

How to acquire the
perfect image

HTA 2



Introduction

Heidelberg Engineering has spent over 10 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 rapidly increasing number of general clinics and private practices. When it comes to retinal imaging and scanning laser technology, Heidelberg Engineering has by far the most experience.

The Heidelberg Retina Angiograph 2 (HRA 2) brings innovative design and enhanced features to our established line of scanning laser imaging devices and provides unmatched detail and contrast in angiography images of both the retina and choroid.

Unique simultaneous digital Fluorescein Angiography (FA) and Indocyanine Green Angiography (ICGA) images with three-dimensional resolution improve the diagnosis of retinal and choroidal pathologies such as diabetic retinopathy and AMD. High Speed ICG (HSICG) dynamic imaging can identify feeder vessels and retinal choroidal anastomoses for safer treatment of CNV.

Autofluorescence imaging and fundus reflectance imaging with blue and infra-red light offer new ways of identifying various manifestations of retinal disease. The HRA 2 provides real benefits for all concerned. Ophthalmologists can make better diagnoses and provide safer treatment. The low light levels used in our scanning laser technology result in examinations which are much more comfortable and safer for patients. Design, software and special applications mean photographers will save time and find the HRA 2 easier to use. And the wide range of applications and effective use of technology mean that the HRA 2 can both optimize time and avoid unnecessary or repeat procedures.

By showing you how to acquire perfect images we hope to give you an easy start with the HRA 2.

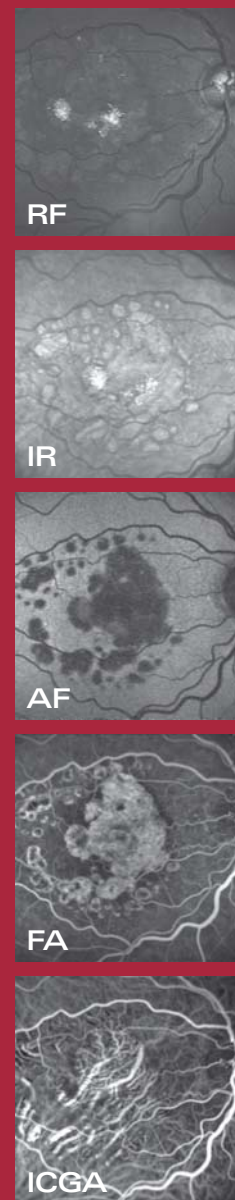
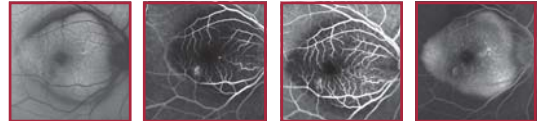


Table of contents

Acquisition Protocol HRA 2	2
Specific Photography Modalities	3
1. Red Free (RF)	3
2. Autofluorescence (AF)	3
3. Infra Red (IR)	5
4. High Magnification	5
5. Wide field Images (Composite, 55° Lens, Staurenghi Wide Field Lens)	6
6. Acquisition Default Settings	8
7. Mean Images	8
8. Stereo Images	9
9. Fluorescein Angiography (FA)	10
10. Indocyanine Green Angiography (ICGA)	11
11. Simultaneous Images	12
12. Anterior Segment (external) Images	13
13. Resolution Modes / Image Brightness / High Myopia Compensation	13
14. Tomography Scans	14
15. Touch Panel	15
16. Application Matrix	16

Acquisition Protocol HRA 2



General Workflow

- ✓ Create New Patient Database Entry or choose existing patient for re-examination.
- ✓ Make sure camera head is pulled all the way back.
- ✓ 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 on Touch Panel.
- ✓ Select acquisition mode using the filter lever (R=Reflectance modes, A=Angiography modes) and the Touch Panel.
- ✓ Open the Set-up/Acquisition Parameter window, and pre-set the default Acquisition Parameters. Pay special attention to the Cyclic buffer setting (see section 6, before commencing photography).
- ✓ Ask patient to put chin in chinrest and forehead against strap/bar.
- ✓ Make sure black line on chinrest pole is at canthus level.
- ✓ Bring camera forward (with the XYZ control to the locked position) and align lens with pupil.
- ✓ Acquire images.
- ✓ Move camera backwards and then over to fellow eye.
- ✓ Acquire images for fellow eye.
- ✓ Save images.
- ✓ Review images for content and quality.
- ✓ Select inferior/redundant images to be deleted.

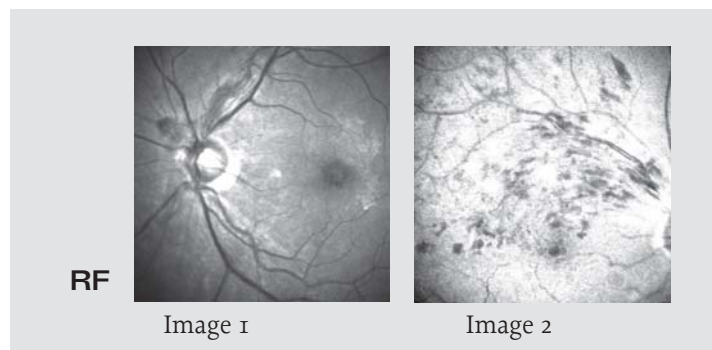


Specific Photography Modalities

1. Red Free (RF)

Usually the first set of photographs is taken in the RED FREE mode. This is done as a 'control' set of photographs before FA or ICGA. Acquisition of IR images is also suggested at this time.

As with all photographs, aim for even illumination, minimal artifacts and centering of the macula (Image 1), unless otherwise indicated. Increase sensitivity just to the point before 'saturation / blooming' occurs – which is the point where white areas of dots with colored specs begin to appear (Image 2). This is a sign of excessive 'light' and that the sensitivity should be decreased. Repeat procedure for the fellow eye.



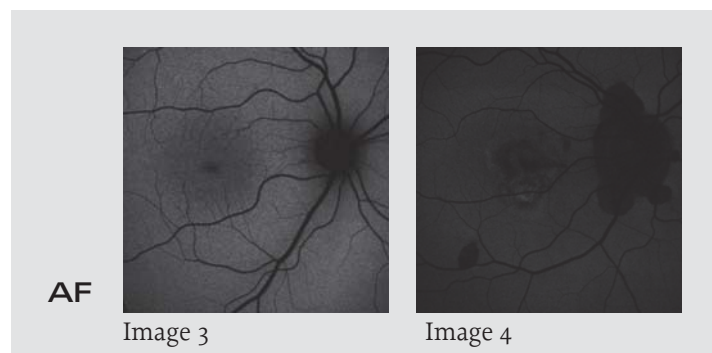
2. Autofluorescence (AF)

Fundus Autofluorescence Imaging offers information beyond conventional fundus photographs or fluorescein angiography and the HRA 2 is currently the best camera to capture them. They are used for a variety of purposes, from outlining optic nerve head drusen (which has been the standard use of AF in fundus cameras) to studying various manifestations of age-related macular diseases and hereditary retinal disorders without the injection of fluorescein dye.

Quick-Tips AF

- ✓ Increase sensitivity until retinal vessels are seen.
- ✓ Acquire, calculate and review before starting FA.
- ✓ 9 images and up.

Align the camera as outlined above, using the RF or IR illumination. Once you see a sharp well-focused image, change to the FA illumination. The image will now be considerably darker, however increasing sensitivity will outline the retinal blood vessels (Images 3, 4).



Acquire a series of 6-24 (or more if needed) images using any of the following options:

1. By pressing the dial button on the Touch Panel you can activate the ART (Automatic Real Time) Mean-option to generate a 'live mean' Autofluorescence image online and view it as it is created.
2. Multiple single images
3. Short movie
4. Using the 'Mean' image option in the Touch Panel (Image 5).

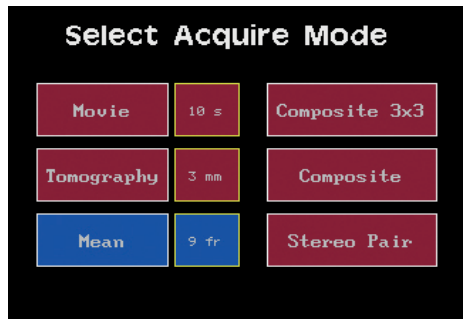


Image 5: Touch Panel: Mean image option

Following the acquisition (method 2 and 3 only), use the Compute Mean option in the HeyEx (Image 6). Using the 'Mean' Image Option (method 4) the computation of the mean image is started automatically. Compute mean images for all the AF images you have taken (Images 7,8), before proceeding with the FA.

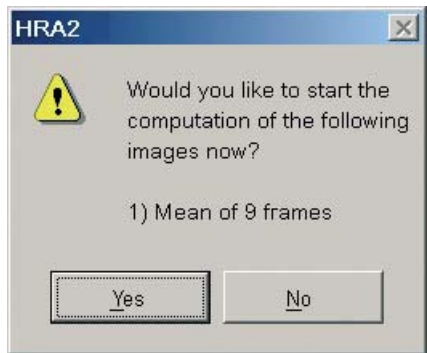
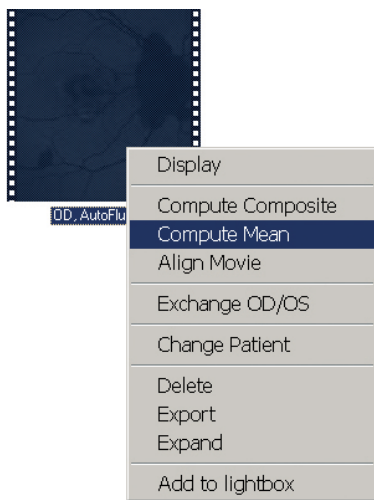
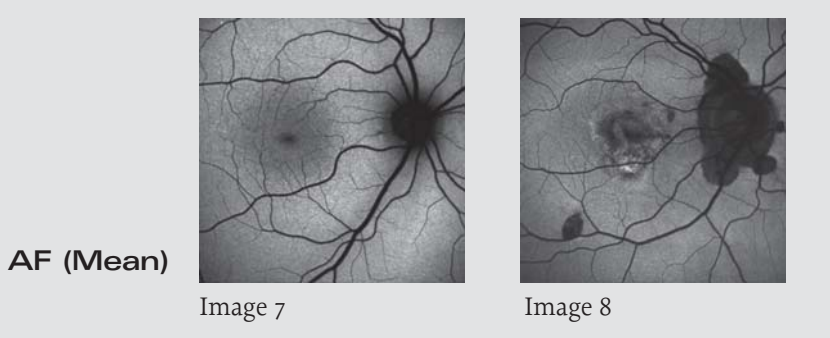
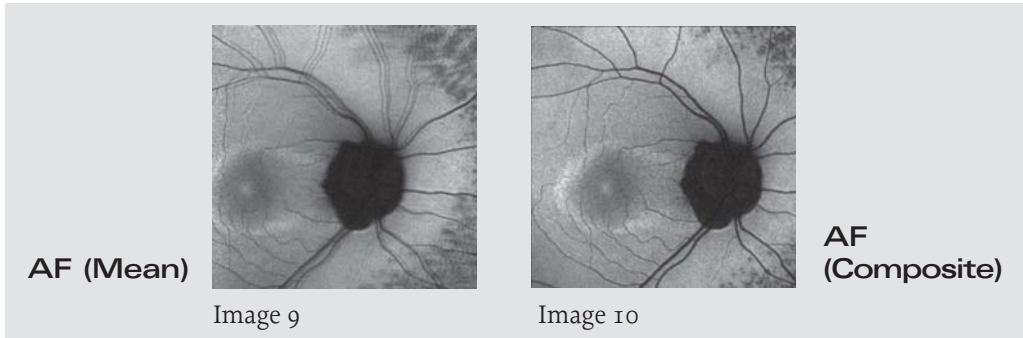


Image 6: Compute Mean option



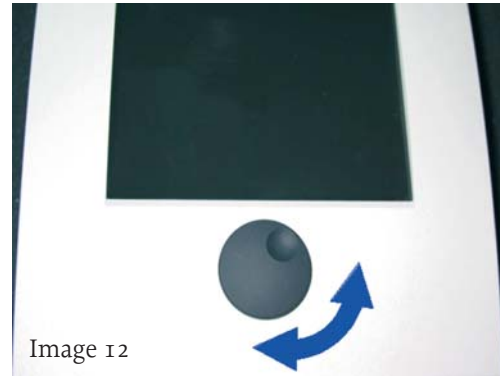
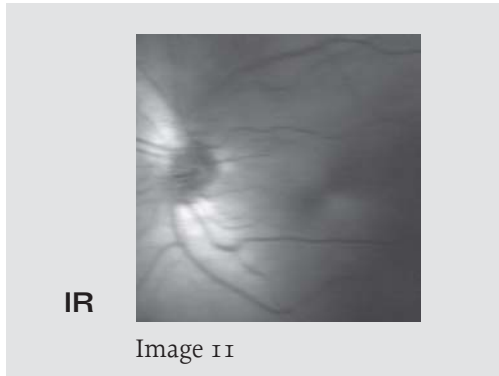
Note: Following the injection of flourescein dye, it will be impossible to perform AF photography.

Evaluate the resultant Mean images, and if necessary, repeat. The most common problem is caused by eye movements, which might not be visible during acquisition (Image 9). In cases of eye movement that result in poor mean images, it is possible to either use the Compute Composite option (Image 10), to delete the images from within the Mean series showing eye-movement and calculate the Mean again, or to try and re-aquire the series.



3. Infra Red (IR)

These images are taken before ICGA or FA photography. Align camera as before and acquire the IR images. Since IR illumination is only barely visible on the iris, it might be helpful to use the RF illumination for alignment and switch to IR illumination for acquisition. As with all types of photography, bright, even illumination is the key to quality images. In the case of IR, however, it is possible to have 'too much' illumination, which demands that the sensitivity be carefully reduced down to an acceptable level. This may result in a 'double image' or very poor, unusable image (Image 11, 12).



In this case, reduce the IR Laser Intensity on the Touch Panel as needed (Image 13) until an acceptable image is seen on the screen (Image 14).

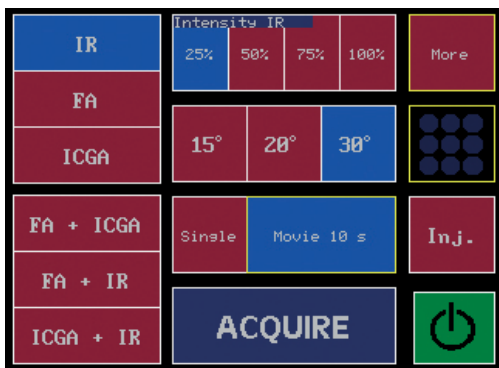
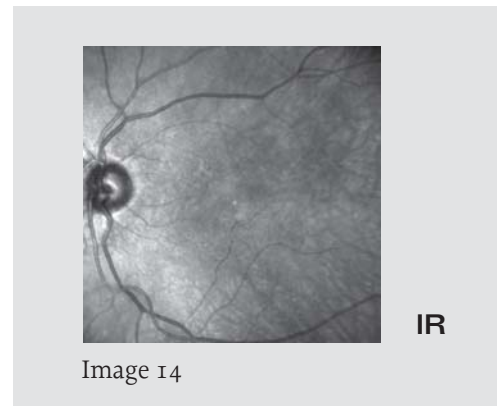


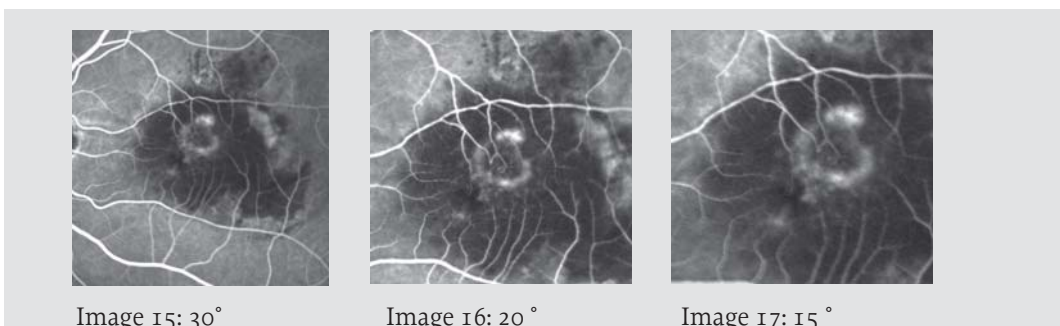
Image 13: IR intensity at 25 % at Touch Panel



4. High Magnification

It is both possible and advisable to take high-magnification images (15°) in the various 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 (Images 15, 16, 17) and the contrast is highest in ICGA. High-magnification is used especially in ICGA when trying to locate a feeder-vessel.

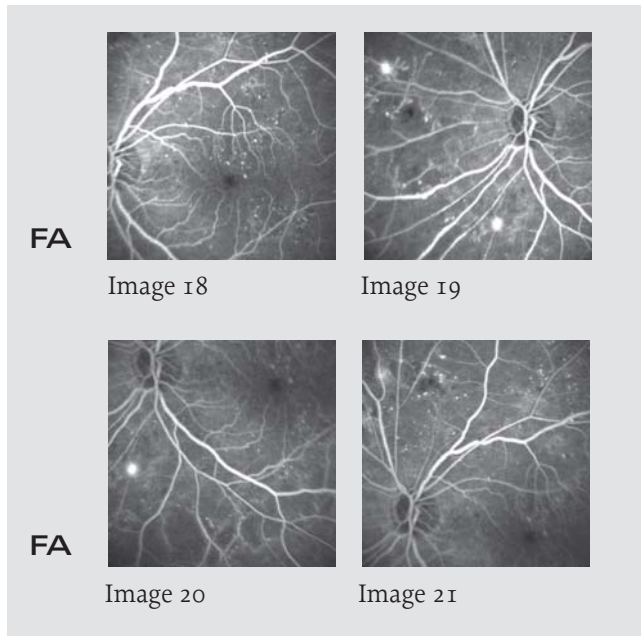
Note: When selecting High Magnification, use High Resolution mode.



5. Wide field Images (Composite, 55° Lens, Staurenghi Wide Field Lens)

Composite Images (COMP)

These images are images made up of multiple single 30-degree images (Images 18-21), resulting in 'mosaic', large-field images of the retina (Image 22). 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.

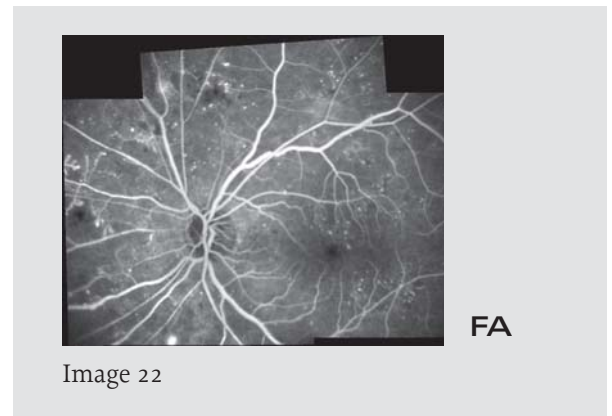


Quick-Tips Manual Composite

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

Quick-Tips Real-time Composite

- ✓ Select 'Composite' on Touch Panel.
- ✓ Practice with IR if necessary.
- ✓ Move camera head around.
- ✓ Save images.



It is best to both practice and teach this modality using the IR photography, since this is the most comfortable mode for the patient and does not require dilation.

Composite Images can be created in three ways:

1. By pressing the dial button on the touch panel you can activate the ART (Automatic Real Time) Composite-option to generate a 'live composite' image online as it is created, and once you are satisfied with the results, you may save the image (Images 23, 24)



Image 23: ART Composite with 55° lens

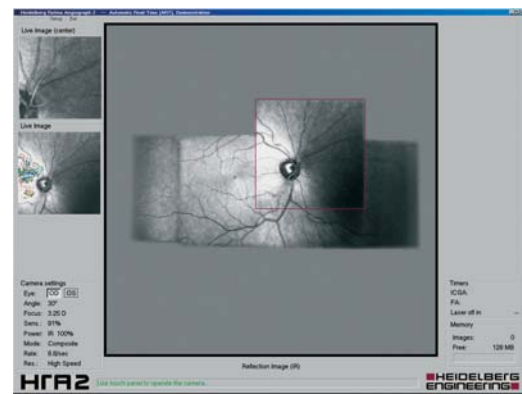


Image 24: ART Composite with 30° lens

2. Creating successful composites takes practice, a 'good' eye and a cooperative patient. But even with the most favorable conditions and selecting single images that look excellent, the software sometimes does not manage to create the composite that we expect. In this case repeat the processing with several different images, and if this does not work, take some new photographs. Start with 3-4 images not far apart to get the feel for the limits of adjacent images which can be added together in order to generate a good composite (Image 22). Always check the resultant images for geographic continuity and their individual quality – it is often necessary to either increase / decrease the illumination and make small adjustments in the focus when swinging the camera head to the sides and up and down.

- Once you feel comfortable obtaining high-quality individual images of the periphery, it should be possible to acquire a series of images in one 'shoot', using the movie option. It is recommended, however, that you both practice and teach beginners to use the individual photo method first.

It is advisable to take more than one photograph at each 'location'. After the composite has been created, it is of course possible to delete the redundant images. In order to acquire images from the peripheral fundus, it is necessary to instruct the patient to look in the desired direction(s). This can be achieved in several ways, depending on the photographer's preference and the patient's vision and cooperation.

Make sure that the internal fixation light is switched off. Ask the patient to look straight ahead, without moving their gaze, while you move the camera head around and acquire images from the periphery. If you need to get further out in the periphery, ask the patient to look in a particular direction and aim the camera in the desired direction.

If this is insufficient, use the external fixation device and instruct the patient to follow it as needed. The third possibility is using the internal fixation target by pressing the corresponding buttons on the touch screen (Image 25).

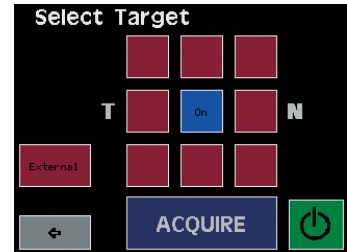
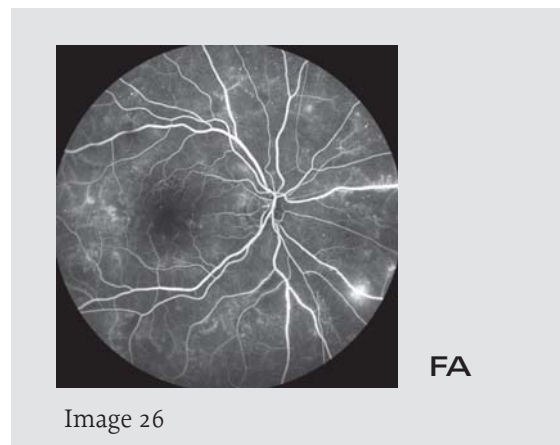


Image 25: Selecting fixation target

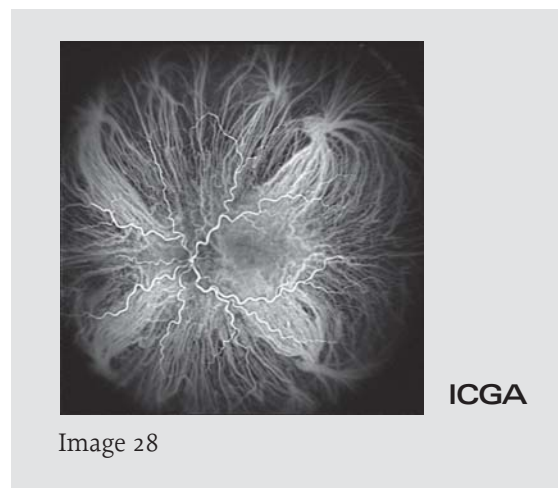
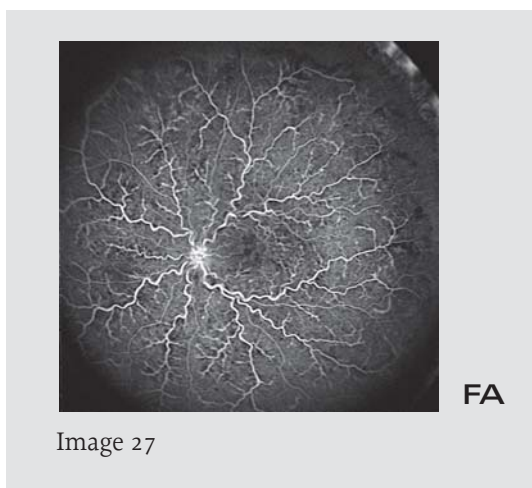
55° Lens Images

With the HRA 2 it is possible to acquire wide-field images in one image, using the new 55 degree lens. This lens is mounted on the camera instead of the standard 30 degree lens, and from that point on the 55 degree lens allows you to use the HRA 2 as before. The images are acquired and reviewed in the normal manner, but they show a much larger area of the fundus (Image 26).



Staurenghi Wide Field Lens Images

The Staurenghi Wide Field Lens, developed by Professor Giovanni Staurenghi (Milan/Italy), allows a spectacular 150° single shot view of the fundus (Images 27, 28). It is a contact lens, held between the eye and camera objective.



6. Acquisition Default Settings

Before starting the photography session, determine which settings you would prefer to have as default. It is important to set the resolution / speed parameters, and especially the Buffer for the movie acquisition (Image 29). It's recommended to enable the 'Show Timer Window' option to display the duration since the last injection (Image 30). See owner's manual for setting details or contact your Heidelberg Engineering representative.

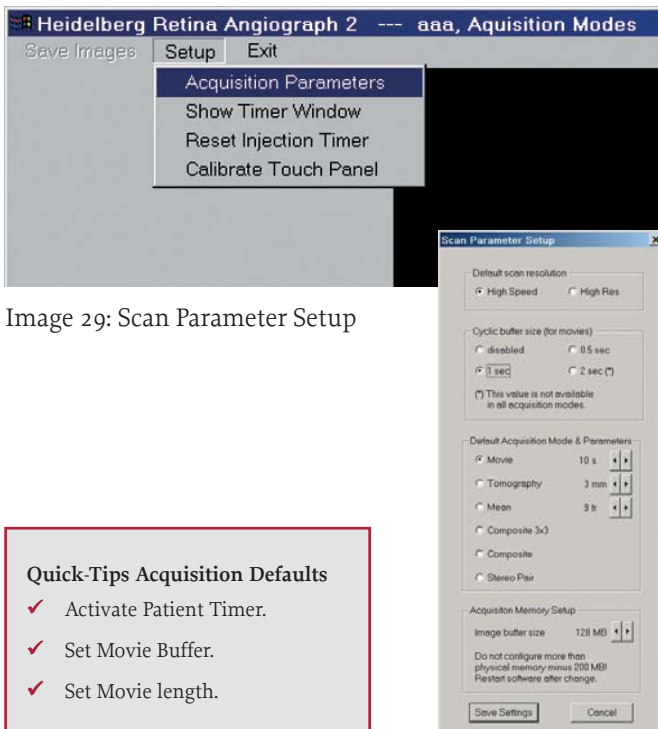


Image 29: Scan Parameter Setup

Quick-Tips Acquisition Defaults

- ✓ Activate Patient Timer.
- ✓ Set Movie Buffer.
- ✓ Set Movie length.

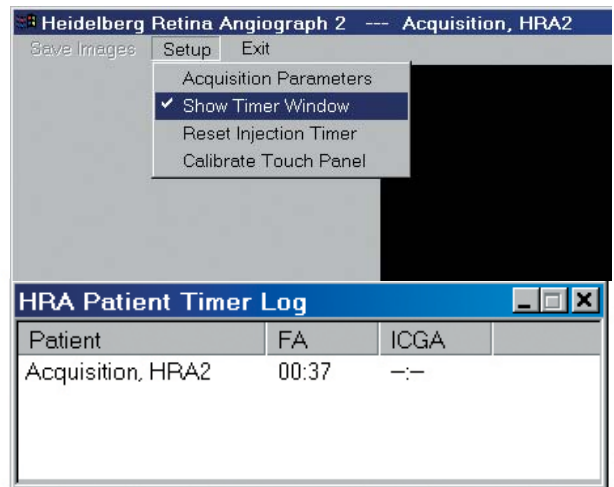


Image 30: Timer Menu and Window

7. Mean Images

Mean images are created by selecting multiple images from any modality and having the software create an 'average' image of the sum of all the images. It is an ingenious way to dramatically improve 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, even though it is many times 'brighter'. It is important to make every effort to acquire the individual images with as little eye movement as possible, so as to create a 'sharp' mean image. If the resultant Mean image is not sharp and shows 'double vessels', try using the Composite option instead. It is not as powerful as the Mean option, but yields good results nonetheless.

Quick-Tips Mean

- ✓ Excellent for AF, 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. By pressing the dial button on the touch panel you can activate the ART Mean-option 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.
2. Select the 'Mean' Option 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. It is possible to do so at this time, or leave them to be computed later, all according to your time considerations.
3. Acquire several single images and after saving them select them all. Once they have been selected, point to one of them and use the right mouse button to select the 'Compute mean' option.

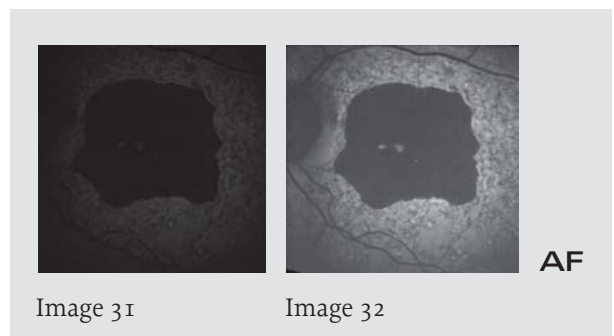


Image 31

Image 32

AF

Although mean images are most impressive when used to demonstrate the information collected in the AF mode, by creating bright Autofluorescence images from dark 'raw' images (Images 31, 32), they are also very useful for greatly improving the quality of poorly illuminated images (Images 33, 34). Dark images, late-stage photos, low-contrast images and images taken through poorly dilated pupils are but several cases where the Mean function is used.

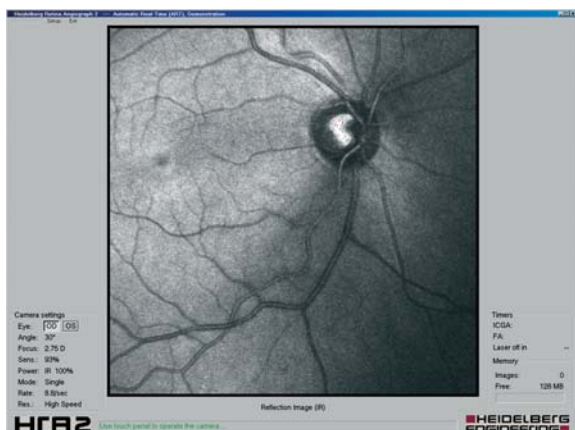


Image 33: Single Image, poor quality

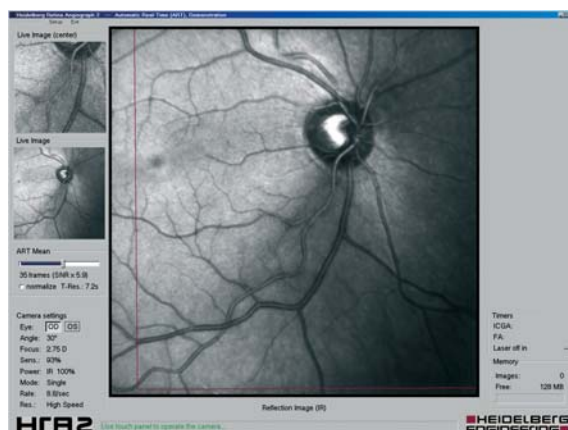


Image 34: ART Mean Image, improved quality

8. Stereo Images

One of the very impressive features of photography using the HRA 2 is the ability to produce Stereo, or three-dimensional, images. This is done by activating the Stereo feature in the Touch panel (Image 35) and then taking subsequent images using the joystick to shift the camera from left to right.

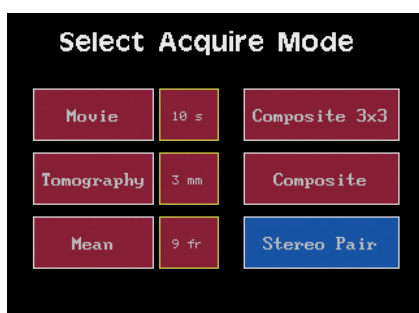


Image 35: Stereo feature is activated

The result is two images taken of the same location in the retina, but from two slightly different angles. When viewing these images using special stereo viewing glasses, one can appreciate the topography of the photographed area. The stereo images, when selected for viewing, come up as a matched pair ready for viewing (Image 36).

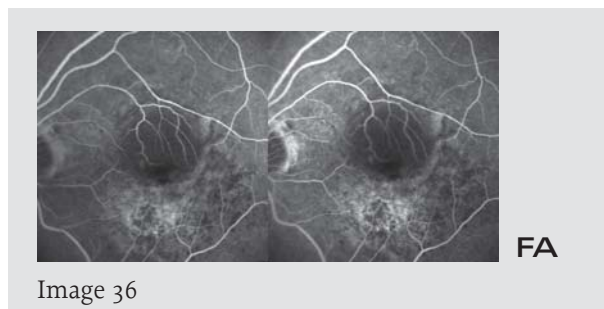


Image 36

Quick-Tips Stereo

- ✓ Activate Stereo Mode on Touch Panel.
- ✓ Very easy to take - sequential Left-Right images.
- ✓ Adds to diagnosis and treatment.
- ✓ Special viewing stereoscope needed (see text).



Image 37: Screen-VU™ stereoscope

When attempting to view these images, one should move straight in front of the monitor and adjust the angle of view so that the images fill ones field of view, and then adjust the prisms in the viewing glasses in order to get a true three-dimensional image (Image 37).

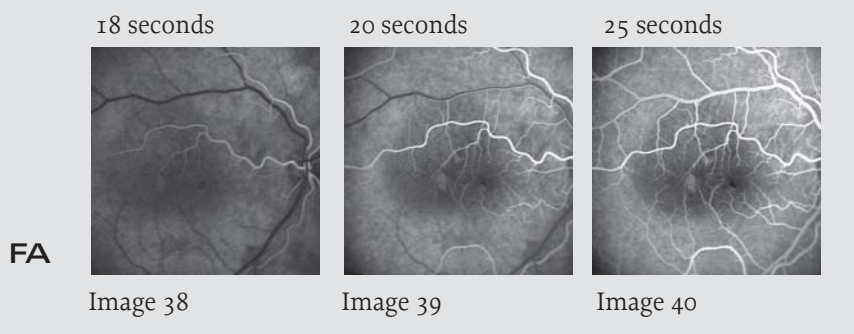
It is once again advisable, for the sake of patient comfort, to practice this modality using the IR option before trying one of the angiography modes.

9. Fluorescein Angiography (FA)

FA images are taken after the fluorescein dye has been injected into the patient's vein, either in the hand or the arm. The location of the vein usually has bearing on the time it takes the dye to reach the eye. Hence, timing is crucial when attempting to document the earliest stages of the angiogram, showing the early stages of the dye arrival into the retina (Images 38-40).

Quick-Tips FA

- ✓ Patient relaxation and cooperation assist greatly.
- ✓ Acquire movies of early stages, then delete if not needed.
- ✓ Use 'Mean' option for late/dark images.



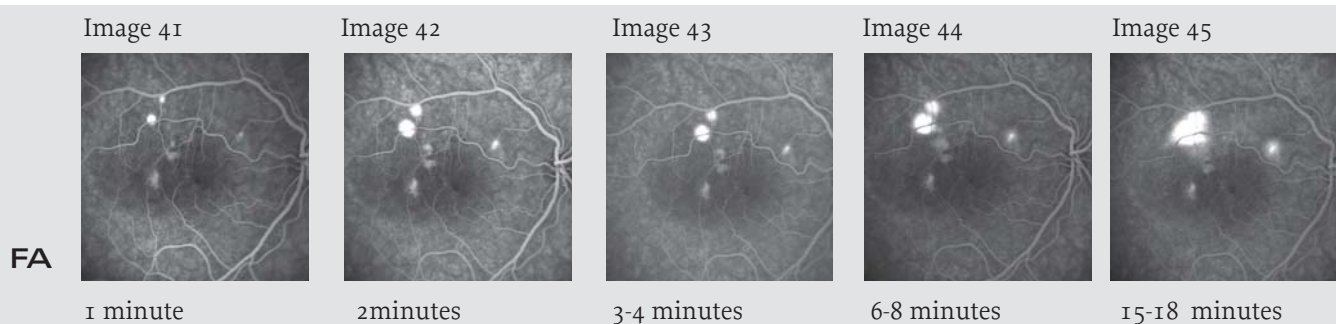
Depending on the initial amount of dye injected, while taking photos of the early stages it is important to adjust the brightness of the images as necessary by using the sensitivity knob.

Taking FA photos is essentially not much different from recording non-angiography images. Knowledge and understanding of the pathology to be documented are essential, both

for the area to be documented and the correct level of illumination to be used.

In cases where the angiography images are too dark, such as in the case of extremely narrow pupils, or in some late stages where there is a very low level of fluorescence, the use of the Mean image will allow you to generate excellent images. It is advisable to try using the Mean image option whenever the FA images you acquire look less than perfect.

Following is a general flow-chart for the acquisition of FA images, but the actual time intervals will vary, of course. This does not include periphery photographs which demand much time, but is rather a 'linear' chart only. (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.



This is only a rough guideline, and of course it is always better to take more images rather than less. But in practice, experienced users take much fewer photographs. Once again, areas other than the disc-macula region are to be taken, according to the diagnosis or special instructions.

12-15 minutes are usually the end of the useful angiogram with fundus cameras, but the HRA 2 can also record excellent images at much later stages. Currently there are only a handful of diagnoses where very late photos, such as at 20-30 minutes, will be expected. This happens in cases of suspected optic nerve head edema, suspected tumors and other rare cases.

Of course, stereo images can, and should be taken, during Fluorescein angiography, but they are most instructive in cases where stereopsis is expected, e.g. edema, CSR, PED and the like.

Note:

When using the HRA 2 it is possible to use considerably less than the standard dose of 5cc/10 % Fluorescein dye in order to obtain excellent images.

10. Indocyanine Green Angiography (ICGA)

Once again, acquiring angiography images is similar to acquiring pre-angiography images, except that one has to know what to look for in order to document it.

Note: However, 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 EXTREMELY bright, unless the illumination is reduced accordingly. In the case of ICGA, it is strongly recommended that the LASER INTENSITY (Image 46) be reduced before the dye is injected – it is sometimes insufficient to reduce the Sensitivity during the early stage. One must remember, though, to return the Intensity to 100 % after 2-3 minutes.

As in FA, the early stages of the dye arrival are both crucial and difficult to acquire. In addition, there are many applications where a MOVIE of the early stages is almost the ‘standard’ application, which again demands close attention to the illumination aspects of the image.

As with FA, there are many ‘protocols’ for acquiring the ICGA images, all according to the institution and the diagnosis. Following is a rough guide, but it is always best to review the patient’s chart and ask for guidance when in doubt.

Images up to 1-2 minutes – early stage, dye arrival, movie. (Images 47, 48)

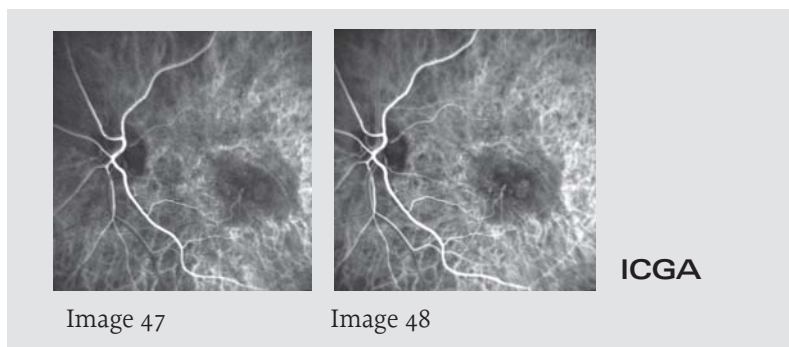
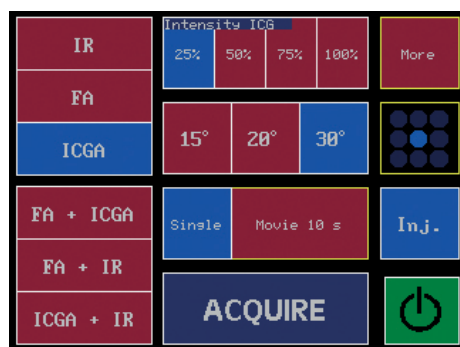
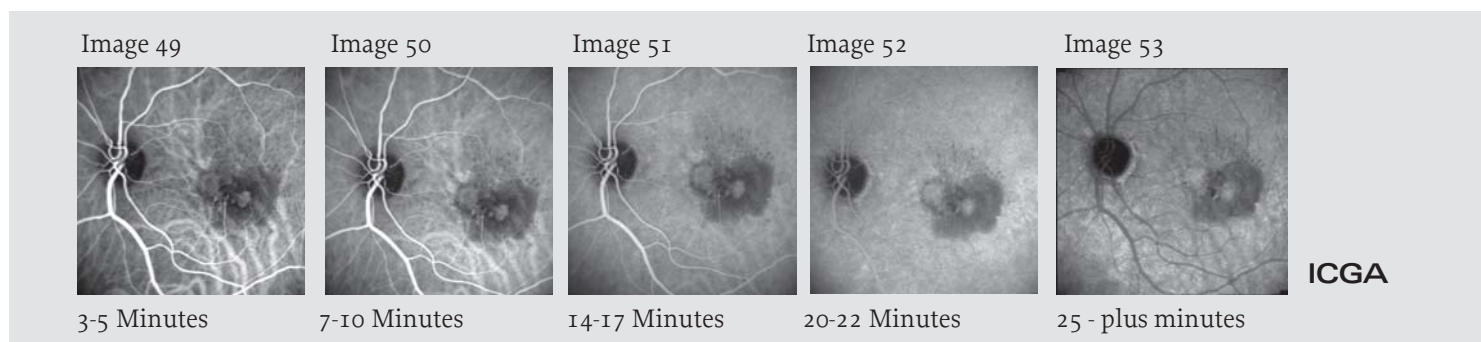


Image 46: ICG laser power reduced to 25 %

Using the Movie mode allows one to obtain the earliest possible angiography images.



In cases where the late stage images seem to be dark or lacking in information, use the Mean image acquisition and processing features, as outlined above. Stereo images may be acquired at any stage. Refer to the Stereo Imaging section for details.

Note:

When using the HRA 2 it is possible to use considerably less than the standard dose of 25mg ICG dye in order to obtain excellent images. This constitutes significant cost-savings.

11. Simultaneous Images

Simultaneous images can be taken in several combinations, as outlined on the control panel (Images 54, 55).

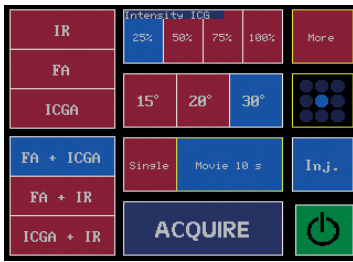


Image 54



Image 55

Quick-Tips Simultaneous

- ✓ Reduce ICGA laser power to 25-50% for earliest stages (reset at 3-5 minutes).
- ✓ Possible to split simultaneous images for viewing/printing (see text).

The most common is to acquire FA and ICGA images together, so as to show any pathology present as demonstrated by the two distinct imaging modalities (Image 56).

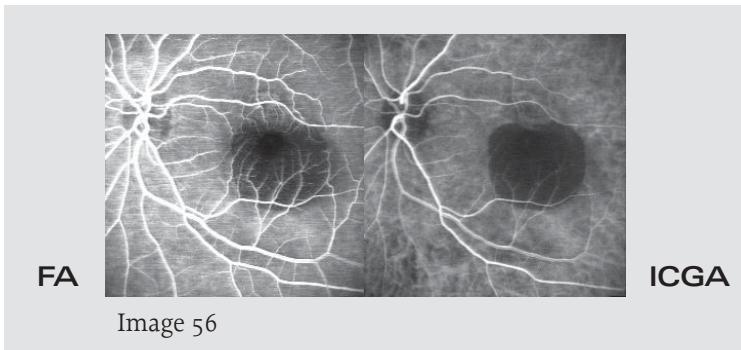


Image 56

The most challenging aspect of the simultaneous acquisition feature is to keep the illumination 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 have the ICGA image overexposed. In order to prevent this, it is recommended that before starting simultaneous angiography, the ICGA LASER INTENSITY setting be reduced to 25 % or 50 % (Image 57).

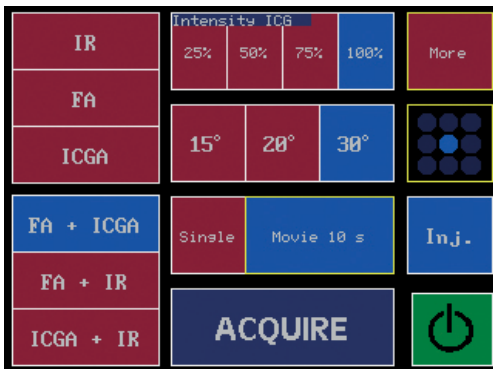


Image 57: ICGA Laser Power 100 %

After the initial high level of illumination during the early stages, one should return the ICGA LASER INTENSITY back to the 100 % level, and continue to acquire simultaneous images as needed (Image 58).

Note: It is recommended that if simultaneous images are acquired, then separate images in the respective angiography modalities should be acquired as well.

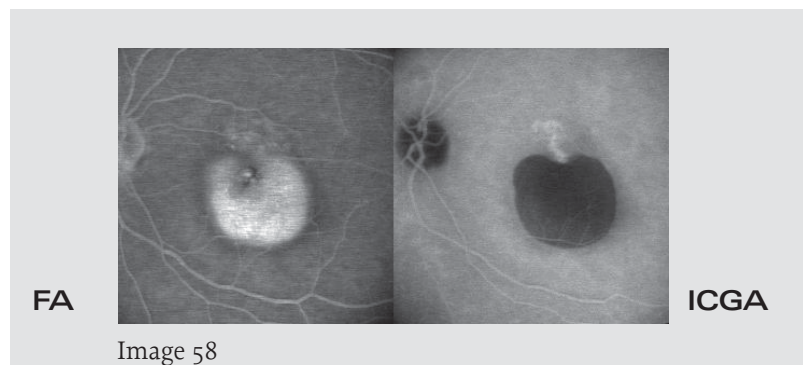
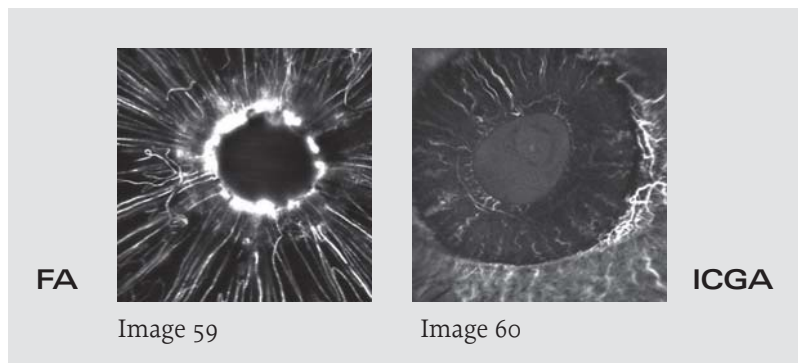


Image 58

12. Anterior Segment (external) Images

With the HRA 2 it is very easy to take excellent anterior segment, or external, photos of the eyes. All that is needed is to pull the camera back a little bit and change the focus until the iris comes into view. It is thus possible to take images in all modalities, including FA (Image 59) and ICGA (Image 60).



Please note that in Iris angiograms should ideally be done with an undilated pupil.

13. Resolution Modes / Image Brightness / High Myopia Compensation

Resolution Modes

The HRA 2 can take images in two 'sizes', or levels of resolution. This is associated with the maximum speed of acquisition as well (Image 61), affecting both the frame-per-second rate as well as the maximum number of images that can be acquired until the memory buffer is full. In addition, bear in mind that the high-res images will take longer to save after photography, which may cause delays in the continuation of photography.

Quick-Tips Resolution Modes

- ✓ Set Resolution as a default setting from within the Acquisition Parameter menu or as a temporary setting using the Touch Panel sub-menu.
- ✓ High-Resolution images occupy considerably more archival space.

Image Brightness

Choosing the Auto Brightness-option the image brightness is controlled automatically.

High Myopia Compensation

In order to be able to image high myopic eyes, the HRA 2 provides the possibility to shift the focus towards negative values down to 24 diopters by adding myopic correction of either -6 or -12 diopters via the Touch Panel.

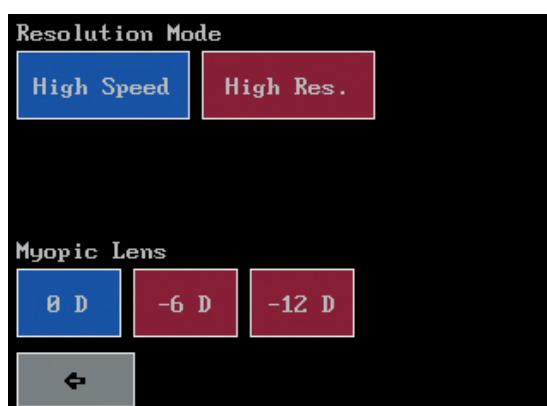


Image 61: Resolution Mode, Brightness Control, Myopic Lens

14. Tomography Scans

The HRA 2, based on confocal scanning laser technology, can acquire images at 0.25 diopter intervals, or 'slices', in all photographic modes (0.25 diopter = approx. 75 microns).

It is possible to acquire these individual images one-by-one and then evaluate them (Image 62), but the Tomography option within the control panel (Image 63) 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 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.

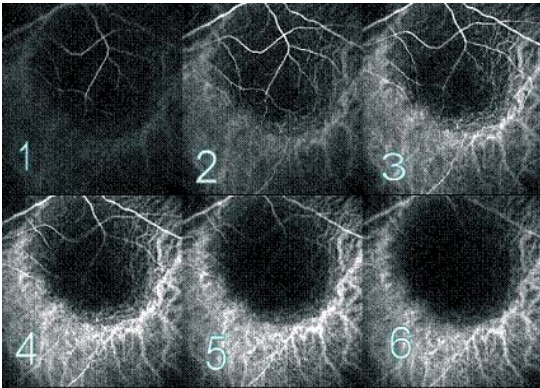


Image 62: Tomography scan of elevated lesion.
Scans 1-6 taken at 1 Diopter intervals.

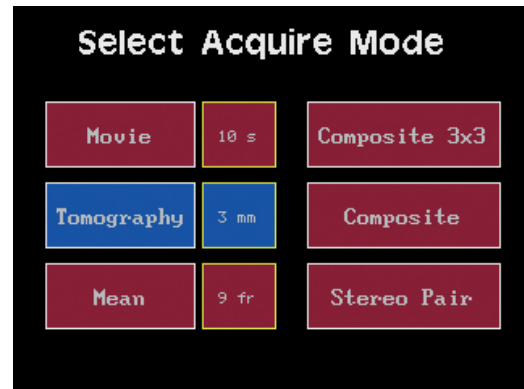


Image 63: Touch Panel: Tomography button

Before documenting an elevated or depressed area of the posterior pole, one should set the 'Depth' of the scan in mm, (Image 64), 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 give us a guide as to 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, double click on the icon (Image 65) in order to view the 'movie' of the depth scan. They can then be Expanded like Movies, and the individual images evaluated, printed, or saved.

Note: Once you have finished using the Tomography option, be sure to return the Touch Panel to its original setting.

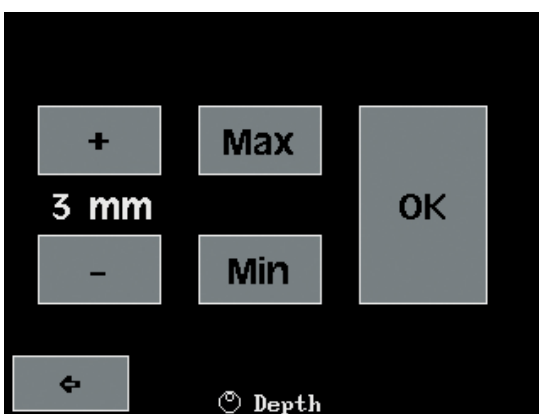


Image 64: Touch Panel: Tomography Depth Settings

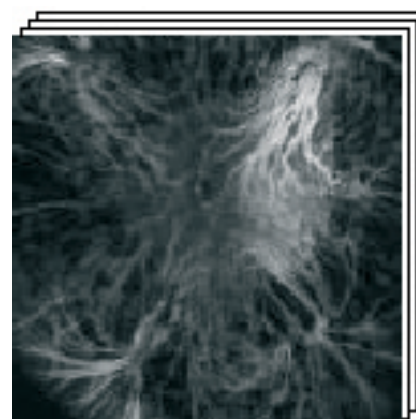
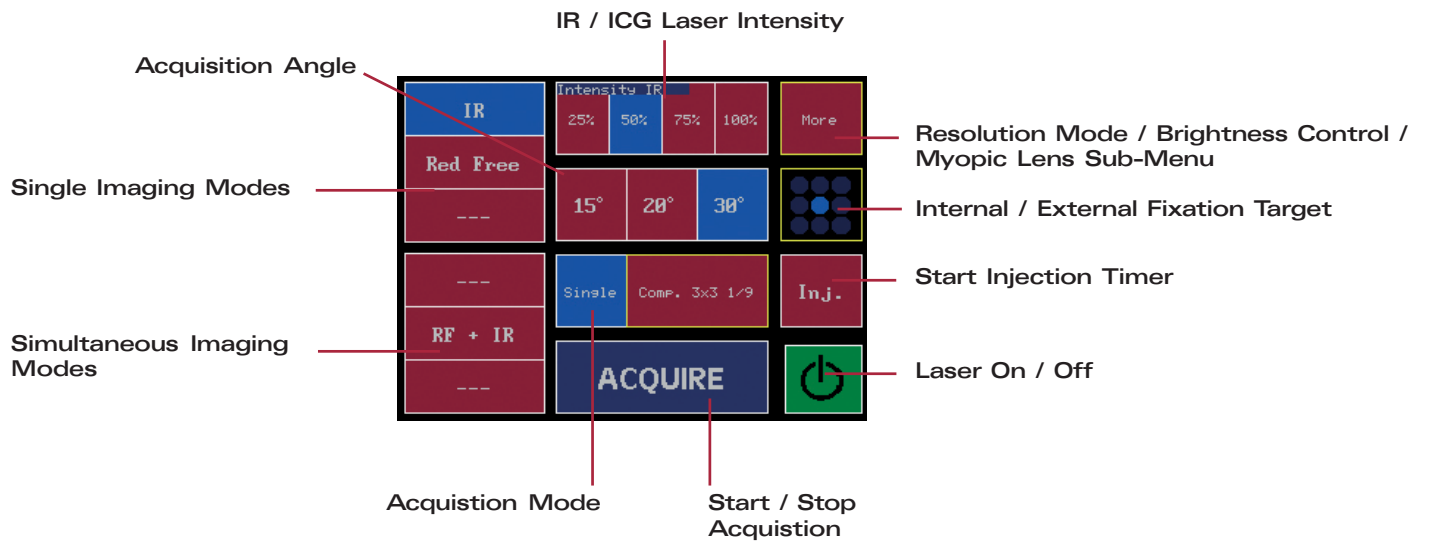


Image 65: Tomography Icon

15. Touch Panel



Dial Button:

Sensitivity (turn)

ART (Automatic Real Time) Functions On / Off (push)

16. Application Matrix

Primary Diagnosis / Applications	RF	IR	AF Mean	FA		ICGA		Simult. FA & ICGA	Mean	Movie	Stereo	Tomo. Scans	Comp./ 55° Lens	High Mag.	High Res.	Staugenhi Lens	Anterior Segment
				early	late	early	late										
Diabetic Retinopathy	●			●	●				● FA**				● FA			● FA	
BVO, CVO, CAO	●			●	●				● FA**	● FA*			● FA			● FA	
AMD	●	●	●	●	●	●	●	●		● FA, ICGA*	● FA, ICGA			● FA, ICGA			
AMD - RAP, RCA, Feeder Vessels	●	●	●	●	●	●	●			● FA, ICGA*	● FA, ICGA			● FA, ICGA			
Tumors	●	●	●	●	●	●	●	●		● FA*	● All modes	● FA, ICGA	● All modes			● All modes	
Optic Nerve Head Drusen	●		●	●	●						● FA						
Epiretinal Membranes	●			●	●				● RF								
Choroiditis / Inflammatory diseases	●	●	●	●	●	●	●	●					● All modes			● All modes	
Iris Rubiosis	●			●	●												● FA
Late photos, hazy photos, narrow pupil									● All modes								
Imaging through cataract		●		●	●	●	●		● FA						●		

● = Recommended

* Dye arrival stages

● = Optional

** Late stage



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