 74

Fig. 75: Screen-VU™ stereoscope

To analyze the images, look straight into the monitor in such a way that both images are in line of sight. Adjust the prisms in the viewing glasses in order to get a true three-dimensional image.

It is advisable, for the sake of patient comfort, to practice this modality using the IR option before trying one of the angiography modes.

12. Simultaneous Images

In many times SPECTRALIS HRA+OCT acquisition modules can be combined with one another (Table overview Page 1). The selection is executed using the touch panel (Fig. 68 and 69).

Quick Tips: Simultaneous images

- ✓ Reduce ICGA laser intensity to 25-50% to acquire the early stages.
- ✓ Return ICGA laser intensity to 100 % after ca. 2-3- minutes.
- ✓ It is possible to split simultaneous images for viewing/printing (see text).

Fig. 76: ICGA laser intensity 25%

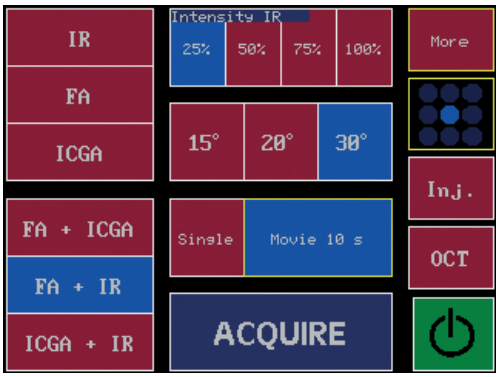


Fig. 77: IR laser intensity 25%

The most common is to acquire FA and ICGA images together to show any pathology present as demonstrated by the two distinct imaging modalities (Fig. 78).

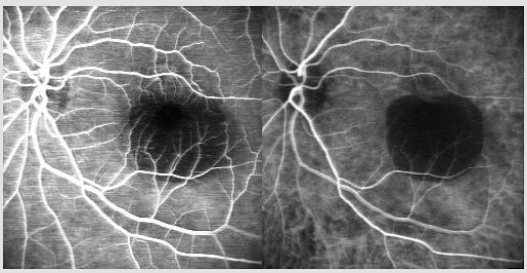
FA  ICGA

Fig. 78: Simultane FA+ICGA-Aufnahme

The most challenging aspect of the simultaneous acquisition feature is to keep the sensitivity at the optimum level for both applications, especially under the changing conditions of the early stages of the dye arrival. The most common problem is to overexpose the ICGA. To prevent this problem, reduce the ICGA laser intensitiy setting 25-50 % before starting simultaneous angiography (Fig. 76). After the initial high level of illumination during the early stages, return the ICGA laser intensitiy back to the 100% level, and continue to acquire simultaneous images as needed (Fig. 79).

Simultaneous images transferred in the lightbox can be viewed and printed independant of one another.

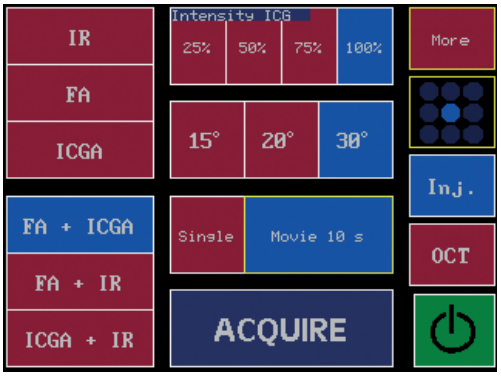


Fig. 79: ICGA laser intensity 100%

Note: If simultaneous images are acquired, then it is recommended to acquire single images in the respective angiography modalities as well.

13. Tomography Scans

The angiographic module of the Spectralis HRA+OCT, based on confocal scanning laser technology, can acquire images at 0.25 diopter intervals, or slices, in all imaging modes (0.25 diopter = approx. 125 microns).

It is possible to acquire these individual images one-by-one and then evaluate them (Fig. 80). The Tomography option within the touch panel (Fig. 81) acquires these images in a continuous series, as a movie of the scan, as it moves deeper into the scanned region of interest in the retina or choroid.

Quick Tips: Tomography

- ✓ Select Tomography from within the touch panel sub-menu.
- ✓ Set anterior-posterior extent of scan from same menu according to estimated lesion topography.
- ✓ Focus at anterior surface of area of interest.
- ✓ Instruct patient to maintain steady gaze.

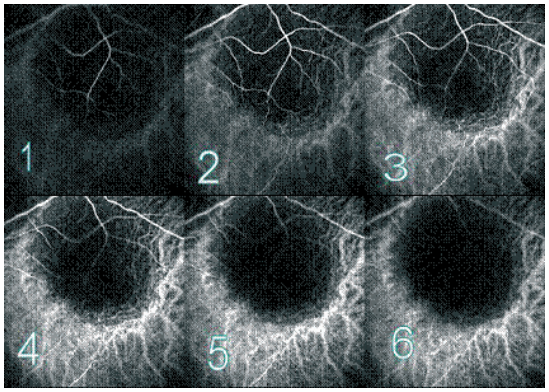


Fig. 80: Tomography scan of elevated lesion. Scans 1-6 taken at 1 diopter intervals

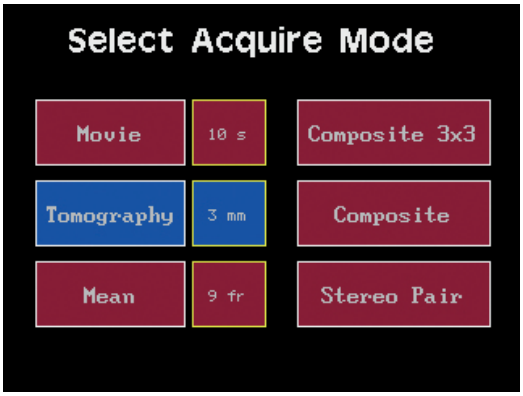


Fig. 81: Touch panel tomography button

Before documenting an elevated or depressed area of the posterior pole ,set the 'depth' of the scan in mm, (Fig. 81 and 82), which determines the anterior and posterior limits of the scan. The number of individual images within each Tomography scan is fixed at 8 scans/mm. The larger the scan, the greater the number of images taken

Focusing on the anterior uppermost surface of the area to be scanned, and then focusing down to the bottom of the lesion, gives us the distance between them in diopters. Dividing the focus shift by 3 will guide the depth setting for the scan. For example, if the focus shift is 2.5 diopters 'top to bottom' of the lesion, then the depth setting should be 0.8 mm, rounded up to 1 mm.

Once the Tomography series has been acquired, doubleclick on the icon (Fig. 83) to view the image series of the depth scan as a movie. They can then be expanded like movies, and the individual images evaluated, printed, or saved.

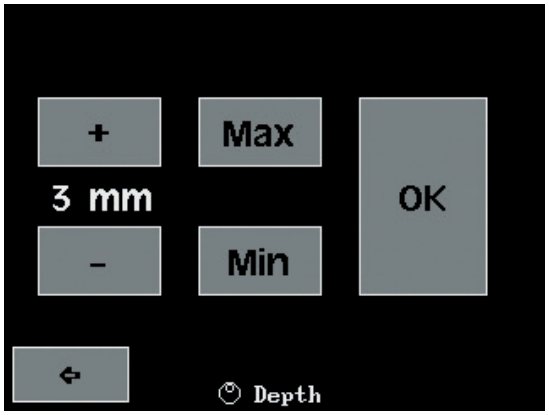


Fig. 82: Tomography depth settings on the touch panel

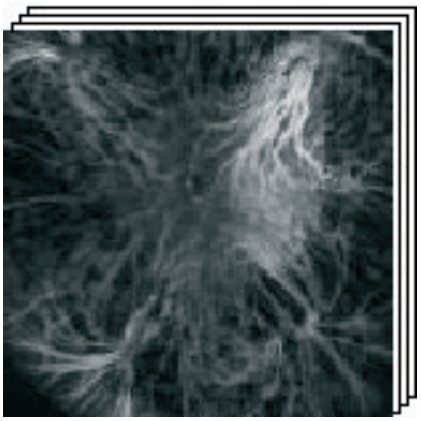


Fig. 83: Tomography thumbnail

14. Anterior Segement Images

Detailed images of the cornea, chamber angle and sclera can be acquired using the **Anterior Segment Module (ASM)**. The ASM concits of a special add-on lens and dedicated software, which is able for all SPECTRALIS models with OCT function.

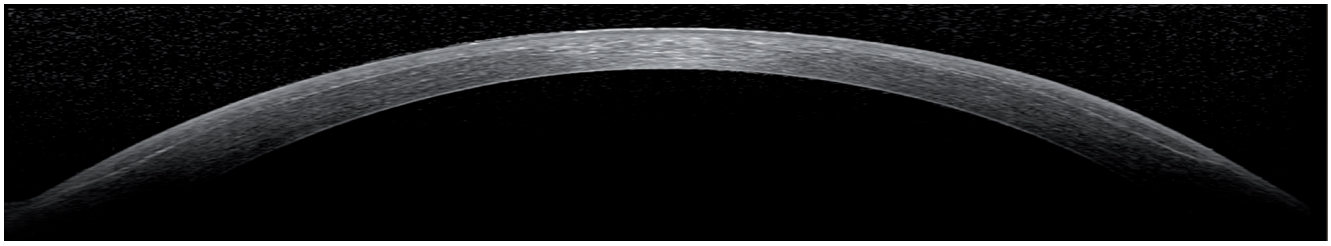


Fig. 84: ASM image of the cornea after LASIK

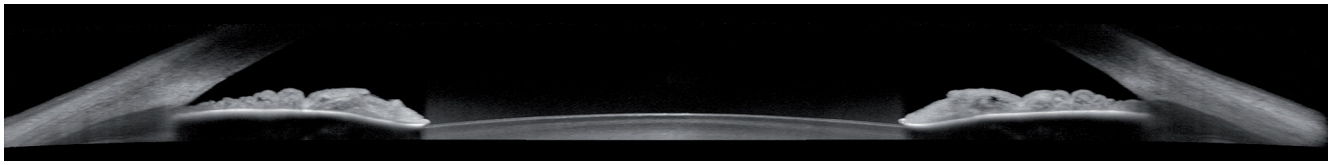


Fig. 85: ASM image of both chamber angles

Detailed information how to use the ASM can be found in the „SPECTRALIS Anterior Segment Module - The Perfect Acquisition“ guide.

15. Acquisition Default Settings

Individual settings can be saved as standard to make the work process easier. The system properties for the resolution, length of circular puffer and the length of movies as well as the desired color scale of the OCT scan are very important.

Quick Tips: Acquisition Defaults

- ✓ Set High Speed / High Resolution.
- ✓ Set Movie Buffer.
- ✓ Set Movie length.
- ✓ Set OCT Color Scale.

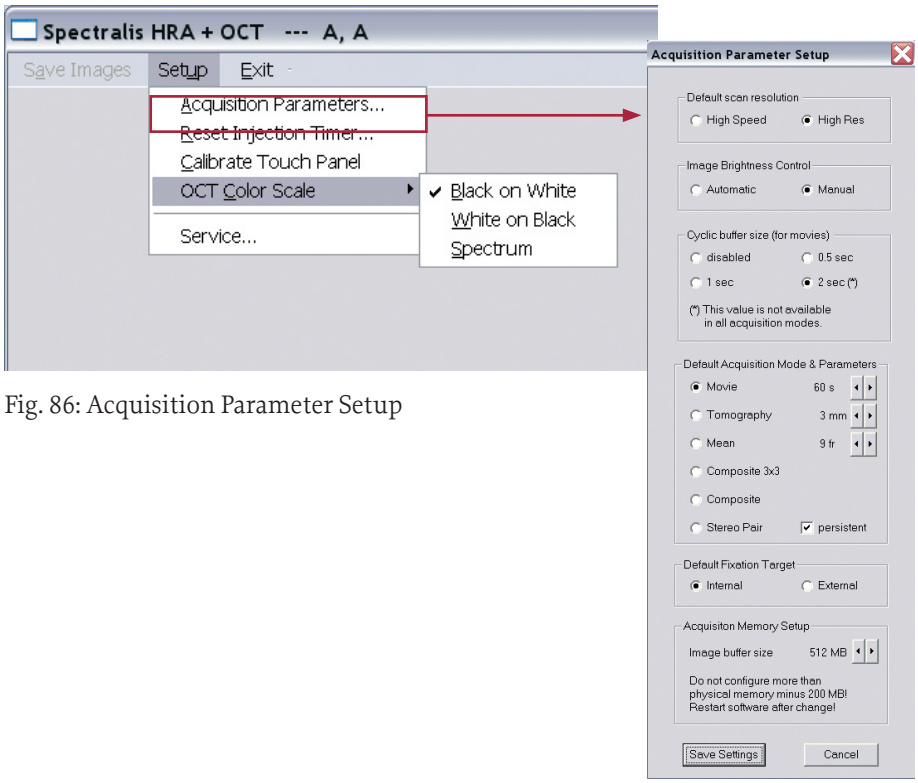


Fig. 86: Acquisition Parameter Setup

16. Resolution Modes / Image Brightness / High Myopia Compensation

Resolution Modes

The SPECTRALIS HRA+OCT can take images in modes „High Speed“ (HS) or „High Resolution“ (HR) (Fig. 87). The „High Speed“ mode is optimized for fast acquistion with high framerate and minimum need for data storage. The „High Resolution“ mode acquires more data points over a longer time period and requires more time and space for data storage. One has to consider that the high-resolution mode might slow down patient flow.

Quick Tips: Resolution Modes

- ✓ Set Resolution as default setting from within the acquisition parameter menu or as a temporary setting using the touch panel sub-menu.
- ✓ High-Resolution image occupy considerably more archival space.

Quick Tips: High Myopia Compensation

- ✓ Myopic lens function not available with OCT imaging.

Image Brightness

The auto image brightness function automatically controls the image brightness. It is selectable on the touch panel sub-menu.

High Myopia Compensation (Myopic Lens)

In order to image high myopic eyes, it is possible to shift the focus towards negative values down to -24 D by adding myopic correction of either -6 D or -12 D via the touch panel.

Note: High Myopia Compensation is not available with OCT imaging.

Fig. 87: Resolution Modes / Image Brightness / High Myopia Compensation

17. Lens Cleaning

One of the most important points for perfect image quality is a clean lens. Check the lens on a regular base. Due to the short operating distance, Wide Field lens, UWF and ASM especially susceptible to grease-marks, reducing the image quality. Sometimes the back surface of the lens has to be cleaned as well.

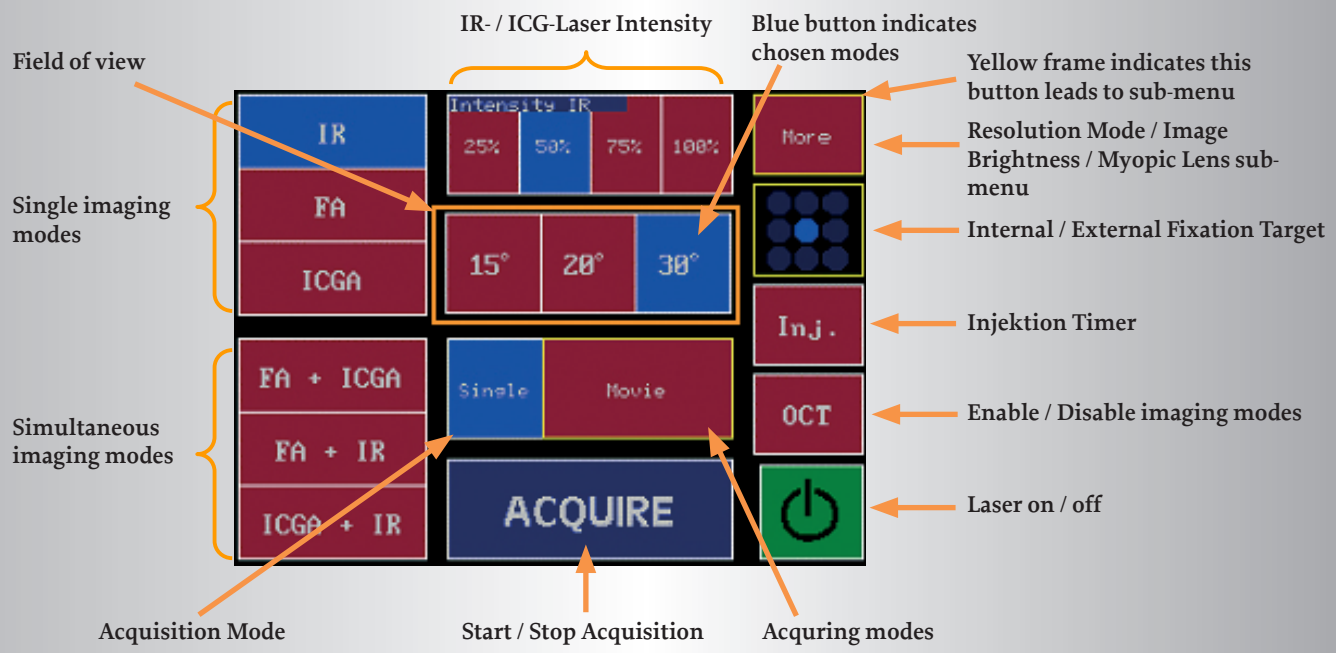
There is a wide range of lens cleaning tools offered by several camera manufactures. For the removal of dust particles use an air blower or special camera brushes. Fingerprints and grease-marks can be removed using special cleaner for optics or pure alcohol, ethanol or isopropanol with minimum 99 % alcohol, applied with a microfibre cloth. To avoid any damage on the lens the microfibre cloth has to be multiple laundred without fabric-softener.

Us the microfibre cloth to wipe the lens in circular motion. Do not apply any pressure while wiping. For fine cleaning, begin wipe spirally from the center of the lens to the outer edges.

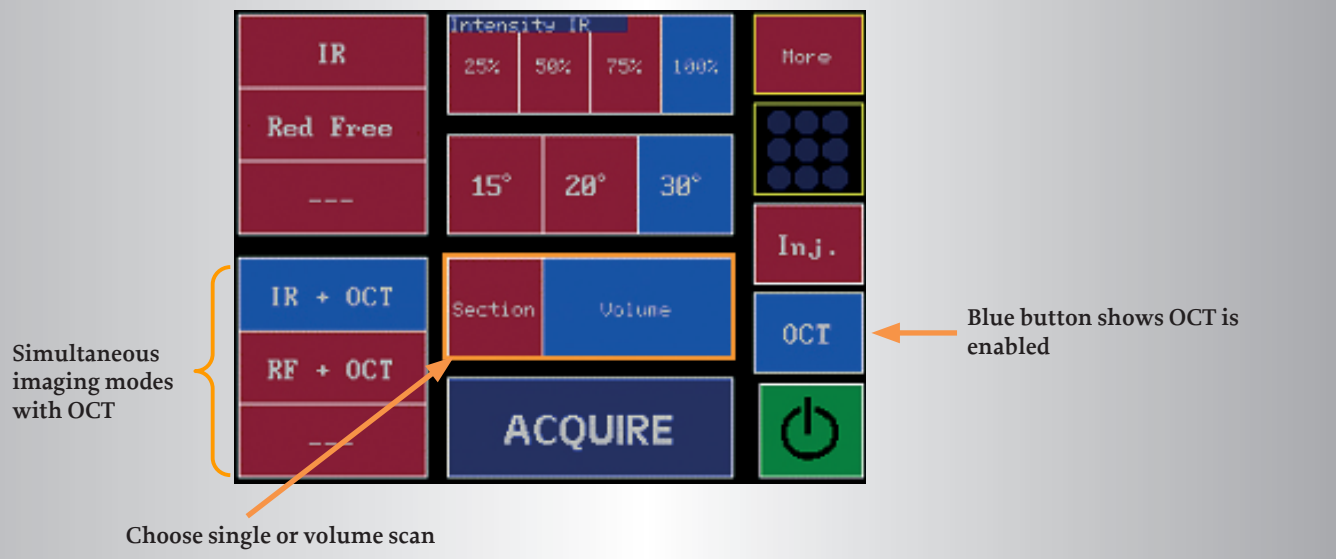
Heidelberg Engineering recommends Descosept AF cleaning towels, mikrozid® AF or other similar antibacterial, antiviral and antifungal cleaning towels to disinfect the non-optic objective lens.

Note:
- Q-Tips, Methanol and Acetone should not be used to clean the lens surface.
- Acetone or hydrogen peroxide products should not be used to clean the non-optic objective lens.

Filter wheel position A (Angiography)

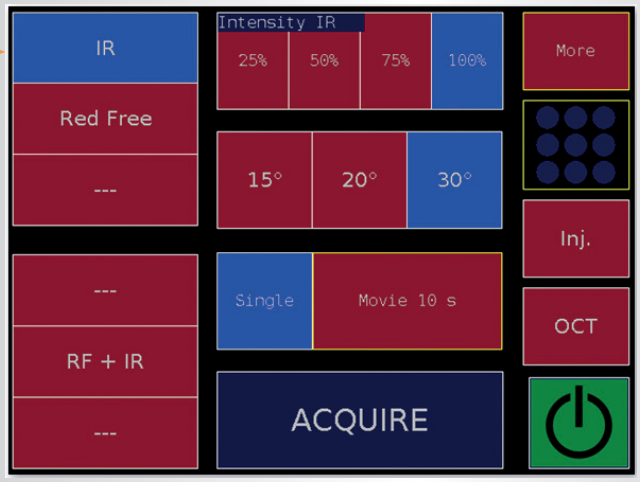


Filter wheel position R (Reflectance)



Filter wheel position P (Polarization)

Selection of IR(XP) Mode



19. Application Matrix

Diagnosis / Applications	IR	BR	BAF Mean	FA		ICGA		OCT	Simult. FA & ICGA	Mean	Movie	Stereo	Tomo-graphies	Comp./ Wide Field Lens	High Mag.	High Res.	Staurenghi Lens	Anterior Segement
				early	late	early	late											
Diabetic Retinopathy		●		●	●			●		○ FA**				● FA			○ FA	
Branch Vein Occlusion, Central Vein Occlusion, Central Artery Occlusion		●		●	●			●		○ FA**	○ FA*			● FA			○ FA	
AMD	●	●	●	●	●	●	●	●	○		○ FA, ICGA*	● FA, ICGA			● FA, ICGA	● FA, ICGA		
RAP, Retinal Choroidal Anastomoses, Feeder Vessel	●	●	●	●	●	●	●	●			● FA, ICGA*	● FA, ICGA			● FA, ICGA	● FA, ICGA		
Tumors	●	●	●	●	●	●	●	●	○		○ FA*	● all modes#	● FA, ICGA	○ all modes #			○ all modes #	
Optic Nerve Head Drusen		●	●	●	●			●				● FA	● FA					
Epiretinal Membranes		●		●	●			●		● BR								
Choroiditis / Inflammatory Diseases	●	●	●	●	●	●	●	●	○					○ alle Modi #			○ all modes#	
Imaging through cataract	●			○	○	●	●	○		● FA						○ all modes		● FA
Late and hazy images, narrow pupils								○		● all modes								

● = Recommended

○ = Optional

* Dye arrival stage

** Late stage

Not available with OCT

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