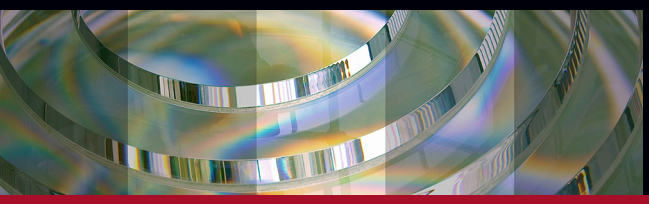

# ANTERION®

## User Manual
## Software Version 1.1

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Please read this document and follow all precautions before using the device and the software.

Mind all safety instructions on the device and in this document while operating the device.

CE 0482

Heidelberg Engineering hereby declares that this product conforms to the requirements of Directive 93/42/EEC of the Council of the European Community dated 14 June 1993 regarding medical devices.

Please note that images shown in this document may vary slightly from the actual product.

**Warranty**

If the device is modified or opened by someone other than authorized service personnel, the warranty will become void.

# Table of contents

# 1 Preface

This user manual serves as a reference guide for software modules from Heidelberg Engineering. Read the entire user manual to gain a full understanding of the software. It is not necessary to read all the chapters in chronological order. Begin with a topic of interest. Follow the links and references included in the text for guidance to other chapters.

If you have any further questions on the ANTERION software, hardware specifications, or HEYEX 2, please refer to the following applicable documents:

**Applicable documents**

| Article No. | Revision | Document | Content |
|---|---|---|---|
| 230111 | 004 et seq. | HEYEX 2 User Manual, 2.4 or higher | In this document, you will find all information on the Heidelberg Eye Explorer. |
| 230031 | 003 et seq. | ANTERION Hardware Manual | In this document, you will find all information on the hardware and software, setting up the device, electrical safety, cleaning and disinfection, disposing of the device, and technical specifications. |

## 1.1 Symbols Used in this Document

This chapter describes the definition, formatting, and symbols used in this document.

**Code** The code of, for example, the heyex.ini file is identified by `monospaced` typeface, for example `DefaultDevice=1`.

**Cross-references** Cross-references are identified by parentheses and a black arrow (➞), for example: (➞ “Cross-references”, p. 7).

**Examples** Examples are identified by a gray background over the entire width of the page.

**Elements of the graphical user interface** Elements of the graphical user interface such as buttons, window names, or file names are identified by quoted *“italic”* font, for example *“Next”*.

**Keys** Keys are identified by their symbol, for example Ctrl + A.

**Lists** Lists are used for structuring information and are marked by red squares:

- List entry
- List entry

**Menu paths**

Menu paths in the software are identified by quoted *"italic"* font. Each menu item is separated by a black triangle ▶, for example *"File ▶ Save as"*.

**Procedures**

Procedures are used for supporting the reader in completing a task and are marked by red triangles:

- Step 1.
- Step 2.

**Safety messages**

Safety messages are indicated by symbols in this document. They are marked by a signal word and a safety alert symbol indicating the category of the hazard.

**WARNING!**
Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.

**CAUTION!**
Caution with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

**NOTICE!**
Notice is used to address practices not related to personal injury.

This symbol indicates helpful hints for using the device and software.

**Embedded safety messages**

Embedded safety messages are integrated into the step of the procedure when they should be followed.

⚠ **CAUTION!** This is an embedded safety message of the type "Caution".

- The embedded safety message includes the use of a signal word, the safety alert symbol, and the message.

i This is an embedded safety message of the type "Note".

Safety messages answer the following questions:

- What is the hazard?
- What are possible consequences of not avoiding the hazard?
- How should the hazard be avoided?

**URL** Information available on websites is identified by underlined text, for example http://www.heidelbergengineering.com. Click on the URL to open the corresponding website.

## 1.2 Intended Use

The ANTERION is a non-contact ophthalmic imaging and analysis device for the eye. It is intended for visualization and measurements of the anterior segment and the measurement of axial length.

The analysis covers:

- Cornea
  - Shape and thickness
- Anterior segment
  - Anterior chamber width, depth, volume, and angle parameters
  - Lens thickness
- Axial Length
- Pupil diameter
- White-to-white distance

The ANTERION also performs calculations to assist users in determining the power of the intraocular lens for implantation.

## 1.3 Qualification of Personnel

The device is intended to be operated by professional users with a health care background and experience in the operation of ophthalmic imaging and diagnostic equipment, such as clinical personnel, physicians, ophthalmic photographers, or optometrists. The operator must have access to the user manual, the enclosed relevant security information and maintenance details comprising proper handling, utilization and the operation of the medical device.

To support continuing education on equipment, Heidelberg Engineering offers regular live and online training courses for clinicians, researchers, photographers, technicians and office staff. For further information, view the Heidelberg Engineering Academy program at http://www.heidelbergengineering.com.

## 1.4 Contraindications

**Absolute contraindications**

There are no known absolute contraindications for the use of the device as a diagnostic imaging tool.

Professional assessment and caution are appropriate.

**Relative contraindications**

**Symptomatic dry eyes**

Symptomatic dry eyes are considered as a contraindication to diagnostic imaging with the ANTERION.

## 1.5 Licensing

The licensing of ANTERION and HEYEX 2 is realized with a dongle.

Examinations and measurements can be performed using four different applications:

- *“Cornea”*
- *“Cataract”*
- *“Metrics”*
- *“Imaging”*

The *“Imaging”* app is part of the ANTERION default setup.

*“Cornea”*, *“Cataract”*, and *“Metrics”* are additional apps which can be purchased separately.

In the *“More”* section of the *“Cornea”* app, the *“Wavefront”* tab is available as additional option.

In the *“More”* section of the *“Cataract”* app, the *“Premium IOL”* tab is available as additional option.

 

# 2 Terms and Definitions

This chapter defines the abbreviations and terms used in this document.

**ACA** Anterior chamber angle

**ACD** Anterior chamber depth

**AQD** Aqueous depth

**AQM** Acquisition module

**AOD** Angle opening distance

**A-scan** The A-scan is the reflective profile at one position, containing information about the spatial dimensions and location of structures within the eye.

**AS** Anterior segment

**BFE** Best fit ellipse

**BFS** Best fit sphere

**BFT** Best fit toric ellipse

**B-scan** A B-scan is a single cross-sectional scan of structures of the eye consisting of a defined amount of A-scans.

**CCT** Central corneal thickness

**D** Diopters

**HOA** Higher-order aberration

**IOL** Intraocular lens

**IR** Infrared reflectance

**K** Keratometry

| | |
|---|---|
| **LOA** | Lower-order aberration |
| **n** | Refractive index |
| **nah** | Refractive index of the aqueous humor |
| **nc** | Refractive index of the cornea |
| **nk** | Keratometric index |
| **OCT** | Optical coherence tomography |
| **OD** | Oculus dexter; right eye |
| **OS** | Oculus sinister; left eye |
| **OU** | Oculi uterque; both eyes |
| **RMS HOA** | Root mean square higher-order aberrations |
| **RMS LOA** | Root mean square lower-order aberrations |
| **ROI** | Region of interest; scan area |
| **SimK** | Simulated keratometry |
| **SSA** | Scleral spur angle |
| **TISA** | Trabecular iris space area |
| **VWM** | Viewing module; also referred to as analysis window |
| **WTW** | White-to-white |

# 3 General Safety Messages

Review the following points before handling the device:

- Carefully read the user manual.
- Keep the user manual within easy access.
- Mind all safety instructions on the device and in the user manual.
- Follow all precautions listed in the user manual.
- Do not service the device during operation.

The inappropriate use of this device could damage the device and/or cause severe injuries. A thorough understanding of how to properly use the device will reduce examination time, increase patient comfort, and allow for the best examination quality.

## 3.1 Patient Safety

Follow the instructions below to ensure patient safety and guarantee the best examination results possible:

- Never leave the patient alone in the examination room during the examination.
- Clean and disinfect the head rest, the chin rest, and the objective lens in front of the patient. Dirty device parts can transmit pathogenic germs causing infections.
  For cleaning and disinfection instructions, please refer to the Hardware Manual.

**WARNING!**

**Incorrect patient data can lead to incorrect diagnostic interpretation**

An incorrect diagnostic interpretation can result in incorrect therapeutic approaches.

- Confirm that the correct patient data is used when starting an examination.
- Confirm that the correct patient data is used when selecting the examination method.
- Confirm that the correct patient data is used when drawing diagnostic conclusions.

**WARNING!**

**Insufficient patient preparation may cause poor examination results**

If the examination results are poor, the examination might have to be repeated.

- Carefully explain the procedure to the patient prior to the examination so that the patient is fully prepared and optimal results may be achieved. This preparation is especially important in elderly patients, patients with poor concentration, and patients with fear of the examination.

**WARNING!**

**If a diagnosis is based on a single examination method, the examination results might be misinterpreted**

An incorrect diagnostic interpretation may result in incorrect therapeutic approaches.

- Always consider performing additional examinations, possibly with other diagnostic devices, to obtain a good clinical judgment.

**WARNING!**

**If the patient is not correctly positioned in front of the device, poor image quality might occur**

Poor image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches.

- Adjust the chin rest so that the patient's eyes are level with the marks on the head rest column.
- Ensure that the patient's forehead touches the forehead rest during the examination.

**WARNING!**

**Only use reliable examination results for clinical assessment. The use of poor examination outcomes may lead to incorrect examination results**

Incorrect examination results may lead to incorrect diagnostic conclusions resulting in incorrect therapeutic approaches.

- Always consider the indicated quality index for each examination to check the validity of the results.
- Always consider performing additional examinations, possibly with other diagnostic devices, to obtain a good clinical judgment.
- Cross-check the patient data, examination data, and IOL parameters of the patient before starting the clinical assessment.
- Compare the patient's OD/OS symmetry before starting the clinical assessment.

**WARNING!**

**The automatic segmentation may not be reliable if the structures of the cornea, anterior segment and/or retinal layers are affected by pathologies or if image quality is not sufficient**

An incorrect diagnostic interpretation may result in incorrect therapeutic approaches.

- Before drawing diagnostic conclusions, review the automatic segmentation of all OCT section images and IR camera images.
- Before drawing diagnostic conclusions, review the automatic peak detection of axial length scans.

**WARNING!**

**Dry eyes may cause incorrect examination results due to reduced fixation and motion compensation**

Incorrect examination results may lead to incorrect diagnostic conclusions which may result in improper therapeutic approaches.

- For patients with dry eyes, apply artificial tear fluid shortly before the examination.

**WARNING!**

**Patients with poor fixation may have incorrect examination results**

Incorrect examination results may lead to incorrect diagnostic conclusions which may result in improper therapeutic approaches.

- Adjust the refraction of the internal fixation light so that patients can easily fixate.
- If the internal fixation light is not adequate for proper fixation, use the external fixation light to engage the fellow eye for fixation.

**WARNING!**

**Corneal pathologies or implants may cause incorrect examination results**

Incorrect examination results may lead to incorrect diagnostic conclusions which may result in improper therapeutic approaches.

- Always consider that examination results of patients with corneal pathologies or implants may be inaccurate.
- Do not mistake segmentation artifacts for pathology.
- Do not mistake refractive correction artifacts for pathology.

**WARNING!**

**Anterior segment pathologies or implants may cause incorrect examinations results**

Incorrect examination results may lead to incorrect diagnostic conclusions which may result in improper therapeutic approaches.

- Always consider that examination results of patients with anterior segment pathologies or implants may be inaccurate.
- Do not mistake segmentation artifacts for pathology.
- Do not mistake refractive correction artifacts for pathology.

**WARNING!**

**Retinal pathologies or implants may cause incorrect examinations results**

Incorrect examination results may lead to incorrect diagnostic conclusions which may result in improper therapeutic approaches.

- Always consider that examination results of patients with retinal pathologies or implants may be inaccurate.
- Consider manual axial length adjustement for pathologic eyes.
- Refractive outcomes after cataract surgery may be reduced for patients with pathology.

**WARNING!**

**Length and area measurements are less accurate for patients wearing glasses or contact lenses or patients with intraocular lenses**

Examination results are less accurate for patients wearing glasses or contact lenses or patients with intraocular lenses.

- Ask the patient to remove glasses or contact lenses before the examination.

  Since contact lenses can influence the cornea shape of an uncorrected eye for several days, Heidelberg Engineering strongly recommends patients to refrain from wearing soft and hard contact lenses for a period of several days or weeks, respectively, prior to examination, until corneal topography and tomography measurements are stable.
- Always consider that examination results for patients with intraocular lenses are less accurate.

**WARNING!**

**Carelessly adjusted image brightness and image contrast might lead to bad image quality**

Bad image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches.

- Carefully adjust image brightness and image contrast.

**WARNING!**

**Do not mistake image artifacts for pathologies**

Axial length scans and cross-sectional images of the cornea or the anterior segment may include artifacts.

**WARNING!**

**Careless movement of the camera might injure the patient's nose or fingers**

- Carefully move the camera towards the patient.

**WARNING!**

**A carelessly adjusted device might lead to bad image quality**

Bad image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches.

- Adjust the device table and/or the patient's chair so that the patient reaches the chin rest comfortably.
- Use the buttons for chin rest alignment to adjust the chin rest until the patient’s eyes are level with the marks on the head rest column.
- Adjust the camera carefully.

**WARNING!**

**If the patient is not correctly positioned in front of the device, poor image quality might occur**

Poor image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches.

- Adjust the chin rest so that the patient's eyes are level with the marks on the head rest column.
- Ensure that the patient's forehead touches the forehead rest.

**WARNING!**

**A monitor that is not optimally adjusted may produce images lacking in brightness and/or sharpness**

Bad image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches.

- Adjust the monitor by means of the *"Monitor Setup Tool"*.

**CAUTION!**

**Instruct the patient not to touch electrically powered devices during the examination. Devices that are internally powered, for example battery or accumulator power, are the only exceptions**

Under some rare instances the device could cause an electric shock that might have a serious impact on the patient's health.

## 3.2 Data Security

Follow the instructions below to ensure data security:

**CAUTION!**

**Non-controlled operations on the PC's operating system may lead to data loss**

Lost data might not be restored.

- Only allow authorized personnel to access the database, the patient data, and the archive media.

**CAUTION!**

**If the disk space is seriously low, images might be lost during the acquisition because they cannot be saved**

The acquired images might not be recovered and patients might need to be re-examined.

- Ensure that enough memory is available on the disk where the patient data are saved.
- Archive data regularly.

**CAUTION!**

**A hardware or software failure during image acquisition may cause the software to crash, which may cause acquired images to be lost**

Lost data might not be restored.

- Repeat the image acquisition.

**CAUTION!**

**Data loss might occur due to missing data backup**

Data loss might occur, if the software crashes or the PC hardware breaks down.

- Heidelberg Engineering recommends archiving data on a daily basis.

# 4 The Device


*Fig. 1: ANTERION*

1. Camera unit
2. Touch screen
3. Joystick
4. External fixation light
5. Forehead rest
6. Head rest column with marks
7. Chin rest
8. Up/down buttons for aligning the chin rest
9. I/O switch

# 5 Technical Description

The ANTERION contains two imaging modalities, a scanning optical coherence tomography (OCT) and an infrared (IR) camera. The OCT modality allows for cross-sectional imaging while the IR camera allows for en-face imaging of a patient's eye.

## 5.1 IR Camera

The IR camera image is used to derive measurements such as pupil diameter, and/or white-to-white. After image acquisition, software algorithms are applied to detect the contrast of certain features within the image in order to differentiate between the different ocular tissues that are present. The distances measured between these features are useful clinical parameters described later in this user manual.

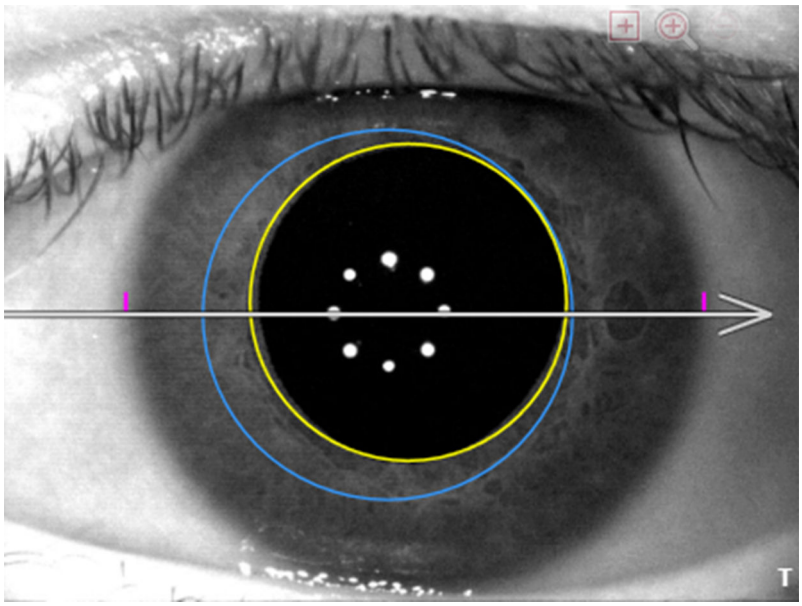

*Fig. 2: IR camera image*

## 5.2 Optical Coherence Tomography

The OCT modality contains a swept-source laser beam that scans a patient's eye laterally. The back scattered or reflected light from this beam is analyzed by the ANTERION, resulting in intensity-based cross-sectional images.

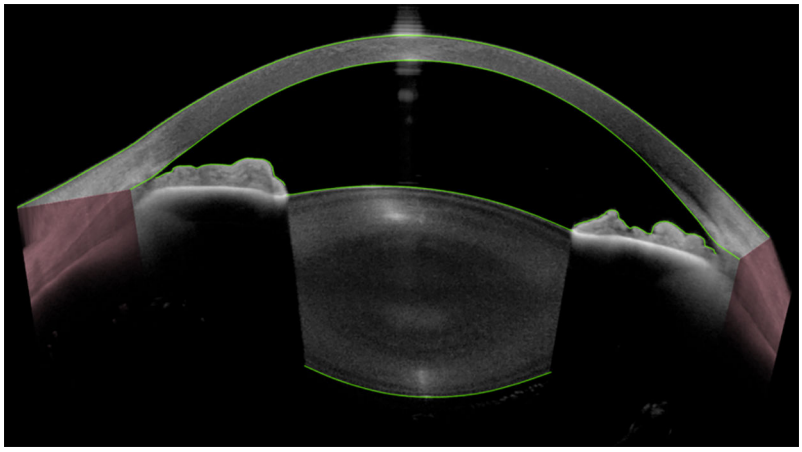

*Fig. 3: OCT section image*

A cross-sectional image (OCT section image) of the anterior segment of the eye is shown (Fig. 3). The analysis software detects specific contrast thresholds within the image and segments the associated anatomical boundaries. Based on these segmented boundaries (green lines), the images are reconstructed and the resulting parameters are corrected for the refractive power of this eye. This reconstruction allows for the resultant image to correctly represent the geometric shape of the eye.

Depending on the examination mode, multiple images can be acquired (Fig. 4).

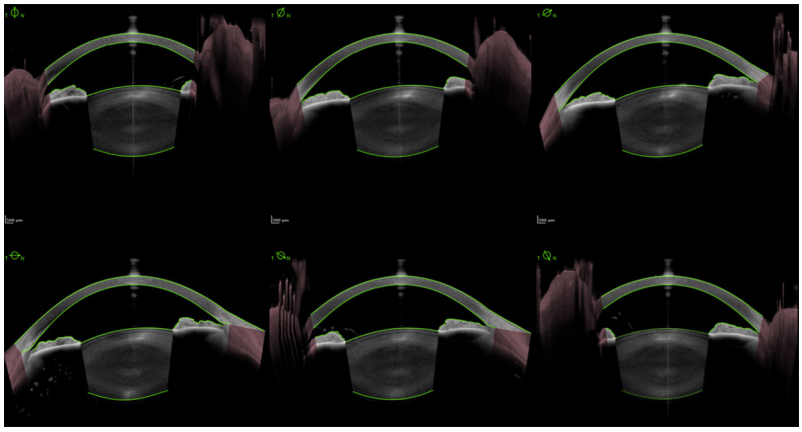

*Fig. 4: Six exemplary OCT section images*

From these multiple OCT section images, a three-dimensional surface is reconstructed.

From this surface, standard maps can be derived and parameters can be calculated (Fig. 5).

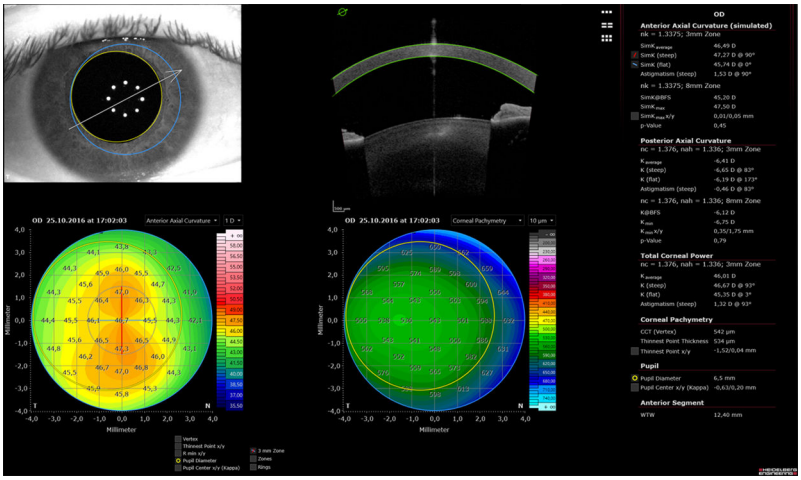


*Fig. 5: Standard maps*

The ANTERION offers a specific scan configuration to measure the ocular axial length, along the line of sight. This scan provides an A-scan intensity profile (Fig. 6) which is used as the basis to measure the axial length. A proprietary segmentation software detects the peak of this profile and thereby defines the axial length.

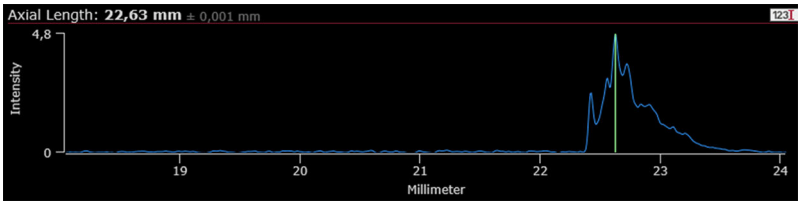


*Fig. 6: A-scan intensity graph and profile*

# 6 User Roles and Rights

Every ANTERION user is part of a user group. A user group has different roles, and every role is assigned to defined rights concerning the use of the software.

The assignments of roles and rights is made in HEYEX 2. For further information on the assignment of user roles and rights, please contact your system administrator.

| User group | Role | Rights |
|---|---|---|
| ▪ Technicians group<br>▪ Physicians group<br>▪ Keyusers group | *“ANTERION Diagnostic Viewer”* | ▪ Data display<br>▪ Data printing<br>▪ Segmentation editing<br>▪ Axial length editing |
| ▪ Physicians group<br>▪ Keyusers group | *“ANTERION Physician”* | ▪ IOL calculation<br>▪ Definition of IOL calculation templates<br>▪ Definition of *“Cornea”* multi view templates |
| ▪ Physicians group<br>▪ Keyusers group | *“ANTERION Surgeon”* | ▪ Personal IOL database management |
| ▪ Keyusers group | *“ANTERION Default Settings”* | ▪ Master IOL database management<br>▪ Default settings editing |

# 7 Applications Overview

The following acquisition applications are available for acquiring data on a patient's eye while the following viewing applications and display options can be used for analyzing the examination data. Each acquisition and viewing application is indicated for a specific clinical application. Each acquisition application contains the appropriate scan patterns in order to allow for acquiring the necessary data for the associated analyses. Each viewing application contains the appropriate analysis options for the desired parameter(s).

## 7.1 *"Cornea"* App

**Available options**

| Options | AQM | VWM |
|---|---|---|
| **Views** | - | *"Single OD/OS"* |
| | - | *"Both eyes"* |
| | - | *"Follow-up"* |
| | - | *"Multi"* |
| **Images** | IR camera images | |
| | OCT section images | |
| **Color Maps** (8 mm zone) | *"Anterior axial curvature"* | |
| | *"Anterior tangential curvature"* | |
| | *"Posterior axial curvature"* | |
| | *"Posterior tangential curvature"* | |
| | *"Pachymetry"* | |
| | *"Anterior elevation (BFS)"* | |
| | *"Anterior elevation (BFT)"* | |
| | *"Posterior elevation (BFS)"* | |
| | *"Posterior elevation (BFT)"* | |
| | *"Total corneal power"* | |
| | - | *"Anterior corneal wavefront"* |
| | - | *"Total corneal wavefront"* |
| **Parameters** | - | Anterior axial curvature values for zones and rings (2 – 8 mm) |
| | - | Radius of min. anterior axial curvature and position on map |
| | - | Radius of anterior cornea "best fit sphere" (in 8 mm zone) |
| | - | Anterior corneal eccentricity |
| | - | Posterior axial curvature values for zones and rings (2 – 8 mm) |
| | - | Radius of min. posterior axial curvature and position on map |

| Options | AQM | VWM |
|---|---|---|
| | - | Radius of posterior cornea “best fit sphere” (in 8 mm zone) |
| | - | Posterior corneal eccentricity |
| | - | Total corneal power values for zones and rings (2 – 8 mm) |
| | - | Central corneal thickness |
| | - | Thinnest point thickness and position on map |
| | - | Pupil diameter |
| | - | Pupil center (kappa) |
| | - | White-to-white |
| | - | Anterior corneal wavefront parameters (up to 7th Zernike order) for different zones |
| | - | Total corneal wavefront parameters (up to 7th Zernike order) for different zones |

## 7.2 *“Cataract”* App

If the *“Cornea”* app is available, all corneal maps, parameters, and the *“Single OD/OS”* and *“Both eyes”* views can be displayed as described for the *“Cornea”* app.

**Available options**

| Options | AQM | VWM |
|---|---|---|
| **Views** | - | *“Biometry OU”* |
| | - | *“Calculation OU”* with Spheric calculator OU Toric calculator OU |
| **Images** | IR camera images | |
| | OCT section images | |
| **Color Maps** (8 mm zone) | *“Anterior axial curvature”* | |
| | *“Total corneal power”* | |
| **Parameters** Standard IOL license | - | Anterior axial curvature values (3 mm ring) |
| | - | Central corneal thickness |
| | - | Aqueous depth |
| | - | Lens thickness |
| | - | Pupil diameter |

| Options | AQM | VWM |
|---|---|---|
| | - | Pupil center (kappa) |
| | - | White-to-white |
| | - | Axial length |
| **Parameters**<br>Premium IOL license | - | Anterior axial curvature values (3 mm ring) |
| | - | Posterior corneal astigmatism (3 mm ring) |
| | - | Total corneal astigmatism (3 mm ring) |
| | - | Total corneal wavefront: spherical and RMS higher order aberrations (3 mm zone, pupil-centered) |
| | - | Central corneal thickness |
| | - | Aqueous depth |
| | - | Lens thickness |
| | - | Pupil diameter |
| | - | Pupil center (kappa) |
| | - | White-to-white |
| | - | Axial length |

## 7.3 *"Metrics"* App

**Available options**

| Options | AQM | VWM |
|---|---|---|
| **Views** | - | *"Single OD/OS"* |
| | - | *"Multi"* |
| **Images** | IR camera images | |
| | OCT section images | |
| **Color Maps**<br>(8 mm zone) | *"Anterior axial curvature"* | |
| | *"Total corneal power"* | |
| **Parameters** | - | Central corneal thickness |
| | - | Aqueous depth |
| | - | Lens thickness |
| | - | Anterior chamber volume |
| | - | Anterior chamber angle (ACA 500 / ACA 750) |
| | - | Scleral spur angle (SSA 500 / SSA 750) |
| | - | Angle opening distance (AOD 500 / AOD 750) |

| Options | AQM | VWM |
|---|---|---|
| | - | Trabecular iris space area (TISA 500 / TISA 750) |
| | - | Spur-to-spur distance |
| | - | Angle-to-angle distance |
| | - | Lens vault |
| | - | Pupil diameter |
| | - | Pupil center (kappa) |
| | - | White-to-white |

## 7.4 *"Imaging"* App

**Available options**

| Options | AQM | VWM |
|---|---|---|
| **Views** | - | *"Single OD/OS"* |
| | - | *"Multi"* |
| **Scan patterns** | This acquisition application offers versatile scan patterns. | This viewing application offers the ability to review the various OCT section images acquired in the *"Imaging"* acquisition application. |

# 8 Preparations

## 8.1 Switching the Device On and Off

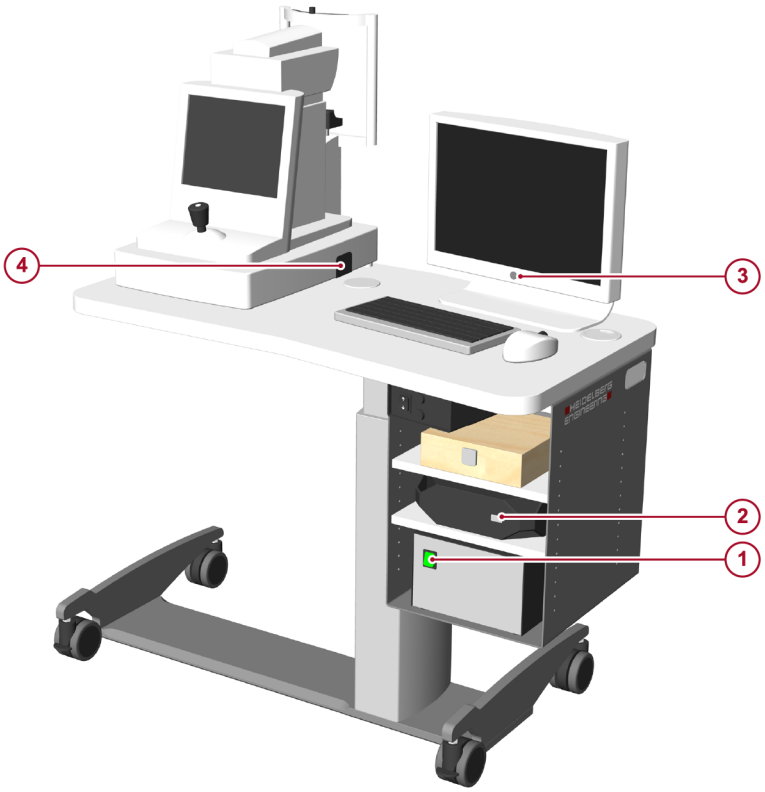


*Fig. 7: Switch-on sequence*

① Isolating transformer
② PC
③ Monitor
④ Device

### Switching the device on

- Switch on the PC ② and monitor ③ (Fig. 7).
- Then, switch on the device ④ (Fig. 7).

  After switching on the device and the PC, the boot sequence is initiated during which the *"Loading your personal settings"* message is displayed. When the login procedure is complete, the Windows desktop is displayed. When the small LED below the touch screen lights up blue, the device and the PC have been successfully switched on.
- Remove the front lens cover from the device.
- Start HEYEX 2.

**Switching the device off**

**NOTICE!**

**Shut-down procedure neglected**

Data may be lost if shut-down procedure is not performed correctly.

- Do not switch off the device when the acquisition window is open.
- Do not switch off the PC without closing the HEYEX software.

- Close HEYEX 2.
- Open the Windows start menu and select *"Shut down"*.

  The *"Shut down"* window is displayed.
- Select *"Shut down"*.

  The PC and monitor turn off.
- Turn off the device ④ (Fig. 7).
- Put the front lens cover on the device.

## 8.2 Downloading the Calibration Files

Device-specific calibration files are required for performing examinations with the device.

When starting the system for the first time, or if you have replaced the device or the PC, a message is displayed indicating that calibration files are required and can now be downloaded from the the device.

- Click *"Download"*.

  The calibration files are downloaded from the device to your computer which may take up to several minutes.

## 8.3 Performing the System Test

Every 24 hours or after transport, the device must pass through a system test. The system test is necessary in order to ensure that certain technical specifications are verified to be accurate and reconfigured, if necessary. Heidelberg Engineering recommends that the system test is initiated prior to use of the device.

**Test target**

- Clean the test target before starting the system test.

  i Keep the test targets clean and dry. The test targets are sensitive and should be kept clean and dry. Avoid touching the glass sphere. If a system test fails, first wipe the glass sphere with a microfiber cloth and repeat the system test.
- Clip the test target to the head rest column.
- Turn it until it is facing the camera head.

**Starting the system test**

After 24 hours, the device automatically recommends to run the system test by prompting the following message *"System test outdated. Please conduct system test."*.

- If *"OK"* is selected, then the system test screen is displayed.
- If *"Cancel"* is selected, then the system test is canceled.

  If the automated system test option is not executed by selecting *"Cancel"*, then the *"System test outdated. Please conduct system test."* message is displayed. This message is displayed until the system test is manually initiated.
- To start the system test manually, tap *"System test"* in the menu bar of the touch screen.

**Performing the system test**

The system test screen is displayed.

- Properly align the camera with the test target (➞ 9.1.4 "Aligning the Camera", p. 49).
  - Start with the lateral alignment of the camera and the test target.
  - When the lateral alignment is successfull, proceed with the axial alignment of the test target and the OCT scan pattern.
- When both alignments are successful, press the joystick button.

  The system test starts and the following examinations are performed:
  - Four *"Cornea"* examinations
  - One *"Metrics"* examination
  - One axial length sequence

  While the device is performing the system test, *"Please wait"* is displayed. The system test ends automatically and, after a brief moment, the system test results are displayed. If the system test was successful, *"System test successful"* is displayed in the upper left corner.
- To confirm, tap *"OK"* in the lower right corner.

  If the system test failed, *"System test failed"* is displayed in the upper left corner.
- Clean the test target using a microfiber cloth.
- To repeat the system test, tap *"Repeat"*.

  If the system test fails after multiple attempts, please contact your Heidelberg Engineering partner.

## 8.4 Preparing the Device

Clean and disinfect the device before each examination. For cleaning and disinfection instructions, please refer to the ANTERION Hardware Manual.

## 8.5 Preparing the Patient

**WARNING!**

**Careless movement of the camera might injure the patient's nose or fingers**

- Carefully move the camera towards the patient.

**WARNING!**

**Insufficient patient preparation may cause poor examination results**

If the examination results are poor, the examination might have to be repeated.

- Carefully explain the procedure to the patient prior to the examination so that the patient is fully prepared and optimal results may be achieved. This preparation is especially important in elderly patients, patients with poor concentration, and patients with fear of the examination.

**WARNING!**

**Corrective lenses may cause incorrect classification results**

If a patient wears corrective lenses such as glasses or contact lenses, images might be incorrectly acquired due to incorrect segmentation or image distortion. The incorrect segmentation might result from the contact lens being mistaken for the cornea. The image distortion might be caused by the refraction of the initial beam.

- Ask the patient to remove glasses or contact lenses before the examination.

### Explaining the examination

- Ask patients that are wearing glasses or contact lenses to remove them prior to initiating the examination.
- Prepare the patient for the examination with the following instructions:
  - Please put your chin on the chin rest and your forehead against the forehead rest.
  - Please lean your forehead against the forehead rest for the duration of the examination.
  - The device will move close to your eye, but the device will not touch it.
  - Please look at the yellow fixation light during the entire examination.
  - Please refrain from blinking, when instructed not to do so, as blinking during the examination may negatively impact the results.
  - The examination will take only a few seconds. You will be informed when the examination is finished.

### Adjusting the device

- Adjust the height of the table for the patient.
- Ask the patient to place the chin on the chin rest.
- Select the *“General”* or the *“Fixation settings”* tab.

- Tap ▲ or ▼ on the *"Chin Rest"* section and adjust the chin rest so that the patient's eyes are level with the marks on the head rest column.

  Alternatively, use the up/down buttons on the device for aligning the chin rest (Fig. 1).

- Ask the patient to place the forehead against the forehead rest.

## 8.6 Preparing the Examination

The default settings can be defined in the *"Settings"* section of the acquisition window.

- In the menu bar, tap *"Settings"*.

  The *"Default settings"* window is displayed.

***"General"* tab**

| Section | Entry | Options |
|---|---|---|
| *"Print"* | *"Default printer"* | Select the desired printer from the list. |
| | *"Default page format"* | *"Auto"* |
| | | *"A4"* |
| | | *"US letter"* |
| *"Examinations"* | *"Save automatically"* | If this checkbox is checked, then examinations that the device deemed to have acceptable acquisition quality will automatically be saved. |

***"Service"* tab**

| Section | Entry | Options |
|---|---|---|
| *"Sequences"* | *"Save"* | To be set for service purposes if recommended by Heidelberg Engineering. |
| | *"Storage location"* | To be set for service purposes if recommended by Heidelberg Engineering. |
| *"Log files"* | *"Logging period per file"* | To be set for service purposes if recommended by Heidelberg Engineering. |
| | *"Maximum size per file"* | To be set for service purposes if recommended by Heidelberg Engineering. |
| | *"Service mode logging"* | To be set for service purposes if recommended by Heidelberg Engineering. |

## 8.7 Preparing the Analysis

Prior to reviewing images in the analysis window for the first time, Heidelberg Engineering recommends to set the default and the individual options.

- Default settings are applied on every workstation.

Only users with administrator rights can configure the default settings.

- Individual settings are only applied on the individual PC and during the current session.

### 8.7.1 Default Settings

Only users with administrator rights can configure the default settings.

Default settings are applied on every workstation.

- In the analysis window, click *"Default settings"*.

  The *"Default settings"* window is displayed.

  The following acquisition settings are available:

- *"General"*
- *"Cornea"*
- *"Cataract"*
- *"Master IOL database"*
- *"Metrics"*
- *"Imaging"*

- Select the desired tab and adjust the settings of choice and click *"Save as defaults"* to confirm.
- To return to the analysis window, click *"Close"*.
- Close and restart the analysis window.

The default settings will come into effect only after a restart of the analysis window.

#### 8.7.1.1 General Settings

***"General"* tab**

| Section | Entry | Options |
|---|---|---|
| *"General"* | *"Expand "More""* | *"Yes"* |
| | | *"No"* |
| | *"B-scan brightness/contrast"* | Adjust the slider to the desired position |
| | *"Color scheme (this workstation only)"* | *"Dark"* |
| | | *"Bright"* |

| Section | Entry | Options |
|---|---|---|
| *"Print"* | *"Default printer (this workstation only)"* | Select the desired printer from the list |
| | *"Default page format"* | *"Auto"* |
| | | *"A4"* |
| | | *"US letter"* |
| *"OKULIX export (this workstation only)"* | *"OKULIX installation directory"* | Select the installation directory<br>**Default:**<br>C:\anterion\okulix |
| | *"Start OKULIX after export"* | *"Yes"* |
| | | *"No"* |

#### 8.7.1.1.1 Monitor Settings

**WARNING!**

**A monitor that is not optimally adjusted may produce images lacking in brightness and/or sharpness**

Bad image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches.

- Adjust the monitor by means of the *"Monitor Setup Tool"*.

- In the analysis window, click *"Default settings"*.

  The *"Default settings"* window is displayed.
- Select the *"General"* tab.
- Click *"Monitor setup tool"* in the upper right corner.

  The test image window is displayed.
- Adjust the monitor brightness and contrast so that:
  - At least stripes 2 and 8 are visible over the entire width.
  - The test image is close to black on the left side.
  - The test image is close to white on the right side.
- To close the monitor setup tool, click *"Close"*.
- To return to the analysis window, click *"Close"*.
- Review the displayed examination and repeat the adjustment if necessary.

### 8.7.1.2 Settings for *"Cornea"* Examinations

***"Cornea"* tab**

| Section | Entry | Options |
|---|---|---|
| *"General"* | *"Preferred unit"* | *"D"* |
| | | *"mm"* |

| Section | Entry | Options |
|---|---|---|
| | *"Astigmatism axis type"* | *"Flat"* |
| | | *"Steep"* |
| | *"Eccentricity"* | *"p-value"* |
| | | *"E-value"* |
| | | *"Q-value"* |
| | *"Default map type"* | *"Anterior axial curvature"* |
| | | *"Anterior tangential curvature"* |
| | | *"Anterior elevation (BFS)"* |
| | | *"Anterior elevation (BFT)"* |
| | | *"Posterior axial curvature"* |
| | | *"Posterior tangential curvature"* |
| | | *"Posterior elevation (BFS)"* |
| | | *"Posterior elevation (BFT)"* |
| | | *"Pachymetry"* |
| | | *"Total corneal power"* |
| | | *"Anterior corneal wavefront"* |
| | | *"Total corneal wavefront"* |
| To open the drop-down list, click *"Map type"*. The default settings may be adjusted for the following color maps:<br>▪ *"Anterior axial curvature"*<br>▪ *"Anterior tangential curvature"*<br>▪ *"Anterior elevation (BFS)"*<br>▪ *"Anterior elevation (BFT)"*<br>▪ *"Posterior axial curvature"*<br>▪ *"Posterior tangential curvature"*<br>▪ *"Posterior elevation (BFS)"*<br>▪ *"Posterior elevation (BFT)"*<br>▪ *"Pachymetry"*<br>▪ *"Total corneal power"*<br>▪ *"Anterior corneal wavefront"*<br>▪ *"Total corneal wavefront"* | *"Color table"* | *"Color map 1"*<br>Heidelberg Engineering recommends working with the *"Color map 1"* color table, which is also convenient for those who are color-blind.<br>An inadequate color table might result in incorrect interpretation of corneal maps. A wrong diagnostic interpretation may result in wrong therapeutic approaches. |
| | | *"Color map 2 (linear)"* |
| | | *"Color map 2 (original)"* |
| | | *"Color map 3"* |
| | | *"Other 1"* |
| | *"No. of color steps"* | *"High"* |
| | | *"Medium"* |
| | | *"Low"* |
| | *"Default difference color table"* | *"Color map 1"*<br>Heidelberg Engineering recommends working with the *"Color map 1"* color table, which is also convenient for those who are color-blind.<br>An inadequate color table might result in incorrect interpretation of corneal maps. A wrong diagnostic interpretation may result in wrong therapeutic approaches. |
| | | *"Color map 2 (linear)"* |

| Section | Entry | Options |
|---|---|---|
| | | *“Color map 3”* |
| | | *“Other 1”* |
| | *“Difference No. of color steps”* | *“High”* |
| | | *“Medium”* |
| | | *“Low”* |
| *“Wavefront”* | *“ROI diameter”* | 3 – 8 mm or Pupil |
| | *“ROI center”* | *“Vertex”* |
| | | *“Pupil center”* |
| | *“RMS LOA”* | *“Yes”* |
| | | *“No”* |
| | *“RMS HOA”* | *“Yes”* |
| | | *“No”* |
| *“Overlays”* | *“Vertex”* | *“Yes”* |
| | | *“No”* |
| | *“Thinnest point”* | *“Yes”* |
| | | *“No”* |
| | *“R min x/y”* | *“Yes”* |
| | | *“No”* |
| | *“Pupil diameter”* | *“Yes”* |
| | | *“No”* |
| | *“Pupil center x/y (kappa)”* | *“Yes”* |
| | | *“No”* |
| | *“Astigmatism”* | *“None”* |
| | | *“3 mm ring”* |
| | | *“Rings”* |
| | | *“Zones”* |
| | *“Astigmatism overlay for zones”* | *“Full meridians”* |
| | | *“Half meridians”* |
| | *“Astigmatism overlay for rings”* | *“Full meridians”* |
| | | *“Half meridians”* |
| | *“B-scan”* | *“Yes”* |
| | | *“No”* |
| | *“ROI”* | *“Yes”* |
| | | *“No”* |
| | *“A-scan”* | *“Yes”* |
| | | *“No”* |

| Section | Entry | Options |
|---|---|---|
| | *“Ring segment mean values on maps”* | *“Yes”* |
| | | *“No”* |
| *“Miscellaneous”* | *“Always show main camera image”* | *“Yes”* |
| | | *“No”* |

#### 8.7.1.3 Settings for *“Cataract”* Examinations

***“Cataract”* tab**

| Section | Entry | Options |
|---|---|---|
| *“General”* | *“Show optimal IOL power (spheric)”* | *“Yes”* |
| | | *“No”* |
| | *“IOL auto-proposal mode (spheric)”* | *“Minimum absolute deviation from IOL power”* |
| | | *“Minimum positive deviation from IOL power”* |
| | | *“Minimum negative deviation from IOL power”* |
| | *“IOL auto-proposal mode (toric)”* | *“Forbid overcorrection (post-incision astigmatism must not be overcorrected by proposed IOL)”* |
| | | *“Allow overcorrection (post-incision astigmatism might be overcorrected by proposed IOL)”* |
| | *“Show warnings for toric calculator”* | *“Diff. pre-incision axis - residual axis >0°”* |
| | | *“Diff. pre-incision axis - residual axis >5°”* |
| | | *“Diff. pre-incision axis - residual axis >10°”* |
| | *“Map visible in toric calculator”* | *“Yes”* |
| | | *“No”* |
| | *“IOL visible in toric calculator”* | *“Yes”* |
| | | *“No”* |
| | *“Default map type”* | *“Anterior axial curvature”* |
| | | *“Total corneal power”* |

**Highlighting recommended values in spheric IOL calculation**

The recommended values are highlighted within a gray frame.

- To recommend the minimum absolute deviation from the target refraction, select *"Minimum absolute deviation from IOL power"* for the option *"IOL auto-proposal mode (spheric)"* in the *"Cataract"* tab of the *"Default settings"*.
- To recommend the minimum positive deviation from the target refraction, select *"Minimum positive deviation from IOL power"* for the option *"IOL auto-proposal mode (spheric)"* in the *"Cataract"* tab of the *"Default settings"*.
- To recommend the minimum negative deviation from the target refraction, select *"Minimum negative deviation from IOL power"* for the option *"IOL auto-proposal mode (spheric)"* in the *"Cataract"* tab of the *"Default settings"*.

For further information, please refer to (➞ 10.2.5.1.1 "Calculating Spheric IOLs", p. 124).

**Displaying optimal IOL power in spheric IOL calculation**

The optimal IOL power for achieving the selected target refraction values is displayed if in the *"Cataract"* tab of the *"Default settings"*, *"Yes"* has been selected for the option *"Show optimal IOL power (spheric)"*.

For further information, please refer to (➞ 10.2.5.1.1 "Calculating Spheric IOLs", p. 124).

**Highlighting recommended values in toric IOL calculation**

The recommended values are highlighted within a gray frame.

- To recommend values excluding an overcorrected post-incision astigmatism, select *"Forbid overcorrection (post-incision astigmatism must not be overcorrected by proposed IOL)"* for the option *"IOL auto-proposal mode (toric)"* in the *"Cataract"* tab of the *"Default settings"*.
- To recommend values including an overcorrected post-incision astigmatism, select *"Allow overcorrection (post-incision astigmatism might be overcorrected by proposed IOL)"* for the option *"IOL auto-proposal mode (toric)"* in the *"Cataract"* tab of the *"Default settings"*.

For further information, please refer to (➞ 10.2.5.1.2 "Calculating Toric IOLs and Incisions", p. 127).

### 8.7.1.4 *"Master IOL database"* Settings

Prior to using the IOL calculator, the relevant IOL constants must be added to the surgeon's database, or these IOL constants can be imported from a master IOL database. For further information on how to get a master IOL database file, please contact your Heidelberg Engineering partner.

**Importing a master IOL database**

- Click *"Import master IOL database"*.

  The Windows Explorer is displayed.
- Browse to the folder where the IOL database file is located.

  The following file types are supported:

  - *"*.mdb"*
  - *"*.json"*
  - *"*.zip"*
- Select the desired file and click *"Open"*.
- Read the *"End User License Agreement (EULA)"* and click *"Accept"* to agree.

  After the import, the master IOL database is displayed.
- To confirm, click *"Save"*.

> **To allow the import of *.mdb files, Microsoft Access is required**
>
> If the master IOL database import fails, the *"AccessDatabaseEngine_X64"* may be missing.
>
> - To install the missing files, double-click *"C:\Heyex\Service\AccessDatabaseEngine_X64.exe"*.

**Editing spheric and toric availability in the *"Master IOL database"***

The spheric and toric availability of an IOL that has been imported from the master IOL database has to be defined before using an IOL for calculation.

- Select the desired IOL and click *"Edit values of this IOL in master IOL database"*.

  The *"Edit entry in master IOL database"* window is displayed.
- Next to *"Spheric availability"*, click *"Edit spheric availability"*.

  The *"Edit spheric availability"* window is displayed.
- Enter ther diopter range and increments and click *"OK"*.
- Next to *"Toric availability"*, click *"Edit toric availability"*.

  The *"Edit toric availability"* window is displayed.
- Enter ther diopter range and increments and click *"OK"*.
- To close the *"Edit entry in master IOL database"* window, click *"OK"*.

▸ To save the changes, click *“Save”*.

#### 8.7.1.5 Settings for *“Metrics”* Examinations

***“Metrics”* tab**

| Section | Entry | Options |
|---|---|---|
| *“Miscellaneous”* | *“Always show main camera image”* | *“Yes”* |
| | | *“No”* |
| | *“360° diagram type (top)”* | *“ACA 500”* |
| | | *“ACA 750”* |
| | | *“SSA 500”* |
| | | *“SSA 750”* |
| | | *“AOD 500”* |
| | | *“AOD 750”* |
| | | *“TISA 500”* |
| | | *“TISA 750”* |
| | *“360° diagram type (bottom)”* | *“ACA 500”* |
| | | *“ACA 750”* |
| | | *“SSA 500”* |
| | | *“SSA 750”* |
| | | *“AOD 500”* |
| | | *“AOD 750”* |
| | | *“TISA 500”* |
| | | *“TISA 750”* |
| *“Overlays”* | *“B-scan”* | *“Yes”* |
| | | *“No”* |
| | *“Vertex”* | *“Yes”* |
| | | *“No”* |
| | *“A-scan”* | *“Yes”* |
| | | *“No”* |
| | *“Scleral spurs”* | *“Yes”* |
| | | *“No”* |
| | *“ACA recess points”* | *“Yes”* |
| | | *“No”* |
| | *“CCT”* | *“Yes”* |
| | | *“No”* |
| | *“Aqueous depth”* | *“Yes”* |
| | | *“No”* |

| Section | Entry | Options |
|---|---|---|
| | *“Anterior chamber volume”* | *“Yes”* |
| | | *“No”* |
| | *“ACA distance”* | *“Yes”* |
| | | *“No”* |
| | *“Spur-to-spur distance”* | *“Yes”* |
| | | *“No”* |
| | *“AOD 500”* | *“Yes”* |
| | | *“No”* |
| | *“AOD 750”* | *“Yes”* |
| | | *“No”* |
| | *“ACA 500”* | *“Yes”* |
| | | *“No”* |
| | *“ACA 750”* | *“Yes”* |
| | | *“No”* |
| | *“SSA 500”* | *“Yes”* |
| | | *“No”* |
| | *“SSA 750”* | *“Yes”* |
| | | *“No”* |
| | *“TISA 500”* | *“Yes”* |
| | | *“No”* |
| | *“TISA 750”* | *“Yes”* |
| | | *“No”* |
| | *“Lens thickness”* | *“Yes”* |
| | | *“No”* |
| | *“Lens vault”* | *“Yes”* |
| | | *“No”* |

#### 8.7.1.6 Settings for *“Imaging”* Examinations

***“Imaging”* tab**

| Section | Entry | Options |
|---|---|---|
| *“Miscellaneous”* | *“Always show main camera image”* | *“Yes”* |
| | | *“No”* |
| *“Overlays”* | *“B-scan”* | *“Yes”* |
| | | *“No”* |
| | *“A-scan”* | *“Yes”* |
| | | *“No”* |

### 8.7.2 Individual Settings

Individual settings can only be set for the selected application.

**Individual settings are only applied on the individual PC and during the current session**
After a restart of the analysis window or after the login of a different user, the default settings will be applied.

- In the analysis window, select the desired app.
- In the analysis window of the selected app, click *"Settings"*.

  The *"Settings"* window is displayed.
- Adjust the settings of choice and click *"Apply"* to confirm.
- To return to the analysis window, click *"Close"*.

#### 8.7.2.1 Settings for *"Cornea"* Examinations

**Map settings**

| Section | Entry | Options |
|---|---|---|
| To open the drop-down list, click *"Map type"*. The default settings may be adjusted for the following color maps:<br>▪ *"Anterior axial curvature"*<br>▪ *"Anterior tangential curvature"*<br>▪ *"Anterior elevation (BFS)"*<br>▪ *"Anterior elevation (BFT)"*<br>▪ *"Posterior axial curvature"*<br>▪ *"Posterior tangential curvature"*<br>▪ *"Posterior elevation (BFS)"*<br>▪ *"Posterior elevation (BFT)"*<br>▪ *"Pachymetry"*<br>▪ *"Total corneal power"*<br>▪ *"Anterior corneal wavefront"*<br>▪ *"Total corneal wavefront"* | *"Color table"* | *"Color map 1"*<br>Heidelberg Engineering recommends working with the *"Color map 1"* color table, which is also convenient for those who are color-blind.<br>An inadequate color table might result in incorrect interpretation of corneal maps. A wrong diagnostic interpretation may result in wrong therapeutic approaches. |
| | | *"Color map 2 (linear)"* |
| | | *"Color map 2 (original)"* |
| | | *"Color map 3"* |
| | | *"Other 1"* |
| | *"No. of color steps"* | *"High"* |
| | | *"Medium"* |
| | | *"Low"* |
| | *"Default difference color table"* | *"Color map 1"*<br>Heidelberg Engineering recommends working with the *"Color map 1"* color table, which is also convenient for those who are color-blind.<br>An inadequate color table might result in incorrect interpretation of corneal maps. A wrong diagnostic interpretation may result in wrong therapeutic approaches. |
| | | *"Color map 2 (linear)"* |

| Section | Entry | Options |
|---|---|---|
| | | *"Color map 3"* |
| | | *"Other 1"* |
| | *"Difference No. of color steps"* | *"High"* |
| | | *"Medium"* |
| | | *"Low"* |

### 8.7.2.2 Settings for *"Cataract"* Examinations

#### 8.7.2.2.1 Personal IOL Database Settings

**Adding a new IOL**

- In the *"Settings"* window, select the *"Personal IOL database settings"* tab.
- Open the *"Default IOL database"* drop-down list in the upper center of the screen and select the surgeon name.
- Click *"Add IOL to my IOL database"* in the upper right corner of the screen.

  The *"Add IOL to my IOL database"* window is displayed.
- Enter an IOL name and the desired IOL constants.
- Next to *"Spheric availability"*, click *"Edit spheric availability"*.

  The *"Edit spheric availability"* window is displayed.
- Enter ther diopter range and increments and click *"OK"*.
- Next to *"Toric availability"*, click *"Edit toric availability"*.

  The *"Edit toric availability"* window is displayed.
- Enter ther diopter range and increments and click *"OK"*.
- To close the *"Add IOL to my IOL database"* window, click *"Close"*.
- To add the new IOL, click *"Create"*.

**Formulas and IOL constants for IOL calculation**

**Available formulas and references**

| Formula | Year | Reference |
|---|---|---|
| *"SRK/T"* | 1990 | J. A. Retzlaff, D. R. Sanders, M. C. Kraff |
| *"Holladay 1"* | 1988 | J. T. Holladay |
| *"Haigis"* | 1997 | W. Haigis |
| *"Haigis-L (post-LASIK)"* | 2012 | W. Haigis |
| *"Hoffer Q"* | 1993 | K. J. Hoffer |

For toric IOL calculations, meridional analysis as described by Fam and Lim [1] and adapted by Savini et al. [2] is performed. Within these calculations the IOL formula chosen for spheric IOL calculations is used.

- [1] Fam HB, Lim KL. *Meridional analysis for calculating the expected spherocylindrical refraction in eyes with toric intraocular lenses.* J Cataract Refract Surg. 2007 Dec;33(12):2072-6
- [2] Savini G, Hoffer KJ, Carbonelli M, Ducoli P, Barboni P. *Influence of axial length and corneal power on the astigmatic power of toric intraocular lenses.* J Cataract Refract Surg. 2013 Dec;39(12):1900-3

**IOL constants**

| Constant | Comment |
|---|---|
| *"Nominal"* | Nominal A-constant given by the IOL manufacturer |
| *"Haigis A0"*, *"Haigis A1"*, *"Haigis A2"* | Optimized constants for the *"Haigis"* formula |
| *"pACD"* | Personalized ACD constant for the *"Hoffer Q"* formula |
| *"SF"* | Optimized surgeon factor for the *"Holladay 1"* formula |
| *"SRK/T"* | Optimized A-constant for the *"SRK/T"* formula |

**Plausibility check**

The plausibility of IOL database entries shown in the user's IOL database is checked by checking all IOL constants against the nominal A-constant.

A yellow square next to a value indicates that this value may not be plausible and should be checked again.

### Adding an IOL from the master IOL database to the surgeon's IOL database

- In the *"Settings"* window, select the *"Personal IOL database settings"* tab.
- Open the *"Default IOL database"* drop-down list in the upper center of the screen and select the surgeon name.

  The surgeon's individual IOL database is displayed in the upper portion of the window, and the master IOL database is displayed in the lower portion of the window.
- To add an IOL from the master IOL database to the surgeon's database, select the desired IOL and click ⊞ *"Add IOL to my IOL database"* in front of the selected IOL name.

  The selected IOL is added to the surgeon's IOL list.
- To save the IOL database changes, click *"Save"*.

**Deleting an IOL from the surgeon's IOL database**

- In the *"Settings"* window, select the *"Personal IOL database settings"* tab.
- To delete an IOL from the surgeon's IOL database, select the IOL to be deleted and click .
- A message is displayed asking you whether you really want to remove the selected IOL from the IOL database.
- To confirm, click *"Yes"*.

**Editing IOL constants in the surgeon's IOL database**

The IOL constants may be edited and adjusted for a clinician's personalized surgeon factor.

- In the *"Settings"* window, select the *"Personal IOL database settings"* tab.
- To edit an IOL in the surgeon's IOL database, select the IOL to be edited and click *"Edit values of this IOL in my IOL database"*.

  The *"Edit entry in my IOL database"* window is displayed.
- Edit the values and click *"OK"* to confirm.

  Manually edited entries are displayed in blue.
- To save the changes, click *"Save"*.

### 8.7.2.2.2 Map Settings

- In the *"Settings"* window, select the *"Map settings"* tab.

**Map settings**

| Section | Entry | Options |
|---|---|---|
| To open the drop-down list, click *"Map type"*. The default settings may be adjusted for the following color maps:<br>▪ *"Anterior axial curvature"*<br>▪ *"Anterior tangential curvature"*<br>▪ *"Anterior elevation (BFS)"*<br>▪ *"Anterior elevation (BFT)"*<br>▪ *"Posterior axial curvature"*<br>▪ *"Posterior tangential curvature"*<br>▪ *"Posterior elevation (BFS)"*<br>▪ *"Posterior elevation (BFT)"*<br>▪ *"Pachymetry"* | *"Color table"* | *"Color map 1"*<br>Heidelberg Engineering recommends working with the *"Color map 1"* color table, which is also convenient for those who are color-blind.<br>An inadequate color table might result in incorrect interpretation of corneal maps. A wrong diagnostic interpretation may result in wrong therapeutic approaches. |
| | | *"Color map 2 (linear)"* |
| | | *"Color map 2 (original)"* |
| | | *"Color map 3"* |
| | | *"Other 1"* |
| | *"No. of color steps"* | *"High"* |
| | | *"Medium"* |
| | | *"Low"* |

| Section | Entry | Options |
|---|---|---|
| ▪ *“Total corneal power”*<br>▪ *“Anterior corneal wavefront”*<br>▪ *“Total corneal wavefront”* | *“Default difference color table”* | *“Color map 1”*<br>Heidelberg Engineering recommends working with the *“Color map 1”* color table, which is also convenient for those who are color-blind.<br>An inadequate color table might result in incorrect interpretation of corneal maps. A wrong diagnostic interpretation may result in wrong therapeutic approaches. |
| | | *“Color map 2 (linear)”* |
| | | *“Color map 3”* |
| | | *“Other 1”* |
| | *“Difference No. of color steps”* | *“High”* |
| | | *“Medium”* |
| | | *“Low”* |

# 9 *“Cornea”* App

## 9.1 Examining Patients

### 9.1.1 Starting Existing Orders

> When starting the system the first time every day, or every 24 hours, the system test has to be performed. For further information on how to perform the system test, please refer to (➞ 8.3 “Performing the System Test”, p. 30).

The following procedure assumes that HEYEX 2 has been started, an order has been created, the navigator is open, and that the desired patient is selected.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

- Select the *“Examination”* tab in the ribbon bar.
- Click *“Start”* in the *“Examinations”* section.

  The *“Select examination”* window is displayed.
- Select the desired order and click *“Start examination”*.

  The acquisition window is displayed on the touch screen of the device.
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31) and select the desired examination application.

### 9.1.2 Adjusting the Internal Fixation Light

If the patient cannot see the internal fixation light clearly, its sharpness and brightness may be adjusted. Ask the patient whether the internal fixation light is clearly visible while the camera is adjusted.

> Please note that the following settings must be adjusted for each eye separately.

> Make sure that the patient is not distracted during fixation, e.g. by persons walking by.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.
- In order to adjust the brightness of the internal fixation light, tap **−** to decrease the brightness and **+** to increase the brightness in the *“Fixation light brightness”* section. The scale of the brightness ranges from 0 to 5, where 0 indicates that the fixation light is off, 1 indicates low brightness and 5 indicates high brightness of the fixation light. Increasing the brightness may be especially helpful for patients with cataracts.

- In order to adjust the sharpness of the internal fixation light, tap — in the *“Fixation light focus”* section to shift the fixation light focus to myopic correction and + to shift the fixation light focus to hyperopic correction. The scale of the focus ranges from -15 D to +15 D and can be adjusted in 0.5 D increments. Changing the internal fixation light focus may be especially helpful for patients with refractive errors, or to improve the axial length signal.

> **Storing the *“Fixation light focus”* settings**
> The *“Fixation light focus”* settings will be stored in the database.
>
> The settings are automatically used for future acquisitions performed on the same patient and eye.

### 9.1.3 Using the External Fixation Light

If the internal fixation light is not adequate for proper fixation, use the external fixation light to engage the fellow eye for fixation.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.

- To switch on the external fixation light, tap the light bulb symbol in the *“External fixation light”* section.

- Move the external fixation light so that the fixation of the patient's fellow eye is achieved with the external fixation light.

### 9.1.4 Aligning the Camera

**Display options** You can change the display of the acquisition window.

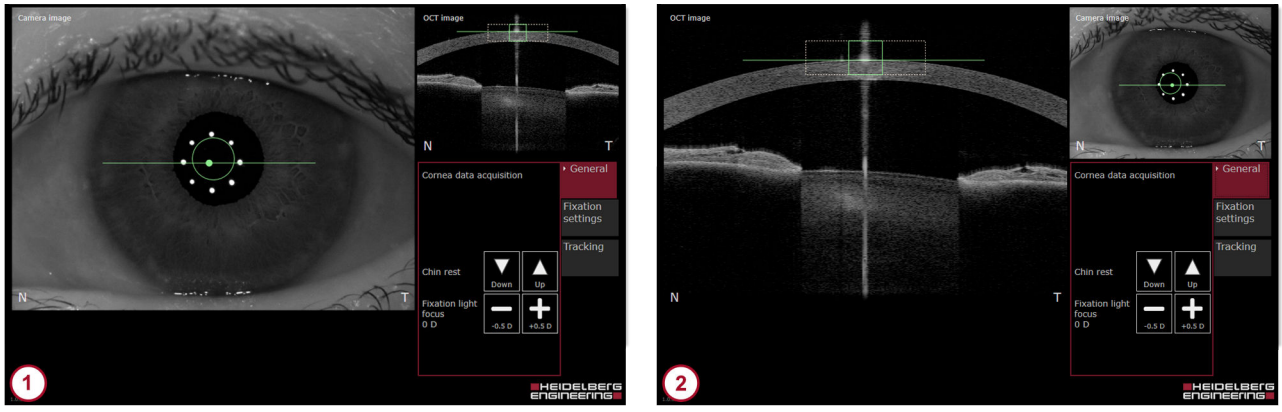


*Fig. 8: Display options*

① Large camera image
② Large OCT section image

By default, the camera image is shown enlarged in the acquisition window ① (Fig. 8).

- To enlarge the OCT section image in the acquisition window ② (Fig. 8), tap the OCT section image.

- To enlarge the camera image again ① (Fig. 8), tap the camera image.

For an optimal examination result, the alignment must be performed according to the following steps in sequence:

- Start with the lateral alignment of the camera and the eye (➞ “Aligning the camera image”, p. 50).
- When the lateral alignment is successfull, proceed with the axial alignment of the eye and the OCT scan pattern (➞ “Aligning the OCT section image”, p. 51).

**Aligning the camera image**

Use the joystick to align the camera so that the circle and the horizontal line are within the eight reflection points on the camera image.

The circle indicates the target position for the corneal vertex in the center of the camera image. The dot in the middle of the line indicates the location of the tracked corneal vertex, i. e. the center of the eight reflection points. The line indicates the lateral position of the live OCT section image.

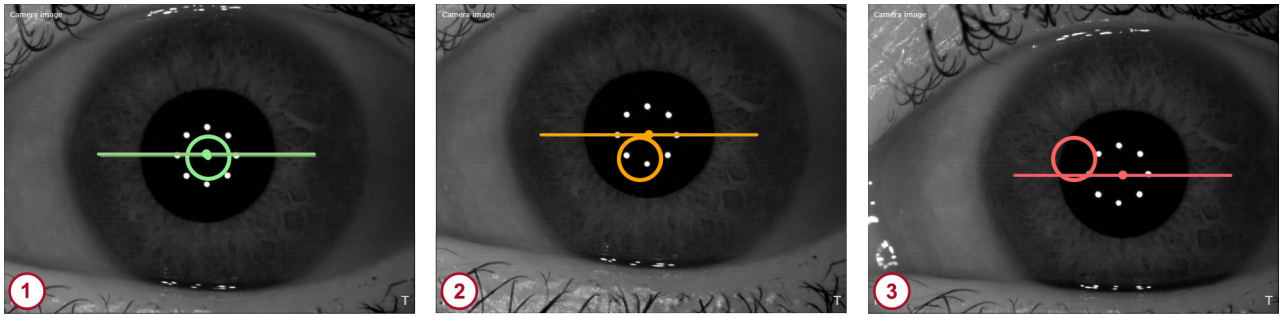


*Fig. 9: Aligning the camera image*

① Camera image correctly aligned
② Camera image acceptably aligned
③ Camera image not properly aligned

- Carefully move the camera towards the patient's eye.
- Move the camera slightly to the left and the right until the iris is visible within the camera image.
- During camera alignment, ask the patient whether the fixation light is bright and clearly visible. If not, readjust the fixation light (➞ 9.1.2 “Adjusting the Internal Fixation Light”, p. 48).
- Turn the joystick clockwise or counterclockwise until the circle and the horizontal line are within the eight reflection points on the camera image.

  If the camera is correctly aligned, the circle and the line turn green ① (Fig. 9). The image acquisition can be initiated.

  If the camera is acceptably aligned, the circle and the line are yellow ② (Fig. 9). While this quality indicator suggests that the alignment is acceptable, Heidelberg Engineering recommends to align the camera correctly ① (Fig. 9) for best results.

  If the camera is not properly aligned, the circle and the line are red ③ (Fig. 9). Image acquisition is not possible when the camera is not acceptably or correctly aligned. Readjust the camera until the image is acceptably or correctly aligned.

**Aligning the OCT section image**

Use the joystick to align the OCT section image so that the square and the horizontal line turn green.

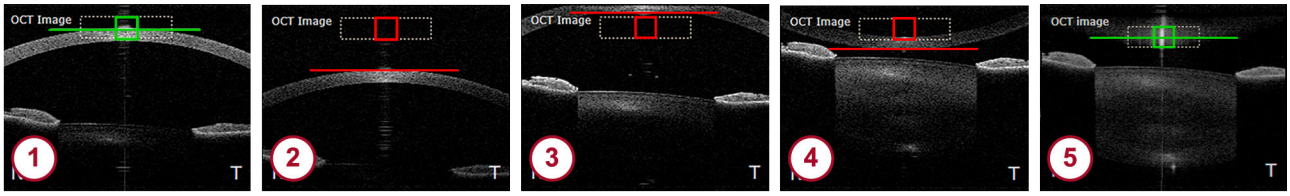


*Fig. 10: Aligning the OCT section image*

① OCT section image is correctly aligned
② Move the camera closer to the patient's eye
③ Move the camera away from the patient's eye
④ Move the camera away from the patient's eye
⑤ Move the camera away from the patient's eye

- Align the camera so that the cornea and the corneal reflex are within the dashed box.

  If the OCT section image is aligned correctly, the square and the line in the dashed box turn green ① (Fig. 10).

  If the camera is too far away from the patient's eye, the OCT section image will be below the dashed box ② (Fig. 10).

- Move the camera closer to the patient's eye.

  If the camera is too close to the patient's eye, the OCT section image will be above the dashed box ③ or flipped ④ (Fig. 10).

- Move the camera away from the patient's eye.

  If the camera is too close to the patient's eye and the cornea is flipped, the square and the line may erroneously turn green because the corneal vertex reflex is detected ⑤ (Fig. 10).

- If the camera is acceptably aligned, the square and the line in the dashed box are yellow. While this quality indicator suggests that the alignment is acceptable, Heidelberg Engineering recommends to align the camera correctly for best results.

- Move the camera away from the patient's eye until the cornea is displayed correctly ① (Fig. 10).

**Disabling tracking**

**WARNING!**

**Disabling tracking may cause inaccurate examination results**

Inaccurate examination results may lead to incorrect diagnostic conclusions resulting in incorrect therapeutic approaches.

- Always consider that examinations without the tracking function may be less accurate.

Unacceptable image alignment during the acquisition process (pressed joystick button) results in a message indicating that acquisition is not possible. This scenario could be present, for example, if the tracked corneal reflex on the camera image is unstable. In such instances, the camera should be realigned, or tracking should be disabled in order to continue the acquisition.

Tracking is disabled only for the current acquisition.

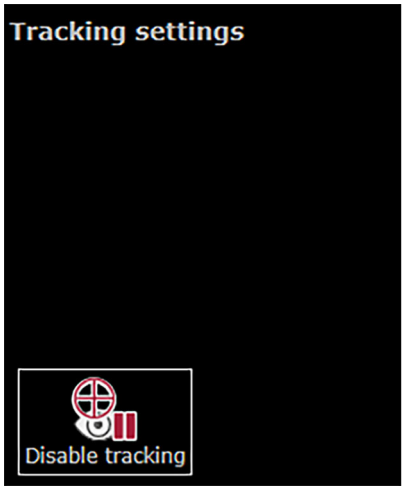


*Fig. 11: Disabling tracking*

- To switch off the tracking function, select the *“Tracking”* tab and click *“Disable tracking”* (Fig. 11).

  The alignment markers on the camera image and OCT section image turn blue.
- Manually align the camera image so that the eight reflection points are centered.
- Manually align the OCT section image so that the cornea is within the dashed box and the corneal vertex reflection is centered laterally.
- Start the examination.

  The aquisition quality parameters *“Motion”*, *“Fixation”* and *“Tear film and lid”* are not applicable and are indicated as *“n/a”*.

  *“Tracking off”* is displayed together with a warning symbol.

**No automatic quality indicators are available when tracking is disabled**

Examination results should be carefully reviewed for accuracy.

- Review all camera images for motion in the analysis window.
- Check the accuracy of the segmented boundaries within the OCT section images in the analysis window.

### 9.1.5 Acquiring Images

**Preparing the examination**

- Start an existing order (➞ 9.1.1 “Starting Existing Orders”, p. 48).
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31).

 

- Tap *“Cornea”* on the touch screen.

**Aligning the camera**

- To examine the right eye, move the camera to the left and use the eye occluder to cover the left eye.

  In the upper left corner of the touch screen, *“OD”* is displayed.
- When switching eyes during the acquisition process, pull the camera back to its farthest back position, then slide it to the left or right.
- To examine the left eye, move the camera to the right and use the eye occluder to cover the right eye.

  In the upper left corner of the touch screen, *“OS”* is displayed.
- Align the camera so that the camera image and the OCT section image are displayed correctly (➞ 9.1.4 “Aligning the Camera”, p. 49).

**Starting the examination**

- Ask the patient to blink.
- Readjust the camera, if needed.
- Ask the patient to refrain from blinking for a few seconds.
- Press the joystick button.

  Image acquisition starts.
- Keep the device as still as possible.

  The examination stops after a brief moment.

**Examination quality**

Immediately after the examination process is completed, the examination quality is checked. If the acquisition quality is acceptable or good, then the basic examination results are displayed after a brief moment.

- Check the examination quality (➞ 9.1.6 “Checking the Examination Quality”, p. 54).

  If the quality of the examination is not ideal or is compromised, then a message is displayed, indicating that one of the following quality parameters is not met:

  - *“Vertex out of alignment”*
  - *“Too strong movement”*
  - *“Cornea out of axial alignment”*
  - *“Possible blinking”*

  A window will appear, indicating the option to repeat the examination or to proceed to the analysis of the data.
- To discard the acquired data and repeat the examination, tap *“Repeat”*.

  The acquisition screen is displayed again.
- Realign the camera and repeat the examination.
- To proceed with analyzing the examination data, tap *“Proceed”*.

  The basic examination results are displayed after a brief moment.
- Check the examination quality (➞ 9.1.6 “Checking the Examination Quality”, p. 54).

### 9.1.6 Checking the Examination Quality

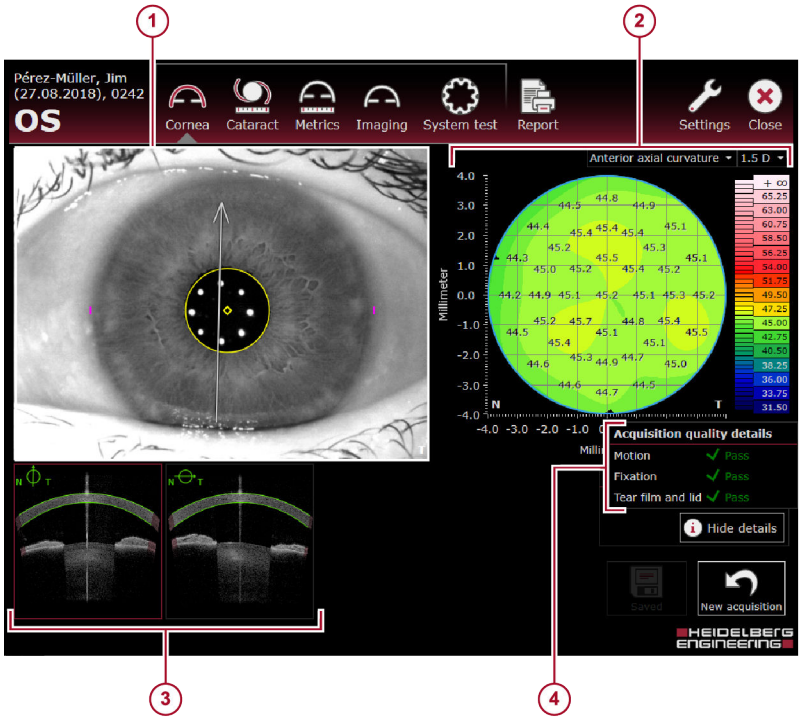


*Fig. 12: Basic examination results*

1. Camera image
2. Color map with color scale
3. OCT section images, the selected OCT section image is marked with a red frame, the direction of the scan is indicated by a symbol in the upper left corner
4. Acquisition quality parameters

By default, the summarized acquisition quality result is displayed and the details are hidden.

**Acquisition quality** ④

- To display the detailed acquisition quality results, click *“Show details”*.
- Check the acquisition quality parameters:
  - If *“Motion”* is yellow or red, then one or more of the following factors may have impacted the results during the acquisition process:
    - The corneal vertex was not correctly aligned, laterally.
    - The corneal vertex moved too much.
    - The corneal vertex was not correctly aligned, axially.
  - If *“Fixation”* is yellow or red, then the patient did not fixate properly during the acquisition process.
  - If *“Tear film and lid”* is yellow or red, then the corneal reflexes were compromised during the acquisition process due to one of the following reasons:
    - The patient did not open his or her eyes wide enough or blinked.
    - The patient has dry eyes.
    - The patient has abnormal corneal irregularities.

  i If any of the quality parameters are red, Heidelberg Engineering recommends reinstructing and reexamining the patient. If any of the quality parameters are yellow, Heidelberg Engineering recommends to carefully review the data and to decide on a case-by-case basis whether the quality of the data is acceptable or if a repeated examination is needed.

  - If *“Refraction correction”* is displayed, please refer to (➞ 9.1.6.1 “Message *“Refraction correction”*”, p. 56).
  - If *“Required data points”* is displayed, please refer to (➞ 9.1.6.2 “Message *“Required data points”*”, p. 56).
  - If *“Camera image segmentation”* is displayed, please refer to (➞ 9.1.6.3 “Message *“Camera image segmentation”*”, p. 56).
- To hide the detailed acquisition quality results, click *“Hide details”*.

**Camera image** ①

- Check that the camera image is sharp.
- Check that the reflection points are sharply displayed, circular in shape, and are displayed in a circular pattern.
- Check that the pupil and/or white-to-white boundaries are acceptably segmented on the IR camera image if these parameters are relevant.

  If the segmentation is not acceptable, Heidelberg Engineering recommends to repeat the measurements.

**OCT section images** ③

- Review the segmentation of the OCT section images.
- If the corneal boundaries are not acceptably segmented on the OCT section image, Heidelberg Engineering recommends to reexamine the patient.

**Color map** ②

- Check the plausibility of the color map.
- Verify that there is adequate data within the central sections of the color map.

**Acquiring additional images**

- To acquire additional images, tap ↶ *“New acquisition”*.

  The examination window is displayed. Align the camera and reexamine the patient.

#### 9.1.6.1 Message *“Refraction correction”*

If the refraction correction failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Refraction correction”* status is displayed in red.
- In the OCT section images, the cornea is not segmented.
- In the color map, no information is displayed.

If the refraction correction failed, no measurements are possible. Heidelberg Engineering recommends reexamining the patient.

#### 9.1.6.2 Message *“Required data points”*

If an insufficient number of data points has been detected during the examination, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Required data points”* status is displayed in red.
- In the color map, there is missing information.

This error message is typically displayed if the patient did not open his or her eye wide enough during the acquisition process. Heidelberg Engineering recommends reinstructing and reexamining the patient.

#### 9.1.6.3 Message *“Camera image segmentation”*

If the segmentation of the pupil failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Camera image segmentation”* status is displayed in red.
- On the camera image, neither the pupil diameter nor the WTW distance are displayed.

The pupil diameter and the WTW distance will not be displayed in the analysis window. When this message appears, it should be decided on a case-by-case basis whether the examination should be accepted with compromised quality or a repeat examination is indicated.

## 9.2 Analyzing Examinations

The analysis window offers the following four views:

- *“Single OD/OS”*
- *“Both eyes”*
- *“Follow-up”*
- *“Multi”*

**When analyzing examinations, always check all parameters for their plausibility**

Cross-check all parameters with respect to the available reference data.

### 9.2.1 Opening Examinations in the Analysis Window

The following procedure assumes that HEYEX 2 has been started.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

- To open examinations in the analysis window, select the desired patient in the *“Patients”* list.

  All examinations are listed in the *“Examinations”* list.
- Select the desired examination.

  All series are displayed in the *“Series”* section.
- To display series as lists, select the *“Series”* tab at the bottom of the *“Series”* section.
- To display series as thumbnails, select the *“Series thumbnails”* tab at the bottom of the *“Series”* section.

  The following sections assume that the *“Series thumbnails”* tab has been selected.
- Double-click the desired thumbnail.

  The analysis window is displayed.

### 9.2.2 Analysis Workflow

**Step 1 – Reviewing the segmentation**

- In the analysis window, open an examination acquired with the *“Cornea”* acquisition application.

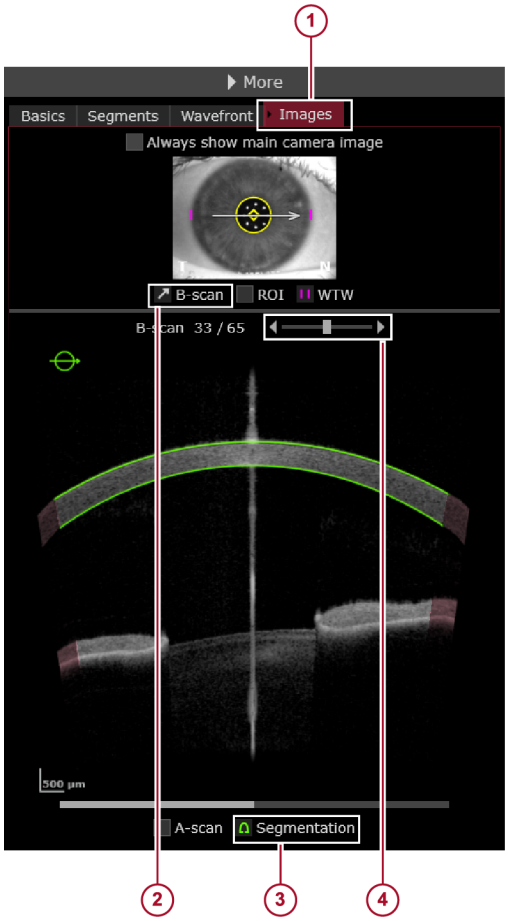


*Fig. 13: Reviewing the segmentation*

1. *“Images”* tab
2. *“B-scan”* checkbox
3. *“Segmentation”* checkbox
4. *“B-scan”* slider

- In the *“More”* section, select the *“Images”* tab ① (Fig. 13).
- Select the *“B-scan”* checkbox ② (Fig. 13).
- Select the *“Segmentation”* checkbox ③ (Fig. 13).
- Scroll through all of the OCT section images of the examination ④ (Fig. 13).
- Verify that the segmentation of the corneal boundaries is acceptable on all OCT section images.

  If the corneal boundaries are not acceptably segmented on all OCT section images, Heidelberg Engineering recommends to reexamine the patient since manual adjustments to the segmentation are not possible. If reexamination of the patient is not possible for any reason, the data may be analyzed with suboptimal segmentation but these errors should be considered.

**Step 2 – Analyzing single examinations**

To analyze the results of a single examination, select one of the following viewing options:

- *“Single OD/OS”*
- *“Both eyes”*
- *“Multi”*

Heidelberg Engineering recommends to use the *“Multi”* view for initial review of the data acquired. The *“Multi”* view option offers 2, 3, 4, or 6 different corneal maps of the same eye to be viewed at the same time. Various templates can be saved and personalized, optimizing the analysis.

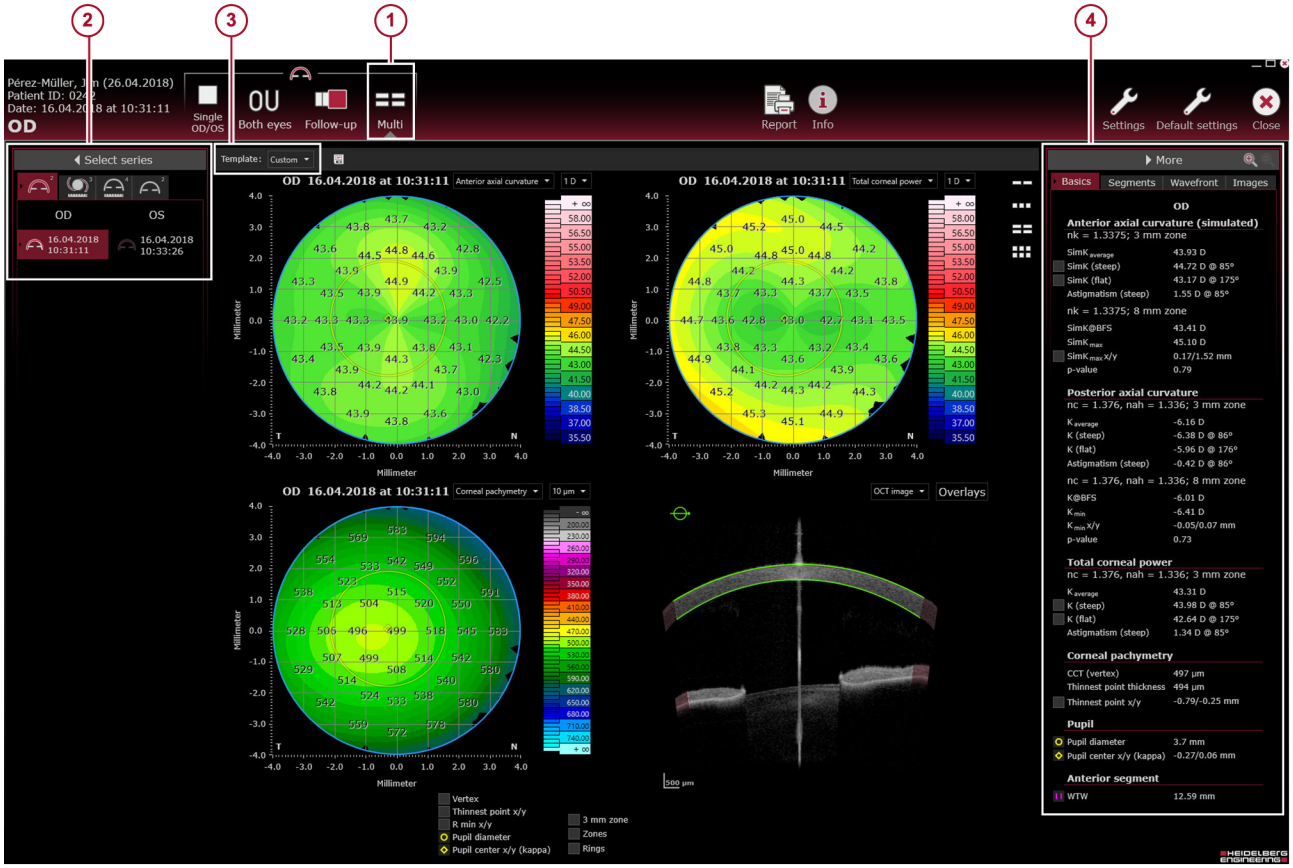


*Fig. 14: Analyzing single examinations - “Multi” view*

1. *“Multi”* view
2. *“Select series”* section
3. *“Template”* drop-down list
4. *“Basics”* tab

- Select *“Multi”* (1) (Fig. 14).
- In the *“Select series”* section (2) (Fig. 14), select the desired examination.
- Open the *“Template”* drop-down list (3) (Fig. 14) and select the desired template.
- In the *“More”* section, select the *“Basics”* tab (4) (Fig. 14) and check the parameters for plausibility.

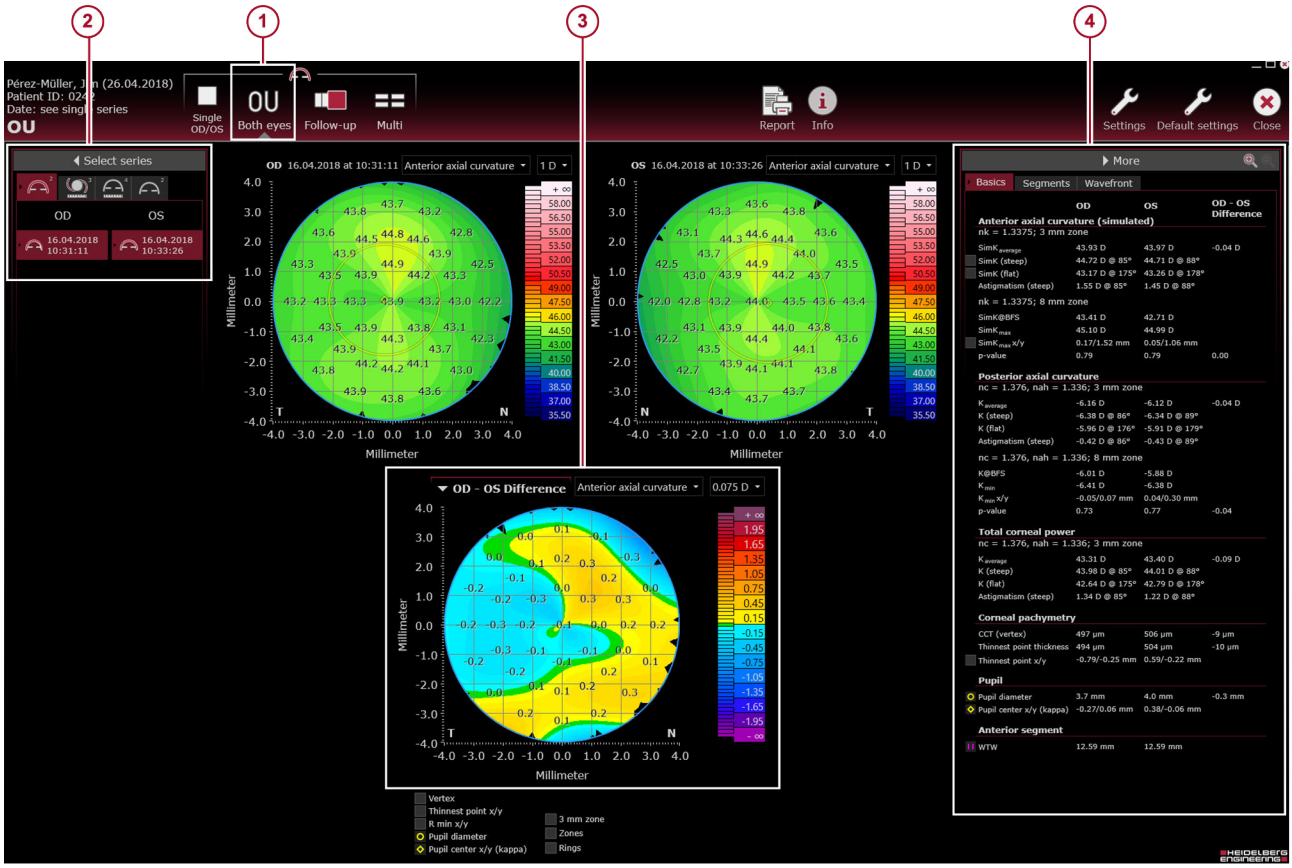


*Fig. 15: Analyzing single examinations - “Both eyes” view*

① “Both eyes” view
② “Select series” section
③ “OD-OS difference” map
④ “Basics” tab

- If symmetry is of clinical interest, then select the “Both eyes” view ① (Fig. 15).

  The “Both eyes” view is only available for examinations that have been performed on the same day.

- In the “Select series” section ② (Fig. 15), select the desired examinations.
- Review the examinations and the automatically generated “OD-OS difference” map ③ (Fig. 15).
- In the “More” section, select the “Basics” tab ④ (Fig. 15) and check the parameters for OD, OS, and the OD-OS difference for data acceptability.

**Step 3 – Analyzing follow-up examinations**

In the *“Follow-up”* view, different examinations of the same eye can be compared. By default, the baseline is the oldest examination and is compared with the most current examination of the progression series. If any other examination is selected, the oldest examination is compared with the most current one.

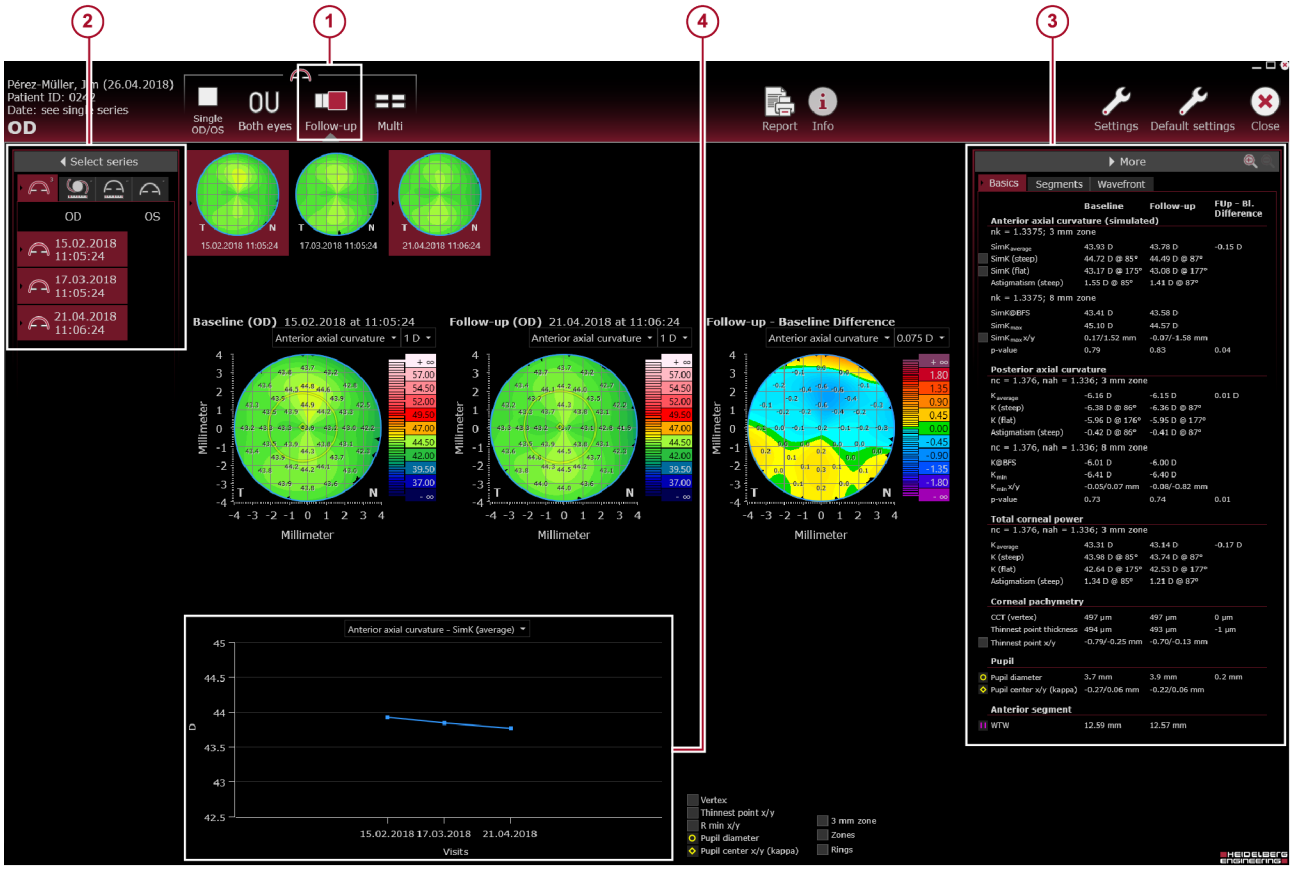


*Fig. 16: Analyzing follow-up examinations*

① *“Follow-up”* view
② *“Select series”* section
③ *“Basics”* tab
④ Trend analysis graph

- Select *“Follow-up”* ① (Fig. 16).
- In the *“Select series”* section ② (Fig. 16), select all examinations to be included in the analysis.
- Select all examinations to be compared with each other.
- In the *“More”* section, select the *“Basics”* tab ③ (Fig. 16) and check the parameters for the baseline examination, the follow-up examination, and the follow-up-baseline difference for data acceptability.
- If a selected progression series contains three or more examinations of different days, a trend analysis graph that shows the progression of key parameters is automatically generated ④ (Fig. 16).

### 9.2.3 Navigating through the Images

Depending on the application and view, different navigating options may be available.

### Navigating options

| Section | Options | Description |
|---|---|---|
| General | Right-click anywhere in the window. | Switches the unit to mm or D.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |
| | Hover with the mouse cursor over the border of a section, e. g. the *“More”* section, in the analysis window. | The mouse cursor switches to ⟷.<br>Drag-and-drop to change the size. |
| | Click ▷. | Expands or retracts a section. |
| Camera image or color map | Hover with the mouse cursor over a camera image or map. | The value at the corresponding location on the map is displayed.<br>The x/y location of the mouse cursor is displayed on the upper right of the map.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |
| OCT section image | Hover with the mouse cursor over the left or right end of the brightness and contrast slider. | The mouse cursor switches to ⟷.<br>Drag-and-drop the slider to change the image brightness of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Hover with the mouse cursor over the brightness and contrast slider. | The mouse cursor switches to ✋.<br>Move the slider to adjust the image contrast of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Click ⊞. | While holding down the left mouse button, draw a square on the OCT section image in order to zoom the selected region to its maximum size. |
| | Click ⊕ or ⊖.<br>Alternatively, press Ctrl and scroll the mouse wheel. | Incrementally zoom in or out on an OCT section image. |
| | Hover with the mouse cursor over the border of a zoomed OCT section image. | The mouse cursor switches to ✥.<br>The automatic scroll function is activated. |
| | Press and hold the left mouse key. | Move the mouse to move the image. |
| | On the *“B-scan”* slider, click ◀ or ▶ to scroll through the OCT section images.<br>Alternatively, scroll through the OCT section images using the mouse wheel. | Shows the OCT section images. |
| | To show the OCT section images as a slide show, click *“Play”*. | Shows the OCT section images as a slide show. |
| A-scan | If the A-scan overlay is activated, hover with the mouse cursor over the green line representing the A-scan. | The mouse cursor switches to ⟷.<br>Drag-and-drop to move the A-scan. |

### 9.2.4 Analysis Window - *“Single OD/OS”* View

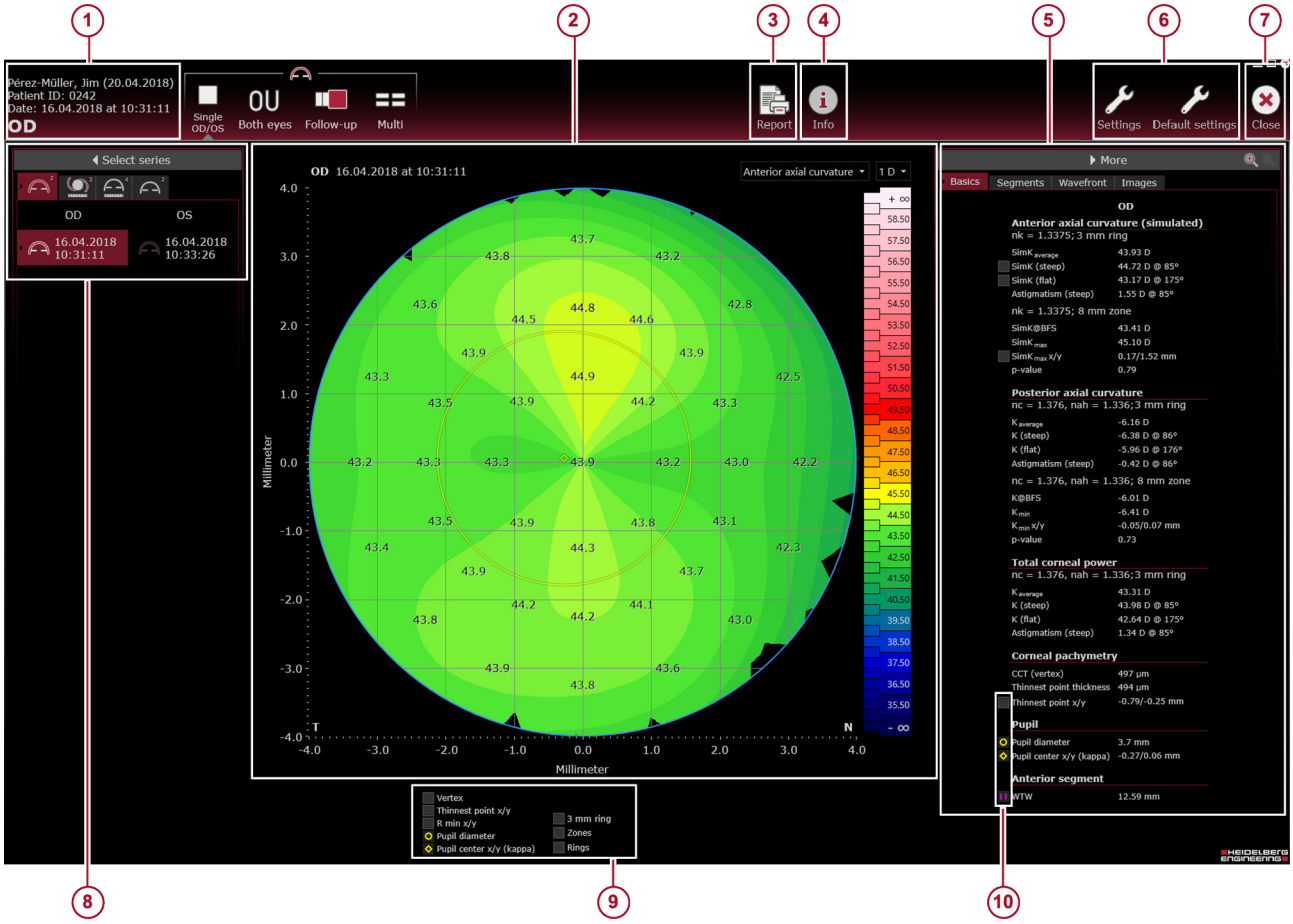


*Fig. 17: “Single OD/OS” view*

1. Patient information (➞ 9.2.4.1 “Patient Information”, p. 63)
2. Color map with color scale (➞ 9.2.4.5 “Color Map with Color Scale”, p. 76)
3. *“Report”* button (➞ 13 “Reports”, p. 192)
4. *“Info”* button (➞ 9.2.4.4 “ *“Info”* Section”, p. 73)
5. *“More”* section (➞ 9.2.4.3 “ *“More”* Section”, p. 64)
6. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
7. *“Close”* button
8. *“Select series”* section (➞ 9.2.4.2 “ *“Select series”* Section”, p. 64)
9. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)
10. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)

#### 9.2.4.1 Patient Information

The following information is displayed:

- Patient name
- Date of birth
- Patient ID
- Examination date and time
- Examined eye

### 9.2.4.2 *“Select series”* Section

In the *“Select series”* section, all series of the currently selected examination are displayed. The series are divided into OD and OS, and are sorted by examination date and time. The most current examination is on top of the list. The oldest examination is on the bottom of the list. The numbers next to the symbols of the application tabs indicate how many acquisitions the patient file series contains, in the corresponding acquisition application.

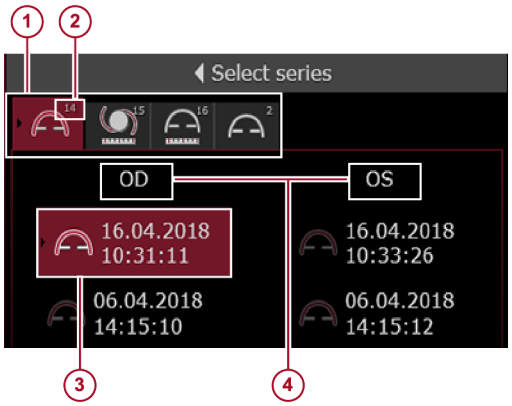


*Fig. 18: “Select series” section*

1. Application tabs
2. Number of series acquired with that application
3. Selected series
4. OD, OS

▸ To select a series for analysis, click the desired entry.

The results of the examination are automatically displayed.

### 9.2.4.3 *“More”* Section

***“Basics”* tab**

In the *“Basics”* tab of the *“More”* section, the following information is displayed:

***“Basics”* tab**

| Section | Entry | | Description |
|---|---|---|---|
| *“Anterior axial curvature (simulated)”* | *“nk ”* | | Keratometric index |
| | *“3 mm ring”* | | The values have been calculated with the indicated keratometric index for a 3 mm ring. |
| | *“D”* values | *“$SimK_{average}$”* | Simulated keratometry average |
| | | *“SimK (steep)”* | Simulated keratometry (steep) |
| | | *“SimK (flat)”* | Simulated keratometry (flat) |
| | | *“Astigmatism (steep)”* | This parameter is defined as the difference of the SimK values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| | *“mm”* values | *“$R_{average}$”* | Radius of corneal axial curvature |
| | | *“R (steep)”* | Radius of corneal axial curvature (steep) |

| Section | Entry | | Description |
|---|---|---|---|
| | | *“R (flat)”* | Radius of corneal axial curvature (flat) |
| | | *“Radii difference (steep)”* | This parameter is defined as the difference of the radii of curvature between the steep and flat radii of the cornea. The axis represents the location of the steep meridian. |
| | *“nk ”* | | Keratometric index |
| | *“8 mm zone”* | | The values have been calculated with the indicated keratometric index for the 8 mm zone. |
| | *“D”* values | *“SimK@BFS”* | SimK value corresponding to radius of curvature of BFS |
| | | *“$SimK_{max}$”* | This parameter is defined as the maximum SimK value, simulated from the anterior corneal surface. |
| | | *“$SimK_{max}$ x/y”* | This parameter is defined as the position of the maximum SimK value, relative to the line of sight. |
| | *“mm”* values | *“BFS”* | Radius of curvature of BFS |
| | | *“$R_{min}$”* | This parameter is defined as the minimum radius of anterior corneal axial curvature. |
| | | *“$R_{min}$x/y”* | This parameter is defined as the position of the minimum radius of anterior corneal axial curvature, relative to the line of sight. |
| | Depending on the setting: *“p-value”*, *“Q-value”*, *“E-value”* | | This parameter indicates the value that best fits the corneal meridian. |
| | *“p-value”* | | The p-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The p-value can describe a prolate ellipsoid (1 > p > 0), a sphere (p = 1.0) or an oblate ellipsoid (p > 1). |
| | *“Q-value”* | | The Q-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The Q-value can describe a prolate ellipsoid (-1< Q < 0), a sphere (Q = 0) or an oblate ellipsoid (Q > 0). |
| | *“E-value”* | | The E-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The E-value can describe a prolate ellipsoid (0 < E < 1), a sphere (E = 0) or an oblate ellipsoid (E < 0). |
| *“Posterior axial curvature”* | *“nc”* | | Refractive index of the cornea |
| | *“nah”* | | Refractive index of the aqueous humor |
| | *“ 3 mm ring”* | | The values have been calculated with the indicated refractive index for a 3 mm ring. |

| Section | Entry | | Description |
|---|---|---|---|
| | *“D”* values | *“$K_{average}$”* | Keratometry average |
| | | *“K (steep)”* | Keratometry (steep) |
| | | *“K (flat)”* | Keratometry (flat) |
| | | *“Astigmatism (steep)”* | This parameter is defined as the difference of the posterior K values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| | *“mm”* values | *“$R_{average}$”* | Radius of corneal axial curvature |
| | | *“R (steep)”* | Radius of corneal axial curvature (steep) |
| | | *“R (flat)”* | Radius of corneal axial curvature (flat) |
| | | *“Radii difference (steep)”* | This parameter is defined as the difference of the radii of curvature between the steep and flat radii of the cornea. The axis represents the location of the steep meridian. |
| | *“nc”* | | Refractive index of the cornea |
| | *“nah”* | | Refractive index of the aqueous humor |
| | *“ 8 mm zone”* | | The values have been calculated with the indicated refractive index for the 8 mm zone. |
| | *“D”* values | *“K@BFS”* | K-value corresponding to radius of curvature of BFS |
| | | *“$K_{min}$”* | Minimal K value |
| | | *“$K_{min}$ x/y”* | This parameter indicates the location of the minimal K value on the map, relative to the line of sight. |
| | *“mm”* values | *“BFS”* | Radius of curvature of BFS |
| | | *“$R_{min}$”* | This parameter is defined as the minimum radius of anterior corneal axial curvature. |
| | | *“$R_{min}$x/y”* | This parameter is defined as the position of the minimum radius of anterior corneal axial curvature, relative to the line of sight. |
| | Depending on the setting: *“p-value”*, *“Q-value”*, *“E-value”* | | This parameter indicates the value that best fits the corneal meridian. |
| | *“p-value”* | | The p-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The p-value can describe a prolate ellipsoid (1 > p > 0), a sphere (p = 1.0) or an oblate ellipsoid (p > 1). |
| | *“Q-value”* | | The Q-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The Q-value can describe a prolate ellipsoid (-1< Q < 0), a sphere (Q = 0) or an oblate ellipsoid (Q > 0). |

| Section | Entry | Description |
|---|---|---|
| | *“E-value”* | The E-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The E-value can describe a prolate ellipsoid (0 < E < 1), a sphere (E = 0) or an oblate ellipsoid (E < 0). |
| *“Total corneal power”* | *“nc”* | Refractive index of the cornea |
| | *“nah”* | Refractive index of the aqueous humor |
| | *“ 3 mm ring”* | The values have been calculated with the indicated refractive index for a 3 mm ring. |
| | *“$K_{average}$”* | Corneal power average |
| | *“K (steep)”* | Corneal power (steep) |
| | *“K (flat)”* | Corneal power (flat) |
| | *“Astigmatism (steep)”* | This parameter is defined as the difference of the SimK values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| *“Pachymetry”* | *“CCT (vertex)”* | Central corneal thickness (vertex). This parameter indicates the perpendicular distance between the anterior and the posterior corneal surfaces, measured from the anterior corneal vertex. |
| | *“Thinnest point thickness”* | This parameter indicates the thickness value of the thinnest point on the pachymetry map. |
| | *“Thinnest point x/y”* | This parameter indicates the location of the thinnest point on the pachymetry map, relative to the line of sight. |
| *“Pupil”* | *“Pupil diameter”* | This parameter indicates the measured pupil diameter, derived from the camera image. |
| | *“Pupil center x/y (kappa)”* | This parameter indicates the x/y position of the center of the pupil, relative to the line of sight. |
| *“Anterior segment”* | *“WTW”* | White-to-white distance. WTW is defined as the horizontal distance between the nasal and temporal limbus, measured on the camera image. |

***“Segments”* tab**

In the *“Segments”* tab of the *“More”* section, the following information is displayed:

- Open the drop-down list and select whether the values should be displayed for *“Rings”* or *“Zones”*.
- To display the rings or zones on the color map, check the checkbox next to the drop-down list.
- To display the mean values of the ring segment on the color map, check the *“Ring segment mean values on maps”* box.

***“Segments”* tab**

| Section | | Zones | Rings | Description |
|---|---|---|---|---|
| *“D”* values | *“Anterior axial curvature – SimK (average)”* | 2 mm zone<br>4 mm zone<br>6 mm zone<br>8 mm zone | 0-2 mm ring<br>2-4 mm ring<br>4-6 mm ring<br>6-8 mm ring | This parameter is defined as the simulated keratometry based on the anterior corneal axial curvature. |
| *“mm”* values | *“Anterior axial curvature – R (average)”* | | | This parameter is defined as the radius of the anterior corneal axial curvature. |
| *“D”* values | *“Posterior axial curvature – K (average)”* | 2 mm zone<br>4 mm zone<br>6 mm zone<br>8 mm zone | 0-2 mm ring<br>2-4 mm ring<br>4-6 mm ring<br>6-8 mm ring | This parameter is the posterior keratometry, calculated from the posterior corneal axial curvature. |
| *“mm”* values | *“Posterior axial curvature – R (average)”* | | | This parameter is defined as the radius of the posterior corneal axial curvature. |
| *“Total corneal power – K (average)”* | | 2 mm zone<br>4 mm zone<br>6 mm zone<br>8 mm zone | 0-2 mm ring<br>2-4 mm ring<br>6-8 mm ring<br>4-6 mm ring | This parameter is defined as the average refractive power of the cornea, derived from the anterior and posterior corneal surfaces. |
| *“D”* values | *“Anterior corneal astigmatism and axis (steep)”* | 2 mm zone<br>4 mm zone<br>6 mm zone<br>8 mm zone | 0-2 mm ring<br>2-4 mm ring<br>4-6 mm ring<br>6-8 mm ring | This parameter is defined as the difference of the SimK values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| *“mm”* values | *“Anterior corneal radii difference and axis (steep)”* | | | This parameter is defined as the difference between the steep and flat anterior corneal curvatures. The axis indicates the location of the steepest curvature. |
| *“D”* values | *“Posterior corneal astigmatism and axis (steep)”* | 2 mm zone<br>4 mm zone<br>6 mm zone<br>8 mm zone | 0-2 mm ring<br>2-4 mm ring<br>4-6 mm ring<br>6-8 mm ring | This parameter is defined as the difference of the posterior K values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| *“mm”* values | *“Posterior corneal radii difference and axis (steep)”* | | | This parameter is defined as the difference between the steep and flat posterior corneal curvatures. The axis indicates the location of the steepest curvature. |

| Section | Zones | Rings | Description |
|---|---|---|---|
| *“Total corneal astigmatism and axis (steep)”* | 2 mm zone<br>4 mm zone<br>6 mm zone<br>8 mm zone | 0-2 mm ring<br>2-4 mm ring<br>4-6 mm ring<br>6-8 mm ring | This parameter indicates an estimation of the total corneal astigmatism, derived from the anterior and posterior corneal surfaces and the corresponding steepest axis. |
| *“Pachymetry”* | 2 mm zone<br>4 mm zone<br>6 mm zone<br>8 mm zone | 0-2 mm ring<br>2-4 mm ring<br>4-6 mm ring<br>6-8 mm ring | Pachymetry is the measurement of corneal thickness, measured as the perpendicular distance from a specific location on the anterior corneal surface to the posterior corneal surface. |

***“Wavefront”* tab** In the *“Wavefront”* tab of the *“More”* section, the following information is displayed:

***“Wavefront”* tab**

| Section | Entry | Description |
|---|---|---|
| *“Anterior corneal wavefront parameters”* | *“ROI diameter”* | Available options:<br>▪ *“3 mm”*<br>▪ *“4 mm”*<br>▪ *“5 mm”*<br>▪ *“6 mm”*<br>▪ *“7 mm”*<br>▪ *“8 mm”*<br>▪ *“Pupil”* |
| | *“ROI center”* | Available options:<br>▪ *“Vertex”*<br>▪ *“Pupil center”* |
| | *“Vertical tilt”* | This parameter indicates a lower-order aberration that represents the deviation in the direction of a propagated beam of light, resulting in a vertically tilted wavefront. |
| | *“Horizontal tilt”* | This parameter indicates a lower-order aberration that represents the deviation in the direction of a propagated beam of light, resulting in a horizontally tilted wavefront. |
| | *“Oblique astigm.”* | This parameter indicates a lower-order aberration that represents the oblique (centered at 45°) portion of the astigmatism. |
| | *“Defocus”* | This parameter indicates the refractive deviation from the ideal focus [D] of an optical system. |

| Section | Entry | Description |
|---|---|---|
| | *“WTRATR astigm.”* | This parameter indicates a lower-order aberration that represents the with-the-rule-against-the-rule portion of the astigmatism. |
| | *“Oblique trefoil”* | This parameter indicates a higher-order aberration where three steep and flat corneal curvatures are present. Corresponding steep and flat radii are opposite to one another. |
| | *“Vertical coma”* | This parameter is a higher-order aberration of the corneal optics that leads to vertical off axis point sources (such as stars having a tail). |
| | *“Horizontal coma”* | This parameter is a higher-order aberration of the corneal optics that leads to horizontal off axis point sources (such as stars having a tail). |
| | *“Horizontal trefoil”* | This parameter indicates a higher-order aberration where three steep and flat corneal curvatures are present. Corresponding steep and flat radii are opposite to one another. |
| | *“Spherical aberration”* | This parameter indicates a higher-order aberration that results from optical imperfections of the human eye. |
| | *“4th order RMS”* | Root mean square of the 4th order wavefront aberrations in the selected region of interest. |
| | *“5th order RMS”* | Root mean square of the 5th order wavefront aberrations in the selected region of interest. |
| | *“6th order RMS”* | Root mean square of the 6th order wavefront aberrations in the selected region of interest. |
| | *“7th order RMS”* | Root mean square of the 7th order wavefront aberrations in the selected region of interest. |
| | *“RMS LOA”* | Root mean square lower-order aberrations |
| | *“RMS HOA”* | Root mean square higher-order aberrations |
| *“Total corneal wavefront parameters”* | *“Vertical tilt”* | This parameter indicates a lower-order aberration that represents the deviation in the direction of a propagated beam of light, resulting in a vertically tilted wavefront. |
| | *“Horizontal tilt”* | This parameter indicates a lower-order aberration that represents the deviation in the direction of a propagated beam of light, resulting in a horizontally tilted wavefront. |

| Section | Entry | Description |
|---|---|---|
| | *“Oblique astigm.”* | This parameter indicates a lower-order aberration that represents the oblique (centered at 45°) portion of the astigmatism. |
| | *“Defocus”* | This parameter indicates the refractive deviation from the ideal focus [D] of an optical system. |
| | *“WTRATR astigm.”* | This parameter indicates a lower-order aberration that represents the with-the-rule-against-the-rule portion of the astigmatism. |
| | *“Oblique trefoil”* | This parameter indicates a higher-order aberration where three steep and flat corneal curvatures are present. Corresponding steep and flat radii are opposite to one another. |
| | *“Vertical coma”* | This parameter is a higher-order aberration of the corneal optics that leads to vertical off axis point sources (such as stars having a tail). |
| | *“Horizontal coma”* | This parameter is a higher-order aberration of the corneal optics that leads to horizontal off axis point sources (such as stars having a tail). |
| | *“Horizontal trefoil”* | This parameter indicates a higher-order aberration where three steep and flat corneal curvatures are present. Corresponding steep and flat radii are opposite to one another. |
| | *“Spherical aberration”* | This parameter indicates a higher-order aberration that results from optical imperfections of the human eye. |
| | *“4th order RMS”* | Root mean square of the 4th order wavefront aberrations in the selected region of interest. |
| | *“5th order RMS”* | Root mean square of the 5th order wavefront aberrations in the selected region of interest. |
| | *“6th order RMS”* | Root mean square of the 6th order wavefront aberrations in the selected region of interest. |
| | *“7th order RMS”* | Root mean square of the 7th order wavefront aberrations in the selected region of interest. |
| | *“RMS LOA”* | Root mean square lower-order aberrations |
| | *“RMS HOA”* | Root mean square higher-order aberrations |

### *“Images”* tab

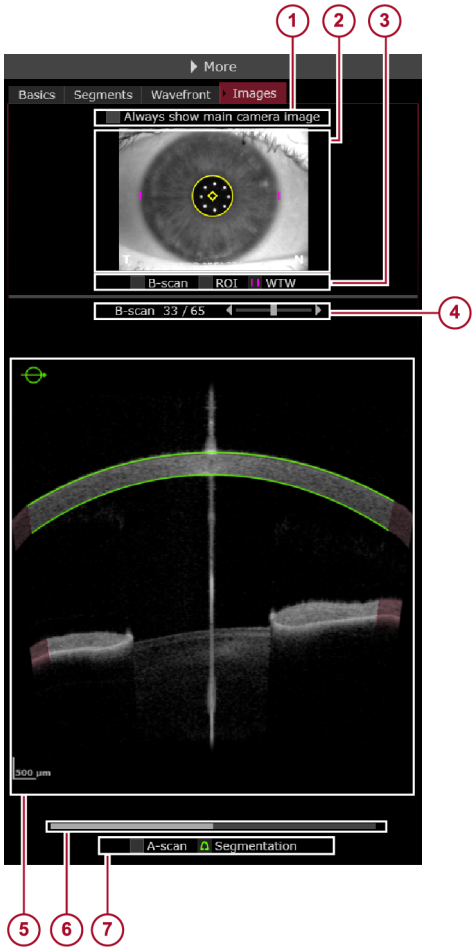


*Fig. 19: “Images” tab*

1. *“Always show main camera image”* checkbox
2. Camera image
3. Overlay options checkboxes
4. *“B-scan”* slider
5. OCT section image
6. Brightness and contrast slider
7. Overlay options checkboxes

The *“Images”* tab is displayed, when the *“Single OD/OS”* or the *“Multi”* displays are selected. In the *“Images”* tab, the camera image ① (Fig. 19) is displayed in the upper portion of the screen. The OCT section image ② (Fig. 19) is displayed in the lower portion of the screen.

The following overlays can be superimposed on the camera image ③ (Fig. 19):

- *“B-scan”*
- *“ROI”*
- *“WTW”*

The following overlays can be superimposed on the OCT section image ④ (Fig. 19):

- *“Vertex”*
- *“A-scan”*
- *“Segmentation”*

**Scrolling through the images**

The slider above the OCT section image ⑤ (Fig. 19) shows the total amount of images and the currently displayed image.

- To scroll through the OCT section images, use the *“B-scan”* slider.
- Alternatively, scroll through the OCT section images using the mouse wheel.
- To show the OCT section images as a slide show, click *“Play”*.

**Showing the main camera image**

- To display the corresponding camera image of the OCT section images when scrolling through the OCT section images, leave the *“Always show main camera image”* checkbox ⑦ (Fig. 19) unchecked.
- To always display the main camera image, check the *“Always show main camera image”* checkbox ⑦ (Fig. 19).

**Adjusting brightness and contrast**

The slider below the OCT section image ⑥ (Fig. 19) is for adjusting image brightness and contrast.

⚠ **WARNING! Carelessly adjusted image brightness and image contrast might lead to bad image quality.** Bad image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches. Carefully adjust image brightness and image contrast.

- Drag-and-drop the slider to the desired position and increase or decrease the image brightness and contrast.
- To reset to the default values, double-click the slider.

**Red areas in OCT section images refer to an extrapolated refraction correction**

The refraction correction in these areas is based on extrapolation of the surface boundaries and should be considered with caution for clinical use.

Measurements using freehand selections are not allowed in red areas.

### 9.2.4.4 *“Info”* Section

By clicking the *“Info”* button at the top of the analysis window, the *“Info”* tab is displayed in the *“More”* section. The following information is displayed:

***“Info”* tab**

| Section | Entry | Description |
|---|---|---|
| *“Eye”* | *“Eye”* | Examined eye, OD or OS |
| | *“Cornea status”* | This parameter indicates whether an eye underwent corneal refractive surgery. |

| Section | Entry | Description |
|---|---|---|
| | *“Lens status”* | This parameter indicates the presence or absence of the eye's natural crystalline lens and, if applicable, the type of implanted artificial lens. |
| | *“Vitreous status”* | This parameter indicates whether there is a history of surgical intervention to the vitreous. |
| *“Acquisition”* | *“Mode”* | Indication of the used acquisition application |
| | *“Date”* | Examination date |
| | *“Time”* | Examination time |
| | *“Operator”* | Name of the operator that examined the patient |
| | *“System test”* | This parameter indicates whether the system test was valid, outdated, or failing at the time of the acquisition. |
| | *“Fixation light focus”* | Internal fixation light focus is an acquisition setting that allows for fixation light sharpness adjustments, based on an eye's refraction. |
| | *“Int. fix. light brightness”* | Internal fixation light brightness is an acquisition setting that allows for fixation light brightness adjustments, based on patients needs. |
| *“Acquisition quality”* Display of parameters depends on the application of the currently loaded scan. | *“Motion”* | Acquisition quality parameter indicating whether eye movements impacted the quality of the acquired scan(s). |
| | *“Fixation”* | Acquisition quality parameter indicating whether excessive fixation loss was presented during acquisition. |
| | *“Tear film and lid”* | Acquisition quality parameter indicating whether the eyelid(s) and/or the tear film impacted the quality of the acquired image(s). |
| | *“Camera image segmentation”* | Acquisition quality parameter indicating whether the camera image segmentation necessary for pupil diameter and WTW distance calculation succeeded. |
| | *“Refraction correction”* | Acquisition quality parameter indicating whether the automatic refraction correction necessary for accurate calculation of measurements succeeded. |
| | *“Required data points”* | Acquisition quality parameter indicating whether a minimum of data points within the central 3 mm zone was calculated. |
| | *“Axial length measurement”* | Acquisition quality parameter indicating whether the axial length measurement could be automatically determined. |

| Section | Entry | Description |
|---|---|---|
| | *“Tracking”* | Acquisition quality parameter indicating whether tracking was activated or not. Tracking is a technique that uses the camera image to detect eye movements during image acquisition, ensuring that each acquired OCT B-scan is centered on the corneal vertex. |
| *“Camera images”* | *“No. of images”* | This parameter indicates the number of images within a series. |
| | *“Main image”* | This parameter indicates the ID of the camera image that is used for calculation of WTW and pupil diameter. This is the camera image with the median pupil diameter. It is displayed when the option “Always show main camera image” is activated. |
| | *“Size”* | Size of the image in pixels |
| *“OCT section images”* | *“No. of images”* | This parameter indicates the number of images within a series. |
| | *“Scan length/No. of A-scans”* | This parameter indicates the scan length and the number of A-scans for the raw OCT section images. |
| | *“Lateral scaling”* | Pixel scaling in lateral direction of raw OCT section images. |
| | *“Axial scaling”* | Pixel scaling in axial direction of raw OCT section images. |
| *“Component versions”* | *“HEYEX (changed by)”* | Version of the HEYEX 2 software used for the most recent changes |
| | *“VWM (changed by)”* | Version of the viewing module used for the most recent changes |
| | *“AQM”* | Version of the acquisition module used for this examination |
| | *“SSC”* | Version of the installed scanning service controller |
| | *“FPGA (SSC)”* | Version of the installed field programmable gate array |
| | *“MCC”* | Version of the installed master component controller |
| | *“EPC”* | Version of the installed external periphery controller |
| | *“CSB”* | Version of the installed camera sensor board |
| | *“SMC”* | Version of the installed stepper motor controller |
| | *“DCB”* | Version of the installed display controller board |
| | *“Internal data format”* | Version of the internal data format |

| Section | Entry | Description |
|---|---|---|
| *“Device”* | *“Device serial number”* | Serial number of the device |
| | *“Sequence timestamp”* | Timestamp of the acquired image. This file name is used to store the corresponding raw data (sequence). |

#### 9.2.4.5 Color Map with Color Scale

Corneal topography and tomography provides information on various curvature and shape characteristics of the cornea that help illustrate corneal astigmatism and irregularities, and the detection of corneal pathologies.

Curvature maps are available in D and mm.

The scaling depends on the type of the selected color map and the number of color steps configured in the settings.

Select one of the following color maps for analysis:

**Color maps**

| Color map | Description |
|---|---|
| *“Anterior axial curvature”* | This map visualizes the simulated keratometry based on the anterior corneal axial curvature. The conversion of anterior radii to keratometry values is performed according to the laws of Gaussian optics using the keratometric index of 1.3375. It does not account for the refractive effect and the radii of the posterior corneal surface. |
| *“Anterior tangential curvature”* | This map visualizes the simulated keratometry based on the actual curvature of the anterior corneal surface in a meridian's plane. The conversion of tangential radii to keratometry values is performed according to the laws of Gaussian optics using the keratometric index of 1.3375. It does not account for the refractive effect and the radii of the posterior corneal surface. |
| *“Anterior elevation (BFS)”* | This map represents the height of the anterior corneal surface relative to the "best fit sphere". Corneal elevation above this reference is indicated in positive microns while a surface below the reference is indicated in negative microns. |
| *“Anterior elevation (BFT)”* | This map represents the height of the anterior corneal surface relative to the "best fit torus". Corneal elevation above this reference torus is indicated in positive microns while a surface below the reference torus is indicated in negative microns. |
| *“Posterior axial curvature”* | This map visualizes the posterior keratometry based on the posterior corneal axial curvature. The conversion of posterior radii to keratometry values is performed according to the laws of Gaussian optics using the refractive indices nc and nah. |
| *“Posterior tangential curvature”* | This map visualizes the posterior keratometry based on the actual curvature of the posterior corneal surface in a meridian's plane. The conversion of tangential radii to keratometry values is performed according to the laws of Gaussian optics using the refractive indices nc and nah. |
| *“Posterior elevation (BFS)”* | This map represents the height of the posterior corneal surface relative to the "best fit sphere". Corneal elevation above this reference is indicated in positive microns while a surface below the reference is indicated in negative microns. |

| Color map | Description |
|---|---|
| *“Posterior elevation (BFT)”* | This map represents the height of the posterior corneal surface relative to the "best fit torus". Corneal elevation above this reference torus is indicated in positive microns while a surface below the reference torus is indicated in negative microns. |
| *“Pachymetry”* | This map displays the thickness of the cornea for all measured positions along a plane orthogonal to the anterior cornea. |
| *“Total corneal power”* | This map displays the power of the cornea, calculated using ray tracing. Ray tracing determines how parallel light beams are refracted according to the slope of cornea, the true refractive indices (nc = 1.376 and nah = 1.336), and the exact point of refraction. Each point on this map corresponds to a focal length, from which a corresponding refractive power can be calculated. |
| *“Anterior corneal wavefront”* | This map displays the anterior corneal wavefront errors using ray tracing from the anterior cornea to a focal plane determined using Gaussian optics. The focal plane is determined using the BFS radius of the anterior corneal surface and the refractive index of the cornea (nc = 1.376). The refractive effect of the posterior corneal surface or the lens surfaces is not taken into account. |
| *“Total corneal wavefront”* | This map displays the total corneal wavefront errors using ray tracing from the anterior cornea through the posterior cornea to a focal plane determined using Gaussian optics. The focal plane is determined using the BFS radius of the anterior and posterior corneal surfaces and the refractive indices of the cornea and aqueous humor (nc = 1.376 and nah = 1.336). The refractive effect of the lens surfaces is not taken into account. |

#### 9.2.4.6 Overlay Options

At the bottom of the *“Single OD/OS”* view or in the *“More”* section, check the checkboxes of all parameters to be superimposed on the color map and/or the images in the *“Images”* tab of the *“More”* section:

- *“Vertex”*
- *“Thinnest point x/y”*
- *“R min x/y”*
- *“Pupil diameter”*
- *“Pupil center x/y (kappa)”*
- *“3 mm ring”*, indicating the values for *“SimK (steep)”* and *“SimK (flat)”*
- *“$SimK_{max}$ x/y”*
- *“Zones”*
- *“Rings”*
- *“WTW”*

In the *“Images”* tab of the *“More”* section, the following additional overlay options are available:

- *“B-scan”*
- *“ROI”*
- *“A-scan”*
- *“Segmentation”*

For easy identification, each parameter has its own symbol. This symbol will be superimposed on the color map.

### 9.2.5 Analysis Window - *“Both eyes”* View

When the *“Both eyes”* view is opened for the first time, select the desired examination of the right and left eye in the *“Select series”* section. This selection displays all information that is available in the *“Both eyes”* view. In the *“More”* section, the values in the *“Basics”*, *“Segments”*, and *“Wavefront”* tabs will be displayed for *“OD”*, *“OS”*, and the *“OD-OS Difference”*.

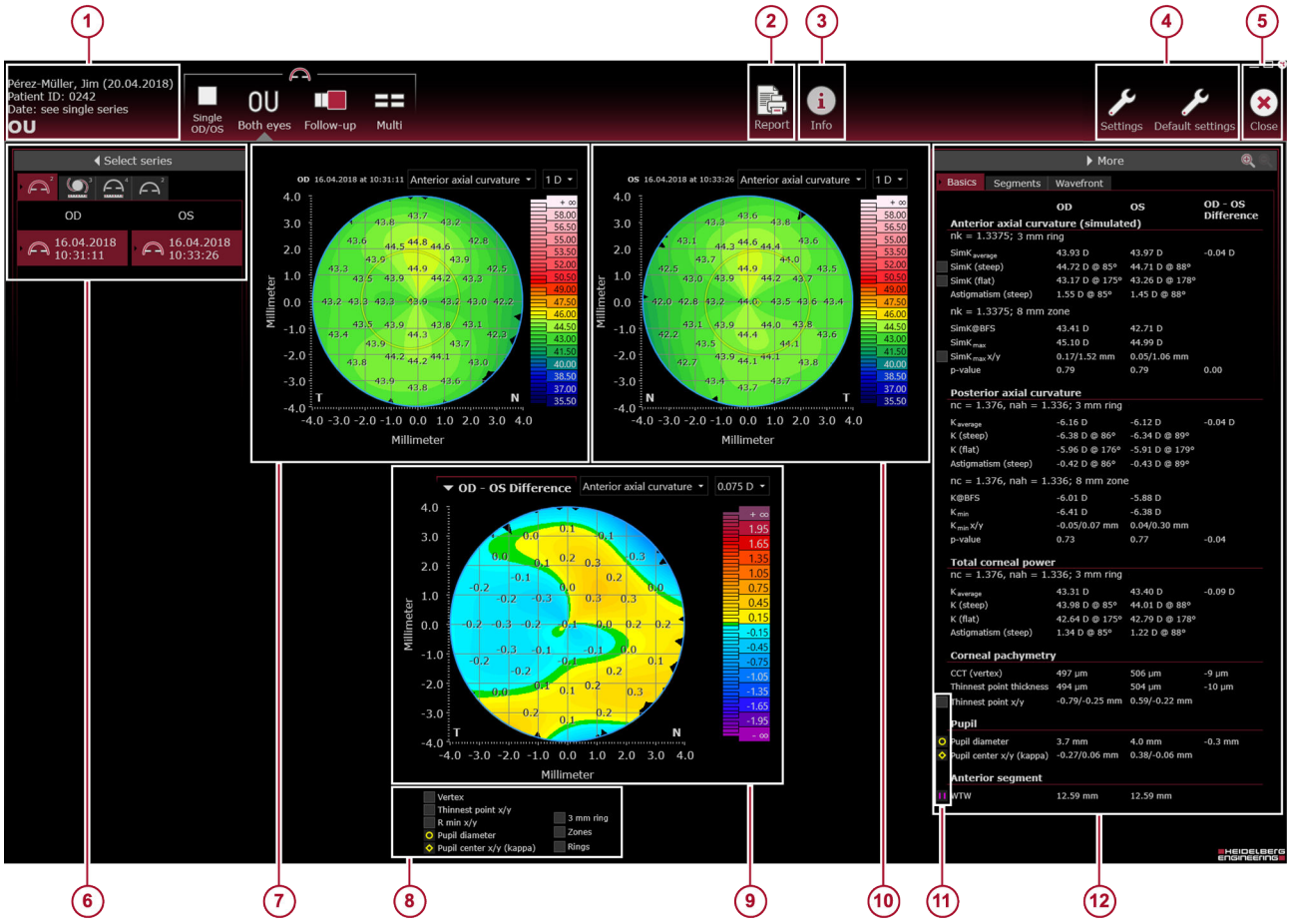


*Fig. 20: “Both eyes” view*

1. Patient information (➞ 9.2.4.1 “Patient Information”, p. 63)
2. *“Report”* button (➞ 13 “Reports”, p. 192)
3. *“Info”* button (➞ 9.2.4.4 “ *“Info”* Section”, p. 73)
4. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
5. *“Close”* button
6. *“Select series”* section (➞ 9.2.4.2 “ *“Select series”* Section”, p. 64)
7. Color map with color scale for OD (➞ 9.2.4.5 “Color Map with Color Scale”, p. 76)
8. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)
9. OD-OS difference map with color scale (➞ 9.2.5.1 “OD-OS Difference Map with Color Scale”, p. 79)
10. Color map with color scale for OS (➞ 9.2.4.5 “Color Map with Color Scale”, p. 76)
11. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)
12. *“More”* section (➞ 9.2.4.3 “ *“More”* Section”, p. 64)

#### 9.2.5.1 OD-OS Difference Map with Color Scale

The *“OD-OS difference”* map displays the difference between the series of the right eye and the series of the left eye. When the *“Both eyes”* view is opened for the first time, the *“OD-OS difference”* map is hidden.

- To show the *“OD-OS difference”* map, click *“OD-OS difference”*.

The *“OD-OS difference”* map is displayed using the same color map and scaling as the above examinations.

- If the *“OD-OS difference”* map or the color map is adjusted in one examination, all other color maps will automatically be updated.

> **i** The *“OD-OS difference”* map is not displayed if the time between the OD and OS measurements exceeds 24 hours.

> **i** There is no differential map for elevation maps because each eye has its own best fit sphere or torus. The parameters of the elevation maps of the right and left eye cannot be compared.

### 9.2.6 Analysis Window - *“Follow-up”* View

When opening the *“Follow-up”* view for the first time, select the desired examination in the *“Select series”* section (➞ 9.2.6.1 “Including and Excluding Series from Trend Analysis”, p. 81). This displays all information that is available in the *“Follow-up”* view. In the *“More”* section, the values in the *“Basics”*, *“Segments”*, and *“Wavefront”* tabs will be displayed for *“Baseline”*, *“Follow-up”*, and the *“FUp-Bl. difference”*.


*Fig. 21: “Follow-up” view*

1. Patient information (➞ 9.2.4.1 “Patient Information”, p. 63)
2. Color maps of all examinations included in the trend analysis
3. *“Report”* button (➞ 13 “Reports”, p. 192)
4. *“Info”* button (➞ 9.2.4.4 “ *“Info”* Section”, p. 73)
5. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
6. *“Close”* button
7. *“Select series”* section (➞ 9.2.4.2 “ *“Select series”* Section”, p. 64)
8. Color map with color scale of the baseline examination
9. Trend analysis graph (➞ 9.2.6.4 “Trend Analysis Graph”, p. 82)
10. Color map with color scale of the follow-up examination
11. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)
12. Follow-up – Baseline difference map with color scale (➞ 9.2.6.3 “Comparing Series”, p. 82)
13. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)
14. *“More”* section (➞ 9.2.4.3 “ *“More”* Section”, p. 64)

### 9.2.6.1 Including and Excluding Series from Trend Analysis

When opening the *“Follow-up”* view for the first time, the series selected for opening the analysis window is automatically selected and displayed as the baseline series. In the *“Select series”* section, all series of the currently selected examination are displayed. The series are divided into OD and OS, and are sorted by examination date and time. The most current examination is on top of the list. The oldest examination is on the bottom of the list.

- Click the entries of the desired series to be included in the trend analysis.

  All selected series are highlighted in red and are automatically displayed as thumbnails in the upper center of the analysis window. The oldest series is labeled as *“Baseline”*, the most current series is labeled as *“Follow-up”*.

- To exclude a series from the trend analysis, click the desired entry in the *“Select series”* section.

  The series is unmarked and the thumbnails in the upper center of the analysis window are automatically updated.

To define other series as the baseline series or the follow-up series used for comparison, please refer to (➞ 9.2.6.2 “Defining Baseline and Follow-up Series”, p. 81).

For further information on comparing examinations, please refer to (➞ 9.2.6.3 “Comparing Series”, p. 82).

### 9.2.6.2 Defining Baseline and Follow-up Series

After all series for the trend analysis have been selected (➞ 9.2.6.1 “Including and Excluding Series from Trend Analysis”, p. 81), the oldest series is automatically set as the baseline series and the most current series is automatically set as the follow-up series used for comparison. The thumbnails of these two series are always highlighted red. The *“Follow-up – Baseline difference”* map is automatically created.

After selecting all series for the trend analysis, any series can be defined as the baseline and follow-up series for comparison purposes.

- To change the baseline series, click the thumbnail of the baseline series.

  The baseline series is now deselected. The *“Baseline”* and the *“Follow-up – Baseline difference”* color maps no longer display information.

- Click the thumbnail desired to be the baseline series.

  The baseline series is highlighted red. The *“Baseline”* color map is updated. If the baseline series is defined, any other series can be selected as the follow-up series.

Now, different examinations can be compared. For further information, please refer to (➞ 9.2.6.3 “Comparing Series”, p. 82).

### 9.2.6.3 Comparing Series

After all series for the trend analysis have been selected (➞ 9.2.6.1 “Including and Excluding Series from Trend Analysis”, p. 81) and the baseline and follow-up series to be used for comparison are defined (➞ 9.2.6.2 “Defining Baseline and Follow-up Series”, p. 81), the *“Follow-up – Baseline difference”* color map is automatically created.

If a selected progression series contains three or more examinations of different days, a trend analysis graph that shows the progression of key parameters is automatically generated. For further information, please refer to (➞ 9.2.6.4 “Trend Analysis Graph”, p. 82).

The *“Follow-up – Baseline difference”* map displays the difference between the follow-up examination and the baseline examination.

When comparing series, the same default color maps are available as described in (➞ 9.2.4.5 “Color Map with Color Scale”, p. 76). If the *“Follow-up – Baseline difference”* map or the color map is adjusted in one examination, all other color maps will automatically be updated.

### 9.2.6.4 Trend Analysis Graph

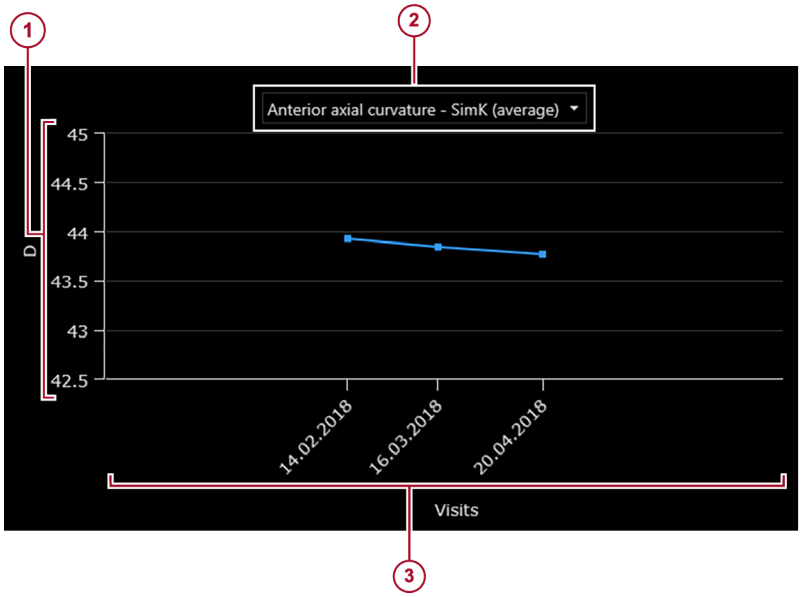


*Fig. 22: Trend analysis graph*

① Values
② Selection of key parameters
③ Examination days

If a selected progression series contains three or more examinations of different days, a trend analysis graph that shows the progression of key parameters is automatically generated. The graph shows how the following values have changed during the visit history:

- *“Anterior axial curvature - SimK (average)”*
- *“Posterior axial curvature - K (average)”*
- *“Total corneal power - K (average)”*
- *“Pachymetry - CCT (vertex)”*
- *“Pachymetry - Thinnest point thickness”*

### 9.2.7 Analysis Window - *“Multi”* View

When opening the *“Multi”* view for the first time, the series used for opening the analysis window is displayed. In the *“Select series”* section, select the desired series for analysis. Either the standard templates or custom templates can be used to analyze the data.

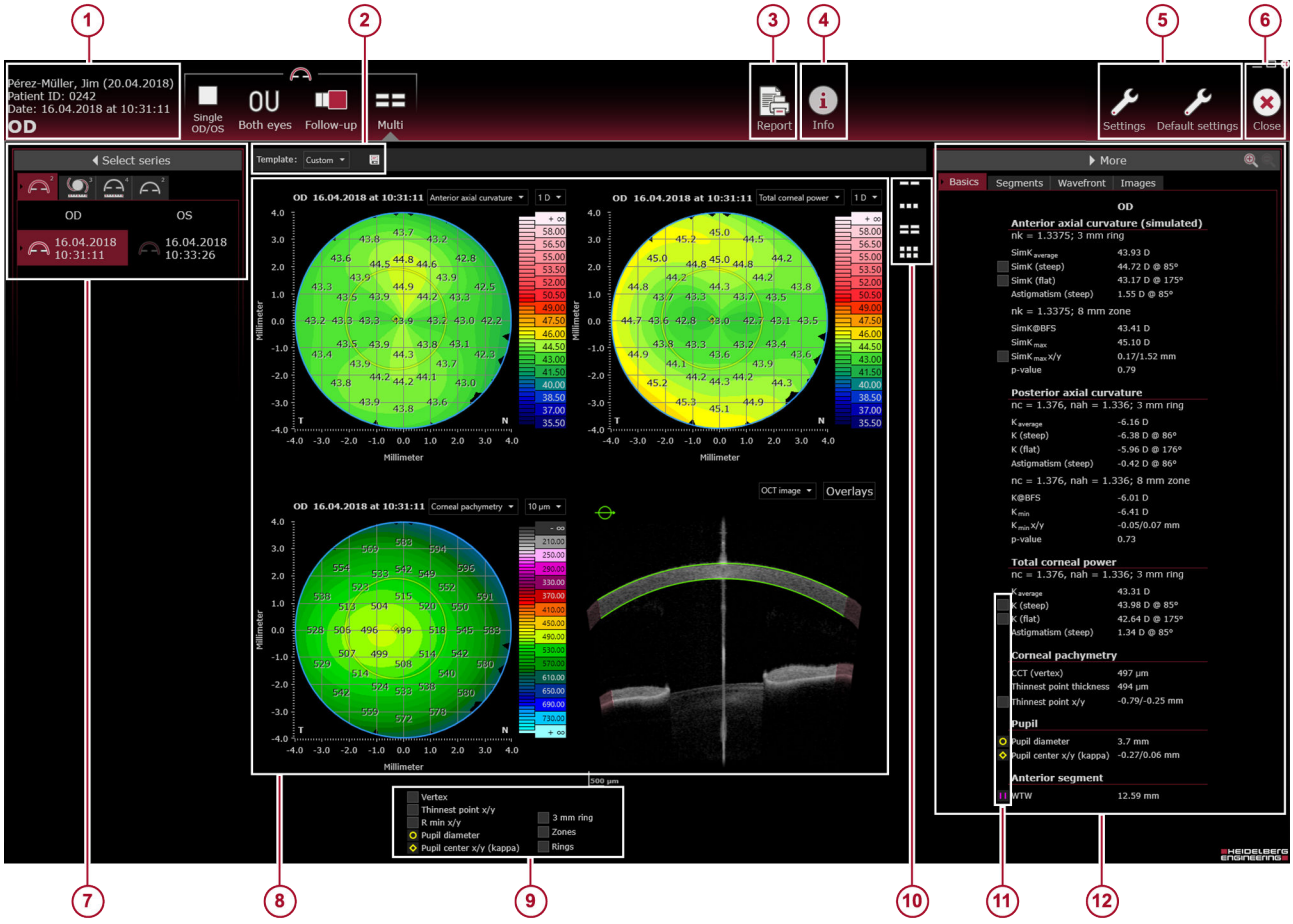


*Fig. 23: “Multi” view*

1. Patient information (➞ 9.2.4.1 “Patient Information”, p. 63)
2. *“Template”* drop-down list (➞ 9.2.7.1 “Default Templates”, p. 85) and (➞ 9.2.7.2 “Customizing Templates”, p. 86)
3. *“Report”* button (➞ 13 “Reports”, p. 192)
4. *“Info”* button (➞ 9.2.4.4 “ *“Info”* Section”, p. 73)
5. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
6. *“Close”* button
7. *“Select series”* section (➞ 9.2.4.2 “ *“Select series”* Section”, p. 64)
8. Color maps with color scale, camera image, OCT section image (➞ 9.2.4.5 “Color Map with Color Scale”, p. 76)
9. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)
10. Viewing options buttons, number of displayed color maps or images (➞ 9.2.7.2 “Customizing Templates”, p. 86)
11. Overlay options checkboxes (➞ 9.2.4.6 “Overlay Options”, p. 77)
12. *“More”* section (➞ 9.2.4.3 “ *“More”* Section”, p. 64)

**Red areas in OCT section images refer to an extrapolated refraction correction**

The refraction correction in these areas is based on extrapolation of the surface boundaries and should be considered with caution for clinical use.

Measurements using freehand selections are not allowed in red areas.

#### 9.2.7.1 Default Templates

In the *“Multi”* view, 2, 3, 4, or 6 different corneal maps or images of the same eye can be displayed at the same time.

By default, the following templates are available on every workstation in the network:

**Default templates**

| Template | Color maps and images | Description |
|---|---|---|
| *“Cornea compact”* | ▪ *“Anterior axial curvature”* color map<br>▪ *“Total corneal power”* color map<br>▪ *“Pachymetry”*color map<br>▪ OCT section image | This template provides an overview on the main corneal parameters. |
| *“Elevation”* | ▪ *“Anterior elevation (BFS)”* color map<br>▪ *“Anterior elevation (BFT)”* color map<br>▪ *“Posterior elevation (BFS)”* color map<br>▪ *“Posterior elevation (BFT)”* color map | The maps of this template show the deviations from the best fit sphere and the best fit toric ellipse, allowing for detection of a potentially abnormal cornea. |
| *“Keratoconus”* | ▪ *“Anterior tangential curvature”* color map<br>▪ *“Anterior elevation (BFT)”* color map<br>▪ *“Pachymetry”* color map<br>▪ *“Posterior elevation (BFT)”* color map | This template is helpful for the detection and monitoring of an existing or suspected keratoconus eye. |
| *“Refractive I”* | ▪ *“Anterior axial curvature”* color map<br>▪ *“Anterior elevation (BFS)”* color map<br>▪ *“Pachymetry”* color map<br>▪ *“Posterior elevation (BFS)”* color map | This template is helpful when planning a refractive surgery. |
| *“Refractive II”* | ▪ *“Anterior axial curvature”* color map<br>▪ *“Pachymetry”* color map<br>▪ *“Posterior axial curvature”* color map<br>▪ *“Total corneal power”* color map | This template is helpful when planning a refractive surgery. |
| *“Wavefront”* | ▪ *“Anterior corneal wavefront”* color map<br>▪ *“Total corneal wavefront”* color map | This template is helpful when planning a refractive surgery and IOL implantation. |

### 9.2.7.2 Customizing Templates

**Editing templates**

It is possible to create custom templates. Individual color maps from a default template can be adjusted or completely new templates with up to six color maps and/or images can be created.

- To change a color map, open the drop-down list above the desired color map.
- Select the desired color map, the *“Camera image”*, or the *“OCT section image”*.

**Changing the number of maps or images**

- To add or reduce the number of displayed color maps or images, select one of the buttons on the right side of the user interface:
  - - Two maps or images
  - - Three maps or images
  - - Four maps or images
  - - Six maps or images

If the view is minimized to show two or three maps or images, either the first two or three color maps of a default template are displayed.

If the view is maximized to show six images per page, the additional informaton can be added by selecting the desired color map, the *“Camera image”*, or the *“OCT section image”* from a drop-down list.

**Example**

If the *“Cornea compact”* template is minimized to show only two images per page, then only the *“Anterior axial curvature”* and the *“Total corneal power”* color maps will be displayed.

If the *“Cornea compact”* template is maximized to show six images per page, more color maps can be added from the drop-down list. Also, the camera image and the OCT section image can be chosen.

**Saving templates**

With each template change, the entry next to the *“Template”* drop-down list will automatically change to *“Custom”*. Next to the *“Template”* drop-down list, a disk symbol is displayed.

- To save the changes, click *“Save and close”*.

  The *“Save as”* window is displayed.
- In the *“Template name”* field, enter the name of the template.
- To confirm the new template, click *“Save and close”*.

  On all workstations in the network, the new template can now be selected from the *“Template”* drop-down list.

**Renaming templates**

Next to the *“Template”* drop-down list, a symbol for editing templates is displayed.

- To edit a template, click *“Rename”*.

  The *“Save as”* window is displayed.
- In the *“Template name”* field, enter the new name of the template.

- To confirm the changes, click *“Rename”*.

  The renamed template can now be selected from the *“Template”* drop-down list.

**Deleting templates**

Next to the *“Template”* drop-down list, a symbol for deleting templates is displayed.

- To delete a template, click *“Delete”*.

  A message will appear asking you whether you really want to delete the template.

- To confirm, click *“Yes”*.

  The template will be deleted and can no longer be selected from the *“Template”* drop-down list anymore.

# 10 *“Cataract”* App

## 10.1 Examining Patients

### 10.1.1 Determining the Status of the Patient's Eye

When adding a new patient, or when editing an existing patient in HEYEX 2, the status of the eye's cornea, lens, and vitreous can be indicated.

For further information on how to add a new patient or edit an existing patient in HEYEX 2, please refer to the HEYEX 2 User Manual (➞ “Applicable documents”, p. 7).

The following procedure assumes that the *“Patient master data”* window of HEYEX 2 is displayed.

To change the eye status in the *“Patient master data”* window, please proceed as follows:

- Select the *“Eyes”* tab.
- Select the desired status for both eyes (➞ “Cornea, lens, and vitreous status”, p. 88).

**Cornea, lens, and vitreous status**

| Anatomic structure | Status |
|---|---|
| *“Cornea”* status | *“No surgery”* |
| | *“Post-refractive (myopic)”* |
| | *“Post-refractive (hyperopic)”* |
| | *“Post-surgery”* |
| *“Lens”* status | *“Phakic”* |
| | *“Phakic IOL”* |
| | *“Aphakic”* |
| | *“Pseudophakic”* |
| | *“Piggyback IOL”* |
| *“Vitreous”* status | *“Vitreous only”* |
| | *“Post-vitrectomy”* |
| | *“Silicone oil”* |
| | *“Gas in vitreous cavity”* |

- To save the changes, click *“Save”*.

Changing the lens and vitreous status may impact the axial length results.

- Axial length values are only displayed for a *“Phakic”*, *“Aphakic”*, or *“Pseudophakic”* lens status and for a *“Vitreous only”*, or *“Post-vitrectomy”* vitreous status.
  Axial length values are not displayed for a *“Phakic IOL”*, or a *“Piggyback IOL”* lens status, and for *“Silicone oil”* or *“Gas in vitreous cavity”* vitreous status.
- Automatic lens segmentation is disabled for a lens status other than *“Phakic”*.

For the axial length measurements in non-phakic eyes, the following offsets are used. The offsets are added.

**Offsets used for axial length measurement**

| Eye status | Offset | Reference |
|---|---|---|
| *“Pseudophakic”* | 0.138 mm | According to *Wolfgang Haigis. Graefes Arch Clin Exp Ophthalmol. 2001 Aug; 239(8):589-98*. The used refractive indices are adapted to device-specific wavelength. |
| *“Aphakic”* | 0.215 mm | |

### 10.1.2 Starting Existing Orders

When starting the system the first time every day, or every 24 hours, the system test has to be performed. For further information on how to perform the system test, please refer to (➞ 8.3 “Performing the System Test”, p. 30).

The following procedure assumes that HEYEX 2 has been started, an order has been created, the navigator is open, and that the desired patient is selected.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

- Select the *“Examination”* tab in the ribbon bar.
- Click *“Start”* in the *“Examinations”* section.

  The *“Select examination”* window is displayed.
- Select the desired order and click *“Start examination”*.

  The acquisition window is displayed on the touch screen of the device.
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31) and select the desired examination application.

### 10.1.3 Editing the Status of the Patient's Eye

If you did not determine the patient's eye status in HEYEX 2 or you want to change the determined status, you can edit the eye's cornea, lens, and vitreous status in the acquisition window before starting the acquisition.

- Select the *“Eye status”* tab.

  The available options for the cornea, lens, and vitreous are displayed.

- Open the drop-down lists and select the desired status for the displayed eye (➞ “Cornea, lens, and vitreous status”, p. 88).
- To save the changes, click *“Save”*.

  The new status information will be saved in the HEYEX 2 database.

> Changing the lens and vitreous status may impact the axial length results.

### 10.1.4 Adjusting the Internal Fixation Light

If the patient cannot see the internal fixation light clearly, its sharpness and brightness may be adjusted. Ask the patient whether the internal fixation light is clearly visible while the camera is adjusted.

> Please note that the following settings must be adjusted for each eye separately.

> Make sure that the patient is not distracted during fixation, e.g. by persons walking by.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.

- In order to adjust the brightness of the internal fixation light, tap − to decrease the brightness and + to increase the brightness in the *“Fixation light brightness”* section. The scale of the brightness ranges from 0 to 5, where 0 indicates that the fixation light is off, 1 indicates low brightness and 5 indicates high brightness of the fixation light. Increasing the brightness may be especially helpful for patients with cataracts.
- In order to adjust the sharpness of the internal fixation light, tap − in the *“Fixation light focus”* section to shift the fixation light focus to myopic correction and + to shift the fixation light focus to hyperopic correction. The scale of the focus ranges from -15 D to +15 D and can be adjusted in 0.5 D increments. Changing the internal fixation light focus may be especially helpful for patients with refractive errors, or to improve the axial length signal.

 

**Storing the *“Fixation light focus”* settings**

The *“Fixation light focus”* settings will be stored in the database.

The settings are automatically used for future acquisitions performed on the same patient and eye.

### 10.1.5 Using the External Fixation Light

If the internal fixation light is not adequate for proper fixation, use the external fixation light to engage the fellow eye for fixation.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.

- To switch on the external fixation light, tap the light bulb symbol in the *“External fixation light”* section.

- Move the external fixation light so that the fixation of the patient's fellow eye is achieved with the external fixation light.

### 10.1.6 Aligning the Camera

**Display options** You can change the display of the acquisition window.

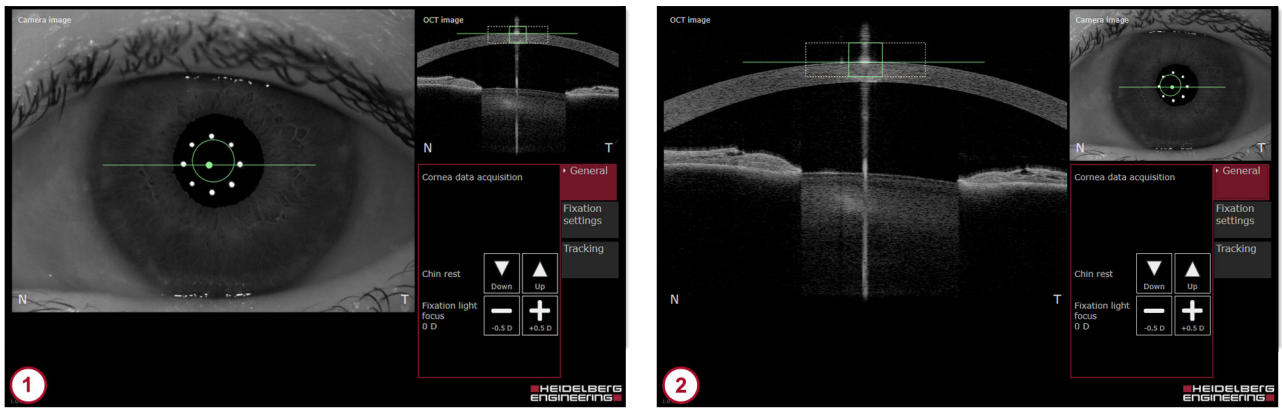


*Fig. 24: Display options*

① Large camera image
② Large OCT section image

By default, the camera image is shown enlarged in the acquisition window ① (Fig. 24).

- To enlarge the OCT section image in the acquisition window ② (Fig. 24), tap the OCT section image.
- To enlarge the camera image again ① (Fig. 24), tap the camera image.

For an optimal examination result, the alignment must be performed according to the following steps in sequence:

- Start with the lateral alignment of the camera and the eye (➞ “Aligning the camera image”, p. 92).
- When the lateral alignment is successfull, proceed with the axial alignment of the eye and the OCT scan pattern (➞ “Aligning the OCT section image”, p. 93).

**Aligning the camera image**

Use the joystick to align the camera so that the circle and the horizontal line are within the eight reflection points on the camera image.

The circle indicates the target position for the corneal vertex in the center of the camera image. The dot in the middle of the line indicates the location of the tracked corneal vertex, i. e. the center of the eight reflection points. The line indicates the lateral position of the live OCT section image.

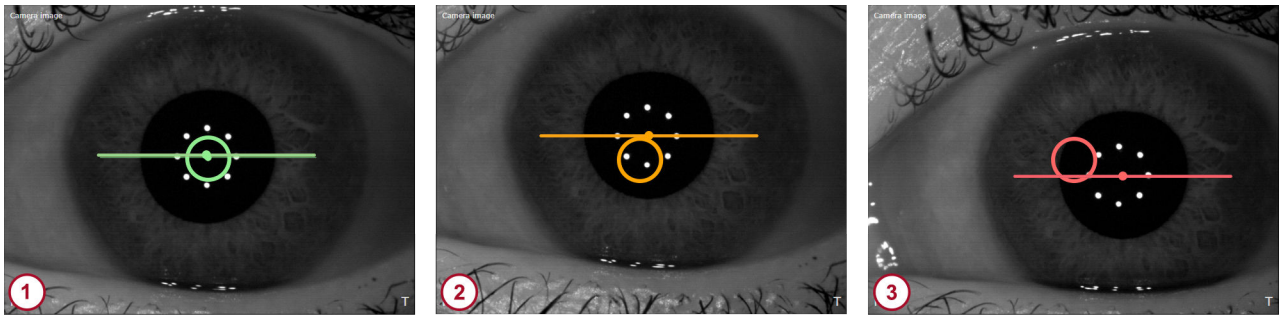


*Fig. 25: Aligning the camera image*

① Camera image correctly aligned
② Camera image acceptably aligned
③ Camera image not properly aligned

- Carefully move the camera towards the patient's eye.
- Move the camera slightly to the left and the right until the iris is visible within the camera image.
- During camera alignment, ask the patient whether the fixation light is bright and clearly visible. If not, readjust the fixation light (➞ 10.1.4 “Adjusting the Internal Fixation Light”, p. 90).
- Turn the joystick clockwise or counterclockwise until the circle and the horizontal line are within the eight reflection points on the camera image.

  If the camera is correctly aligned, the circle and the line turn green ① (Fig. 25). The image acquisition can be initiated.

  If the camera is acceptably aligned, the circle and the line are yellow ② (Fig. 25). While this quality indicator suggests that the alignment is acceptable, Heidelberg Engineering recommends to align the camera correctly ① (Fig. 25) for best results.

  If the camera is not properly aligned, the circle and the line are red ③ (Fig. 25). Image acquisition is not possible when the camera is not acceptably or correctly aligned. Readjust the camera until the image is acceptably or correctly aligned.

**Aligning the OCT section image**

Use the joystick to align the OCT section image so that the square and the horizontal line turn green.

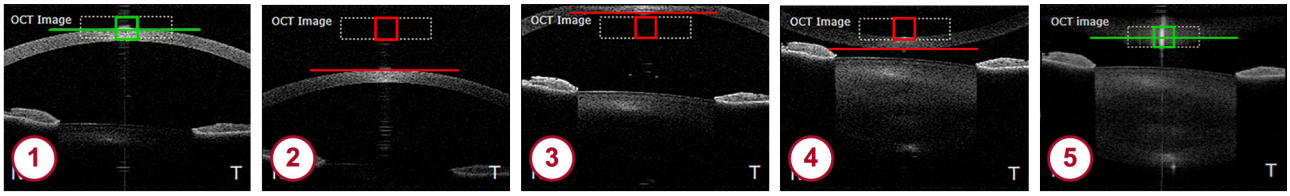


*Fig. 26: Aligning the OCT section image*

① OCT section image is correctly aligned
② Move the camera closer to the patient's eye
③ Move the camera away from the patient's eye
④ Move the camera away from the patient's eye
⑤ Move the camera away from the patient's eye

- Align the camera so that the cornea and the corneal reflex are within the dashed box.

  If the OCT section image is aligned correctly, the square and the line in the dashed box turn green ① (Fig. 26).

  If the camera is too far away from the patient's eye, the OCT section image will be below the dashed box ② (Fig. 26).

- Move the camera closer to the patient's eye.

  If the camera is too close to the patient's eye, the OCT section image will be above the dashed box ③ or flipped ④ (Fig. 26).

- Move the camera away from the patient's eye.

  If the camera is too close to the patient's eye and the cornea is flipped, the square and the line may erroneously turn green because the corneal vertex reflex is detected ⑤ (Fig. 26).

- If the camera is acceptably aligned, the square and the line in the dashed box are yellow. While this quality indicator suggests that the alignment is acceptable, Heidelberg Engineering recommends to align the camera correctly for best results.

- Move the camera away from the patient's eye until the cornea is displayed correctly ① (Fig. 26).

**Disabling tracking**

**WARNING!**

**Disabling tracking may cause inaccurate examination results**

Inaccurate examination results may lead to incorrect diagnostic conclusions resulting in incorrect therapeutic approaches.

- Always consider that examinations without the tracking function may be less accurate.

Unacceptable image alignment during the acquisition process (pressed joystick button) results in a message indicating that acquisition is not possible. This scenario could be present, for example, if the tracked corneal reflex on the camera image is unstable. In such instances, the camera should be realigned, or tracking should be disabled in order to continue the acquisition.

Tracking is disabled only for the current acquisition.

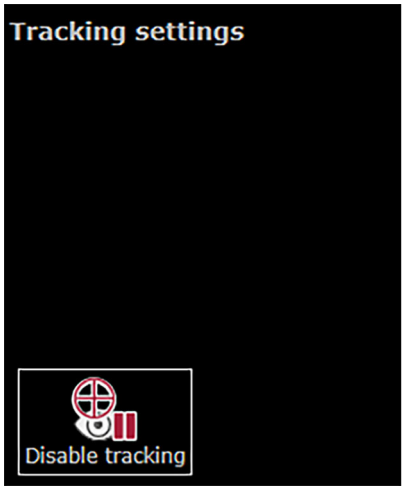


*Fig. 27: Disabling tracking*

- To switch off the tracking function, select the *“Tracking”* tab and click *“Disable tracking”* (Fig. 27).

  The alignment markers on the camera image and OCT section image turn blue.
- Manually align the camera image so that the eight reflection points are centered.
- Manually align the OCT section image so that the cornea is within the dashed box and the corneal vertex reflection is centered laterally.
- Start the examination.

  The aquisition quality parameters *“Motion”*, *“Fixation”* and *“Tear film and lid”* are not applicable and are indicated as *“n/a”*.

  *“Tracking off”* is displayed together with a warning symbol.

**No automatic quality indicators are available when tracking is disabled**

Examination results should be carefully reviewed for accuracy.

- Review all camera images for motion in the analysis window.
- Check the accuracy of the segmented boundaries within the OCT section images in the analysis window.

### 10.1.7 Acquiring Images

**Preparing the examination**

- Start an existing order (➞ 10.1.2 “Starting Existing Orders”, p. 89).
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31).

- Tap *“Cataract”* on the touch screen.

**Aligning the camera**

- To examine the right eye, move the camera to the left and use the eye occluder to cover the left eye.

  In the upper left corner of the touch screen, *“OD”* is displayed.
- When switching eyes during the acquisition process, pull the camera back to its farthest back position, then slide it to the left or right.
- To examine the left eye, move the camera to the right and use the eye occluder to cover the right eye.

  In the upper left corner of the touch screen, *“OS”* is displayed.
- Align the camera so that the camera image and the OCT section image are displayed correctly (➞ 10.1.6 “Aligning the Camera”, p. 91).

**Starting the examination**

The *“Cataract”* examination consists of four steps of image acquisition.

**First acquisition**

- Ask the patient to blink before each examination step.
- Readjust the camera, if needed, before each examination step.
- Ask the patient to refrain from blinking for a few seconds.
- Press the joystick button.

  Image acquisition starts and the parameters of the cornea are being acquired. After a brief moment, the acquisition stops.

**Second acquisition**

- Readjust the camera, if needed.
- Ask the patient to refrain from blinking for a few seconds.
- Press the joystick button.

  Image acquisition continues and the parameters of the anterior segment biometry are being acquired. After a brief moment, the acquisition stops.

**Third acquisition**

- Readjust the camera, if needed.
- Ask the patient to refrain from blinking for a few seconds.
- Press the joystick button.

  Image acquisition continues and the first measurements of the axial length are being acquired. After a brief moment, the acquisition stops.

**Fourth acquisition**

- Readjust the camera.
- Ask the patient to refrain from blinking for a few seconds.
- Press the joystick button.

  Image acquisition continues and the further parameters of the axial length are being acquired.

  After a brief moment, the examination stops automatically.

**Examination quality**

Immediately after the examination process is completed, the examination quality is checked. If the acquisition quality is acceptable or good, then the basic examination results are displayed after a brief moment.

- Check the examination quality (➞ 10.1.8 “Checking the Examination Quality”, p. 97).

  If the quality of one or more of the four examination steps is not ideal or is compromised, then a message is displayed, indicating that one of the following quality parameters is not met:

  - *“Vertex out of alignment”*
  - *“Too strong movement”*
  - *“Cornea out of axial alignment”*
  - *“Possible blinking”*

  A window will appear, indicating the option to repeat the examination or to proceed to the analysis of the data.

- To discard the acquired data of the failed examination step and to repeat the step, tap *“Repeat”*.

  The acquisition screen is displayed again.

- Realign the camera and repeat the failed examination step.

- To proceed with analyzing the examination data, tap *“Proceed”*.

  The basic examination results are displayed after a brief moment.

- Check the examination quality (➞ 10.1.8 “Checking the Examination Quality”, p. 97).

### 10.1.8 Checking the Examination Quality

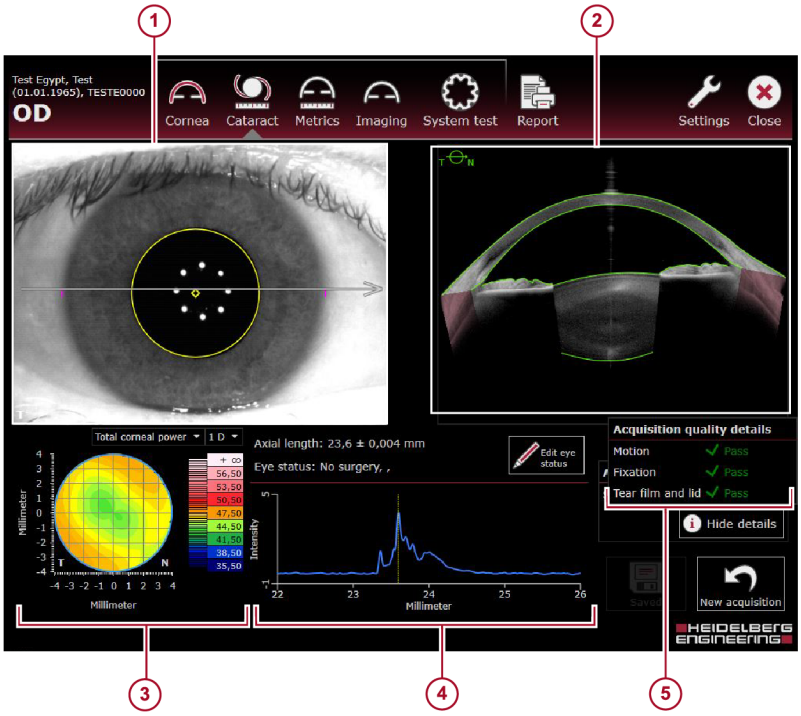


*Fig. 28: Basic examination results*

1. Camera image
2. OCT section image
3. Color map with color scale
4. Axial length graph
5. Acquisition quality parameters

By default, the summarized acquisition quality result is displayed and the details are hidden.

**Acquisition quality** ⑤

- To display the detailed acquisition quality results, click *“Show details”*.
- Check the acquisition quality parameters:
  - If *“Motion”* is yellow or red, then one or more of the following factors may have impacted the results during the acquisition process:
    - The corneal vertex was not correctly aligned, laterally.
    - The corneal vertex moved too much.
    - The corneal vertex was not correctly aligned, axially.
  - If *“Fixation”* is yellow or red, then the patient did not fixate properly during the acquisition process.
  - If *“Tear film and lid”* is yellow or red, then the corneal reflexes were compromised during the acquisition process due to one of the following reasons:
    - The patient did not open his or her eyes wide enough or blinked.
    - The patient has dry eyes.
    - The patient has abnormal corneal irregularities.

  i If any of the quality parameters are red, Heidelberg Engineering recommends reinstructing and reexamining the patient. If any of the quality parameters are yellow, Heidelberg Engineering recommends to carefully review the data and to decide on a case-by-case basis whether the quality of the data is acceptable or if a repeated examination is needed.

  - If *“Refraction correction”* is displayed, please refer to (➞ 10.1.8.1 “Message *“Refraction correction”*”, p. 99).
  - If *“Required data points”* is displayed, please refer to (➞ 10.1.8.2 “Message *“Required data points”*”, p. 99).
  - If *“Axial length measurement”* is displayed, please refer to (➞ 10.1.8.3 “Message *“Axial length measurement”*”, p. 100).
  - If *“Camera image segmentation”* is displayed, please refer to (➞ 10.1.8.4 “Message *“Camera image segmentation”*”, p. 100).
- To hide the detailed acquisition quality results, click *“Hide details”*.

**Camera image** ①

- Check that the camera image is sharp.
- Check that the reflection points are sharply displayed, circular in shape, and are displayed in a circular pattern.
- Check that the pupil and/or white-to-white boundaries are acceptably segmented on the IR camera image if these parameters are relevant.

  If the segmentation is not acceptable, Heidelberg Engineering recommends to repeat the measurements.

**OCT section images** ③

- Review the segmentation of the OCT section images.
- If the corneal boundaries are not acceptably segmented on the OCT section image, Heidelberg Engineering recommends to reexamine the patient. Manual adjustments of measurements along the line of sight, i. e. the aqueous depth or lens thickness, are possible in the analysis window (➞ 10.2.4.7.1 “Editing Anatomic Boundaries”, p. 120).

**Color map** ③

- Check the plausibility of the color map.
- Verify that there is adequate data within the central sections of the color map.

 

**Axial length graph** ④

- Check the axial length graph. If the peak of intensity does not represent the RPE, adjust it manually (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122).

**Editing the patient's eye status**

If you did not determine the patient's eye status in HEYEX 2 or before the image acquisition or you want to change the determined status, you can edit the eye's cornea, lens, and vitreous status.

- Tap *“Edit eye status”*.

  The available options for the cornea, lens, and vitreous are displayed.

- Open the drop-down lists and select the desired status for the displayed eye (➞ “Cornea, lens, and vitreous status”, p. 88).
- To save the changes, click *“Save”*.

  The axial length measurement will be updated and the new status information will be saved in the HEYEX 2 database.

Changing the lens and vitreous status may impact the axial length results.

**Acquiring additional images**

- To acquire additional images, tap ↶ *“New acquisition”*.

  The examination window is displayed. Align the camera and reexamine the patient.

#### 10.1.8.1 Message *“Refraction correction”*

If the refraction correction failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Refraction correction”* status is displayed in red.
- In the OCT section images, the cornea is not segmented.
- In the color map, no information is displayed.

If the refraction correction failed, no measurements are possible. Heidelberg Engineering recommends reexamining the patient.

#### 10.1.8.2 Message *“Required data points”*

If an insufficient number of data points has been detected during the examination, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Required data points”* status is displayed in red.
- In the color map, there is missing information.

This error message is typically displayed if the patient did not open his or her eye wide enough during the acquisition process. Heidelberg Engineering recommends reinstructing and reexamining the patient.

### 10.1.8.3 Message *“Axial length measurement”*

**Automatic peak detection failed**

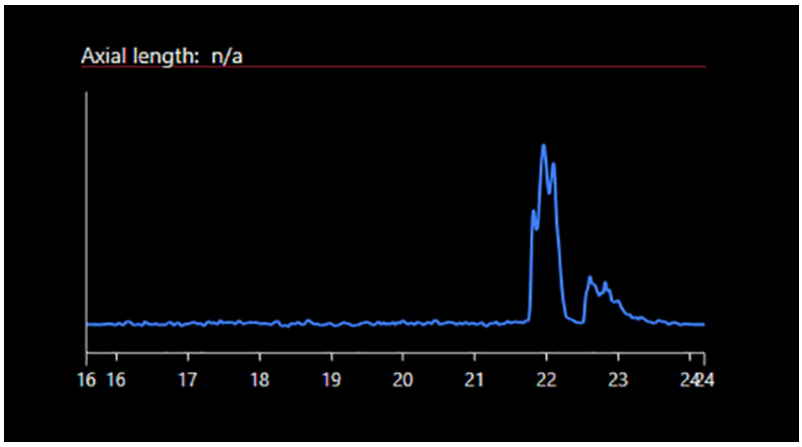


*Fig. 29: Insufficient retinal peak detection*

The fixation light focus adjustment may affect the quality of axial length peaks. If the detection of the retinal peak failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Axial length measurement”* status is displayed in yellow.
- In the axial length profile, multiple peaks with relatively similar heights have been detected. One definitive maximum peak was not automatically detected (Fig. 29).
- The axial length could not be automatically measured and, therefore, manual identification of the maximum peak is needed. For further information, please refer to (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122).

**Insufficient retinal signal**

If the detection of the retinal signal failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Axial length measurement”* status is displayed in red.
- In the axial length graph, no information is displayed.
- The axial length could not be measured.

Heidelberg Engineering recommends reexamining the patient.

### 10.1.8.4 Message *“Camera image segmentation”*

If the segmentation of the pupil failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Camera image segmentation”* status is displayed in red.
- On the camera image, neither the pupil diameter nor the WTW distance are displayed.

The pupil diameter and the WTW distance will not be displayed in the analysis window. When this message appears, it should be decided on a case-by-case basis whether the examination should be accepted with compromised quality or a repeat examination is indicated.

## 10.2 Analyzing Examinations

The analysis window offers the following four views:

- *“Cornea single OD/OS”*; full analysis features only available if you purchased the *“Cornea”* app.
- *“Cornea OU”*; full analysis features only available if you purchased the *“Cornea”* app.
- *“Biometry OU”*
- *“Calculation OU”*

**When analyzing examinations, always check all parameters for their plausibility**

Cross-check all parameters with respect to the available reference data.

### 10.2.1 Opening Examinations in the Analysis Window

The following procedure assumes that HEYEX 2 has been started.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

▸ To open examinations in the analysis window, select the desired patient in the *“Patients”* list.

All examinations are listed in the *“Examinations”* list.

▸ Select the desired examination.

All series are displayed in the *“Series”* section.

▸ To display series as lists, select the *“Series”* tab at the bottom of the *“Series”* section.

▸ To display series as thumbnails, select the *“Series thumbnails”* tab at the bottom of the *“Series”* section.

The following sections assume that the *“Series thumbnails”* tab has been selected.

▸ Double-click the desired thumbnail.

The analysis window is displayed.

### 10.2.2 Analysis Workflow

Heidelberg Engineering recommends starting with the *“Biometry OU”* view, which provides an overview of all relevant data for both eyes. If the overview shows irregularities, the *“Cornea single OD/OS”* view (➞ 9.2.4 “Analysis Window - *“Single OD/OS”* View”, p. 63) and the *“Cornea OU”* view (➞ 9.2.5 “Analysis Window - *“Both eyes”* View”, p. 78) allow checking all maps for further details.

**Step 1 – Editing the eye status**

Editing the eye status is only necessary if it was not defined during the examination.

▸ Click the eye status.

The context menu is displayed.

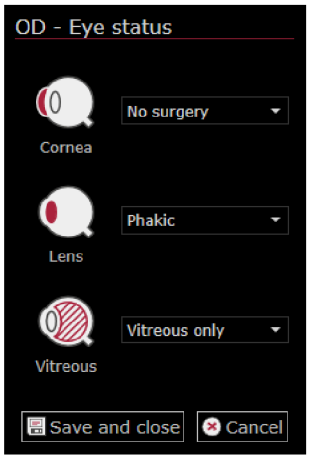


*Fig. 30: Eye status*

- Edit the status of the *“Cornea”*, *“Lens”*, and *“Vitreous”* for both eyes.
- To confirm the changes, click *“Save and close”*.

  For further information, please refer to (➞ 10.2.4.5 “Editing the Eye Status”, p. 116).

**Step 2 – Reviewing the corneal geometry and segmentation**

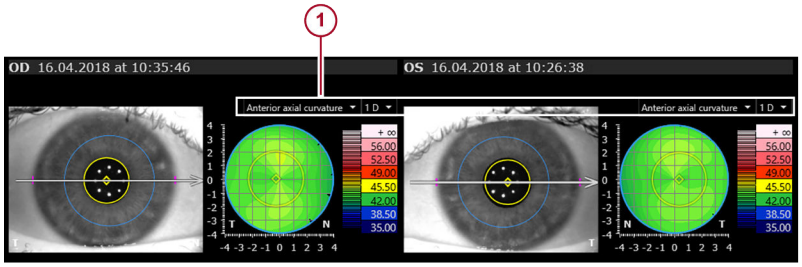


*Fig. 31: “Anterior axial curvature”*

① *“Anterior axial curvature”* map

- Above the color map, open the drop-down list and select *“Anterior axial curvature”* to review the anterior axial curvature.

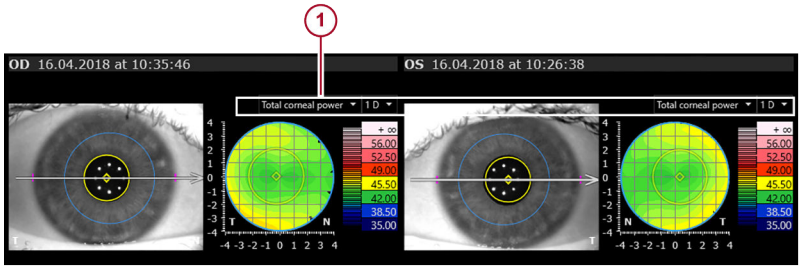


*Fig. 32: “Total corneal power”*

① *“Total corneal power”* map

- Above the color map, open the drop-down list and select *“Total corneal power”* to review the total corneal power.

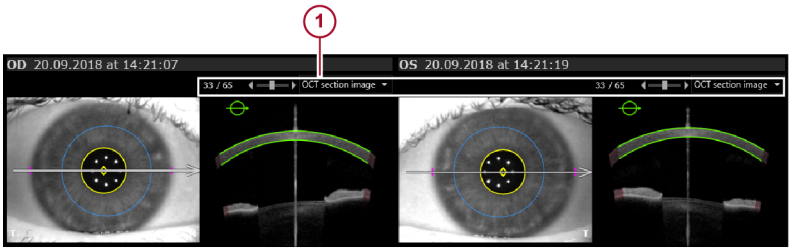


*Fig. 33: “OCT section image”*

① *“OCT section image”*

- Above the color map, open the drop-down list and select *“OCT section image”* to review the segmentation.

**Step 3 – Reviewing the segmentation and anatomic boundaries**

> **i** Only the parameters for anterior chamber depth and lens thickness may be adjusted. The segmentation boundaries cannot be edited.

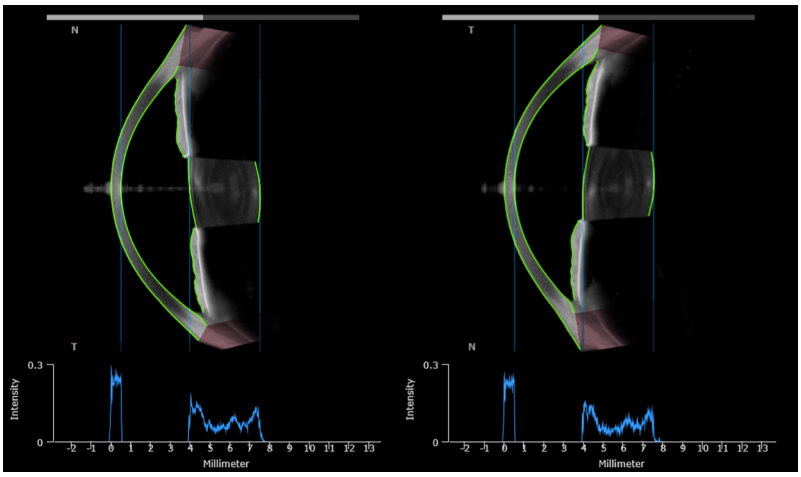


*Fig. 34: Segmentation and anatomic boundaries*

- Verify that the OCT section image has been segmented acceptably.
- In the OCT section image, verify that the boundaries of the anterior corneal surface, the posterior corneal surface, the anterior lens surface, and the posterior lens surface are correctly detected.
- If the boundaries of the anterior corneal surface are not correctly detected, Heidelberg Egineering recommends reexamining the patient.
- If the boundaries of the posterior corneal surface, anterior lens surface, or posterior lens surface along the line of sight are not correctly detected, the corresponding boundaries represented by blue lines should be manually adjusted. For further information, please refer to (➞ 10.2.4.7.1 “Editing Anatomic Boundaries”, p. 120).

**Step 4 – Reviewing the axial length**

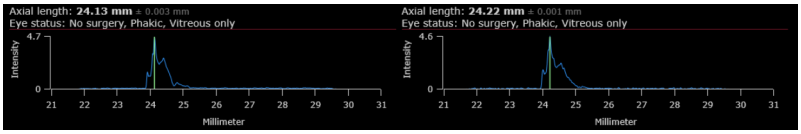


*Fig. 35: “Axial length”*

- In the *“Axial length”* section, check the standard deviation.

  i For non-pathological eyes with a clearly defined RPE peak, the standard deviation should be below 0.02 mm.

- In the profile, verify that the retinal peak corresponds to the position of the RPE.

  The profile shows the retinal peak detection. It is assumed that the highest peak represents the RPE.

- If the retinal peak does not represent the RPE, correct it manually. For further information, please refer to (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122).

### 10.2.3 Navigating through the Images

Depending on the application and view, different navigating options may be available.

**Navigating options**

| Section | Options | Description |
|---|---|---|
| General | Right-click anywhere in the window. | Switches the unit to mm or D.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |
| | Hover with the mouse cursor over the border of a section, e. g. the *“More”* section, in the analysis window. | The mouse cursor switches to ⇔.<br>Drag-and-drop to change the size. |
| | Click ▷. | Expands or retracts a section. |
| Camera image or color map | Hover with the mouse cursor over a camera image or map. | The value at the corresponding location on the map is displayed.<br>The x/y location of the mouse cursor is displayed on the upper right of the map.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |
| OCT section image | Hover with the mouse cursor over the left or right end of the brightness and contrast slider. | The mouse cursor switches to ⇔.<br>Drag-and-drop the slider to change the image brightness of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Hover with the mouse cursor over the brightness and contrast slider. | The mouse cursor switches to ✋.<br>Move the slider to adjust the image contrast of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Click ⊞. | While holding down the left mouse button, draw a square on the OCT section image in order to zoom the selected region to its maximum size. |

| Section | Options | Description |
|---|---|---|
| | Click or .<br>Alternatively, press Ctrl and scroll the mouse wheel. | Incrementally zoom in or out on an OCT section image. |
| | Hover with the mouse cursor over the border of a zoomed OCT section image. | The mouse cursor switches to .<br>The automatic scroll function is activated. |
| | Press and hold the left mouse key. | Move the mouse to move the image. |
| | On the *“B-scan”* slider, click ◀ or ▶ to scroll through the OCT section images.<br>Alternatively, scroll through the OCT section images using the mouse wheel. | Shows the OCT section images. |
| | To show the OCT section images as a slide show, click *“Play”*. | Shows the OCT section images as a slide show. |
| A-scan | If the A-scan overlay is activated, hover with the mouse cursor over the green line representing the A-scan. | The mouse cursor switches to .<br>Drag-and-drop to move the A-scan. |

### 10.2.4 Analysis Window - *“Biometry OU”* View


*Fig. 36: “Biometry OU” view*

① Patient information (➞ 10.2.4.1 “Patient Information”, p. 106)
② *“Select series”* section (➞ 10.2.4.2 “ *“Select series”* Section”, p. 107)
③ Camera image and color map with color scale for OD (➞ 10.2.4.6 “Camera Image and Color Map with Color Scale”, p. 117)

④ Camera image and color map with color scale for OS (➞ 10.2.4.6 “Camera Image and Color Map with Color Scale”, p. 117)
⑤ *“Report”* button (➞ 13 “Reports”, p. 192)
⑥ *“Info”* button (➞ 10.2.4.4 “ *“Info”* Section”, p. 113)
⑦ *“More”* section (➞ 10.2.4.3 “ *“More”* Section”, p. 107)
⑧ *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
⑨ *“Close”* button
⑩ OCT section image with intensity graph for OD (➞ 10.2.4.7 “OCT Section Image with Intensity Graph”, p. 119)
⑪ Axial length for OD (➞ 10.2.4.9 “Axial Length”, p. 121)
⑫ Overlay options checkboxes (➞ 10.2.4.8 “Overlay Options”, p. 121)
⑬ Axial length for OS (➞ 10.2.4.9 “Axial Length”, p. 121)
⑭ OCT section image with intensity graph for OS (➞ 10.2.4.7 “OCT Section Image with Intensity Graph”, p. 119)
⑮ Overlay options checkboxes (➞ 10.2.4.8 “Overlay Options”, p. 121)

**Red areas in OCT section images refer to an extrapolated refraction correction**

The refraction correction in these areas is based on extrapolation of the surface boundaries and should be considered with caution for clinical use.

Measurements using freehand selections are not allowed in red areas.

### 10.2.4.1 Patient Information

The following information is displayed:

- Patient name
- Date of birth
- Patient ID
- Examination date and time
- Examined eye

### 10.2.4.2 *“Select series”* Section

In the *“Select series”* section, all series of the currently selected examination are displayed. The series are divided into OD and OS, and are sorted by examination date and time. The most current examination is on top of the list. The oldest examination is on the bottom of the list. The numbers next to the symbols of the application tabs indicate how many acquisitions the patient file series contains, in the corresponding acquisition application.

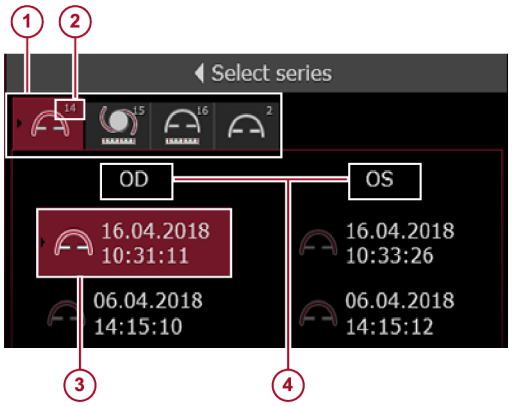


*Fig. 37: “Select series” section*

1. Application tabs
2. Number of series acquired with that application
3. Selected series
4. OD, OS

- To select a series for analysis in the *“Cataract”* view, click the desired OD and OS entries.

  The camera image and the color map, the OCT section image with the intensity graph, and the axial length are automatically displayed for both selected examinations.

> It is only possible to display both eyes if the time between the examinations of both eyes does not exceed 24 hours.

### 10.2.4.3 *“More”* Section

In the *“More”* section of the *“Cataract”* app, the values in the *“Basics”* tab will be displayed for *“OD”*, *“OS”*, and the *“OD-OS difference”*.

**“Basics” tab**

In the *“Basics”* tab of the *“More”* section, the following information is displayed:

***“Basics”* tab**

| Section | Entry | | Description |
|---|---|---|---|
| *“Anterior axial curvature (simulated)”* | *“nk ”* | | Keratometric index |
| | *“3 mm ring”* | | The values have been calculated with the indicated keratometric index for a 3 mm ring. |
| | *“D”* values | *“$SimK_{average}$”* | Simulated keratometry average |
| | | *“SimK (steep)”* | Simulated keratometry (steep) |
| | | *“SimK (flat)”* | Simulated keratometry (flat) |
| | | *“Astigmatism (steep)”* | This parameter is defined as the difference of the SimK values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| | *“mm”* values | *“$R_{average}$”* | Radius of corneal axial curvature |
| | | *“R (steep)”* | Radius of corneal axial curvature (steep) |
| | | *“R (flat)”* | Radius of corneal axial curvature (flat) |
| | | *“Radii difference (steep)”* | This parameter is defined as the difference of the radii of curvature between the steep and flat radii of the cornea. The axis represents the location of the steep meridian. |
| | *“nk ”* | | Keratometric index |
| | *“8 mm zone”* | | The values have been calculated with the indicated keratometric index for the 8 mm zone. |
| | *“D”* values | *“SimK@BFS”* | SimK value corresponding to radius of curvature of BFS |
| | | *“$SimK_{max}$”* | This parameter is defined as the maximum SimK value, simulated from the anterior corneal surface. |
| | | *“$SimK_{max}$ x/y”* | This parameter is defined as the position of the maximum SimK value, relative to the line of sight. |
| | *“mm”* values | *“BFS”* | Radius of curvature of BFS |
| | | *“$R_{min}$”* | This parameter is defined as the minimum radius of anterior corneal axial curvature. |
| | | *“$R_{min}$x/y”* | This parameter is defined as the position of the minimum radius of anterior corneal axial curvature, relative to the line of sight. |
| | Depending on the setting: *“p-value”*, *“Q-value”*, *“E-value”* | | This parameter indicates the value that best fits the corneal meridian. |
| | *“p-value”* | | The p-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The p-value can describe a prolate ellipsoid (1 > p > 0), a sphere (p = 1.0) or an oblate ellipsoid (p > 1). |

| Section | Entry | | Description |
|---|---|---|---|
| | *“Q-value”* | | The Q-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The Q-value can describe a prolate ellipsoid (-1< Q < 0), a sphere (Q = 0) or an oblate ellipsoid (Q > 0). |
| | *“E-value”* | | The E-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The E-value can describe a prolate ellipsoid (0 < E < 1), a sphere (E = 0) or an oblate ellipsoid (E < 0). |
| *“Posterior axial curvature”* | *“nc”* | | Refractive index of the cornea |
| | *“nah”* | | Refractive index of the aqueous humor |
| | *“ 3 mm ring”* | | The values have been calculated with the indicated refractive index for a 3 mm ring. |
| | *“D”* values | *“$K_{average}$”* | Keratometry average |
| | | *“K (steep)”* | Keratometry (steep) |
| | | *“K (flat)”* | Keratometry (flat) |
| | | *“Astigmatism (steep)”* | This parameter is defined as the difference of the posterior K values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| | *“mm”* values | *“$R_{average}$”* | Radius of corneal axial curvature |
| | | *“R (steep)”* | Radius of corneal axial curvature (steep) |
| | | *“R (flat)”* | Radius of corneal axial curvature (flat) |
| | | *“Radii difference (steep)”* | This parameter is defined as the difference of the radii of curvature between the steep and flat radii of the cornea. The axis represents the location of the steep meridian. |
| | *“nc”* | | Refractive index of the cornea |
| | *“nah”* | | Refractive index of the aqueous humor |
| | *“ 8 mm zone”* | | The values have been calculated with the indicated refractive index for the 8 mm zone. |
| | *“D”* values | *“K@BFS”* | K-value corresponding to radius of curvature of BFS |
| | | *“$K_{min}$”* | Minimal K value |
| | | *“$K_{min}$ x/y”* | This parameter indicates the location of the minimal K value on the map, relative to the line of sight. |
| | *“mm”* values | *“BFS”* | Radius of curvature of BFS |
| | | *“$R_{min}$”* | This parameter is defined as the minimum radius of anterior corneal axial curvature. |

| Section | Entry | Description |
|---|---|---|
| | *“$R_{min}$x/y”* | This parameter is defined as the position of the minimum radius of anterior corneal axial curvature, relative to the line of sight. |
| | Depending on the setting: *“p-value”*, *“Q-value”*, *“E-value”* | This parameter indicates the value that best fits the corneal meridian. |
| | *“p-value”* | The p-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The p-value can describe a prolate ellipsoid (1 > p > 0), a sphere (p = 1.0) or an oblate ellipsoid (p > 1). |
| | *“Q-value”* | The Q-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The Q-value can describe a prolate ellipsoid (-1< Q < 0), a sphere (Q = 0) or an oblate ellipsoid (Q > 0). |
| | *“E-value”* | The E-value defines the asphericity and type (prolate or oblate) of the conic section that best fits a corneal meridian. The E-value can describe a prolate ellipsoid (0 < E < 1), a sphere (E = 0) or an oblate ellipsoid (E < 0). |
| *“Total corneal power”* | *“nc”* | Refractive index of the cornea |
| | *“nah”* | Refractive index of the aqueous humor |
| | *“ 3 mm ring”* | The values have been calculated with the indicated refractive index for a 3 mm ring. |
| | *“$K_{average}$”* | Corneal power average |
| | *“K (steep)”* | Corneal power (steep) |
| | *“K (flat)”* | Corneal power (flat) |
| | *“Astigmatism (steep)”* | This parameter is defined as the difference of the SimK values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| *“Pachymetry”* | *“CCT (vertex)”* | Central corneal thickness (vertex). This parameter indicates the perpendicular distance between the anterior and the posterior corneal surfaces, measured from the anterior corneal vertex. |
| | *“Thinnest point thickness”* | This parameter indicates the thickness value of the thinnest point on the pachymetry map. |
| | *“Thinnest point x/y”* | This parameter indicates the location of the thinnest point on the pachymetry map, relative to the line of sight. |
| *“Pupil”* | *“Pupil diameter”* | This parameter indicates the measured pupil diameter, derived from the camera image. |

| Section | Entry | Description |
|---|---|---|
| | *“Pupil center x/y (kappa)”* | This parameter indicates the x/y position of the center of the pupil, relative to the line of sight. |
| *“Anterior segment”* | *“WTW”* | White-to-white distance. WTW is defined as the horizontal distance between the nasal and temporal limbus, measured on the camera image. |

***“Standard IOL”* tab** Depending on the license of your *“Cataract”* app, the *“Standard IOL”* or the *“Premium IOL”* tab is available.

***“Standard IOL”* tab**

| Section | Entry | Description |
|---|---|---|
| *“Anterior axial curvature (simulated)”* | *“nk”* | Keratometric index |
| | *“3 mm ring”* | The values have been calculated with the indicated keratometric index for a 3 mm ring. |
| | *“$SimK_{average}$”* | Simulated keratometry |
| | *“SimK (steep)”* | Simulated keratometry (steep) |
| | *“SimK (flat)”* | Simulated keratometry (flat) |
| | *“Astigmatism (steep)”* | This parameter is defined as the difference of the SimK values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| *“Pachymetry”* | *“CCT (vertex)”* | Central corneal thickness (vertex). This parameter indicates the perpendicular distance between the anterior and the posterior corneal surfaces, measured from the anterior corneal vertex. |
| *“Anterior segment”* | *“AQD”* | The aqueous depth is defined as the distance from the posterior corneal surface to the anterior lens surface, measured perpendicular to the anterior corneal surface and along the line of sight. |
| | *“WTW”* | White-to-white distance. WTW is defined as the horizontal distance between the nasal and temporal limbus, measured on the camera image. |
| | *“Lens thickness”* | This parameter is defined as the distance between the anterior and posterior lens surfaces, measured perpendicular to the anterior corneal surface and along the line of sight. |
| *“Pupil”* | *“Pupil diameter”* | This parameter indicates the measured pupil diameter, derived from the camera image. |

| Section | Entry | Description |
|---|---|---|
| | *“Pupil center x/y (kappa)”* | This parameter indicates the x/y position of the center of the pupil, relative to the line of sight. |
| *“Axial length”* | *“Length”* | The axial length is defined as the distance between the anterior corneal surface and the retinal pigment epithelium, along the line of sight. |

***“Premium IOL”* tab** Depending on the license of your *“Cataract”* app, the *“Standard IOL”* or the *“Premium IOL”* tab is available.

***“Premium IOL”* tab**

| Section | Entry | Description |
|---|---|---|
| *“Anterior axial curvature (simulated)”* | *“nk”* | Keratometric index |
| | *“3 mm ring”* | The values have been calculated with the indicated keratometric index for a 3 mm ring. |
| | *“$SimK_{average}$”* | Simulated keratometry |
| | *“SimK (steep)”* | Simulated keratometry (steep) |
| | *“SimK (flat)”* | Simulated keratometry (flat) |
| | *“Astigmatism (steep)”* | This parameter is defined as the difference of the SimK values between the steep and flat radii of the cornea. The axis represents the location of the steepest meridian. |
| *“Astigmatism (steep)”* | *“nc”* | Refractive index of the cornea |
| | *“nah”* | Refractive index of the aqueous humor |
| | *“3 mm ring”* | The values have been calculated with the indicated refractive index for a 3 mm ring. |
| | *“Astigm. (total)”* | This parameter indicates the value of the overall corneal astigmatism based on the anterior and posterior corneal surfaces. |
| | *“Astigm. (posterior)”* | This parameter indicates the measured astigmatism of the posterior corneal surface. |
| | *“Δ Ast. (anterior-total)”* | This parameter is defined as the difference between the total astigmatism calculated based on SimK and the total corneal power. |
| *“Total corneal wavefront”* | *“3 mm zone”* | The values have been calculated with the indicated refractive index for the 3 mm zone. |
| | *“Z Spherical aberration”* | This parameter indicates a higher-order aberration that results from optical imperfections of the human eye. |
| | *“RMS HOA”* | Root mean square higher-order aberrations |

 

| Section | Entry | Description |
|---|---|---|
| *“Pachymetry”* | *“CCT (vertex)”* | Central corneal thickness (vertex). This parameter indicates the perpendicular distance between the anterior and the posterior corneal surfaces, measured from the anterior corneal vertex. |
| *“Anterior segment”* | *“AQD”* | The aqueous depth is defined as the distance from the posterior corneal surface to the anterior lens surface, measured perpendicular to the anterior corneal surface and along the line of sight. |
| | *“WTW”* | White-to-white distance. WTW is defined as the horizontal distance between the nasal and temporal limbus, measured on the camera image. |
| | *“Lens thickness”* | This parameter is defined as the distance between the anterior and posterior lens surfaces, measured perpendicular to the anterior corneal surface and along the line of sight. |
| *“Pupil”* | *“Pupil diameter”* | This parameter indicates the measured pupil diameter, derived from the camera image. |
| | *“Pupil center x/y (kappa)”* | This parameter indicates the x/y position of the center of the pupil, relative to the line of sight. |
| *“Axial length”* | *“Length”* | The axial length is defined as the distance between the anterior corneal surface and the retinal pigment epithelium, along the line of sight. |

#### 10.2.4.4 *“Info”* Section

By clicking the *“Info”* button at the top of the analysis window, the *“Info”* tab is displayed in the *“More”* section. The following information is displayed:

***“Info”* tab**

| Section | Entry | Description |
|---|---|---|
| *“Eye”* | *“Eye”* | Examined eye, OD or OS |
| | *“Cornea status”* | This parameter indicates whether an eye underwent corneal refractive surgery. |
| | *“Lens status”* | This parameter indicates the presence or absence of the eye's natural crystalline lens and, if applicable, the type of implanted artificial lens. |
| | *“Vitreous status”* | This parameter indicates whether there is a history of surgical intervention to the vitreous. |
| *“Acquisition”* | *“Mode”* | Indication of the used acquisition application |

| Section | Entry | Description |
|---|---|---|
| | *“Date”* | Examination date |
| | *“Time”* | Examination time |
| | *“Operator”* | Name of the operator that examined the patient |
| | *“System test”* | This parameter indicates whether the system test was valid, outdated, or failing at the time of the acquisition. |
| | *“Fixation light focus”* | Internal fixation light focus is an acquisition setting that allows for fixation light sharpness adjustments, based on an eye's refraction. |
| | *“Int. fix. light brightness”* | Internal fixation light brightness is an acquisition setting that allows for fixation light brightness adjustments, based on patients needs. |
| *“Acquisition quality”* Display of parameters depends on the application of the currently loaded scan. | *“Motion”* | Acquisition quality parameter indicating whether eye movements impacted the quality of the acquired scan(s). |
| | *“Fixation”* | Acquisition quality parameter indicating whether excessive fixation loss was presented during acquisition. |
| | *“Tear film and lid”* | Acquisition quality parameter indicating whether the eyelid(s) and/or the tear film impacted the quality of the acquired image(s). |
| | *“Camera image segmentation”* | Acquisition quality parameter indicating whether the camera image segmentation necessary for pupil diameter and WTW distance calculation succeeded. |
| | *“Refraction correction”* | Acquisition quality parameter indicating whether the automatic refraction correction necessary for accurate calculation of measurements succeeded. |
| | *“Required data points”* | Acquisition quality parameter indicating whether a minimum of data points within the central 3 mm zone was calculated. |
| | *“Axial length measurement”* | Acquisition quality parameter indicating whether the axial length measurement could be automatically determined. |
| | *“Tracking”* | Acquisition quality parameter indicating whether tracking was activated or not. Tracking is a technique that uses the camera image to detect eye movements during image acquisition, ensuring that each acquired OCT B-scan is centered on the corneal vertex. |
| *“Camera images”* | *“No. of images”* | This parameter indicates the number of images within a series. |

 

| Section | Entry | Description |
|---|---|---|
| | *“Main image”* | This parameter indicates the ID of the camera image that is used for calculation of WTW and pupil diameter. This is the camera image with the median pupil diameter. It is displayed when the option “Always show main camera image” is activated. |
| | *“Size”* | Size of the image in pixels |
| *“OCT section images”* | *“No. of images”* | This parameter indicates the number of images within a series. |
| | *“Scan length/No. of A-scans”* | This parameter indicates the scan length and the number of A-scans for the raw OCT section images. |
| | *“Lateral scaling”* | Pixel scaling in lateral direction of raw OCT section images. |
| | *“Axial scaling”* | Pixel scaling in axial direction of raw OCT section images. |
| *“Component versions”* | *“HEYEX (changed by)”* | Version of the HEYEX 2 software used for the most recent changes |
| | *“VWM (changed by)”* | Version of the viewing module used for the most recent changes |
| | *“AQM”* | Version of the acquisition module used for this examination |
| | *“SSC”* | Version of the installed scanning service controller |
| | *“FPGA (SSC)”* | Version of the installed field programmable gate array |
| | *“MCC”* | Version of the installed master component controller |
| | *“EPC”* | Version of the installed external periphery controller |
| | *“CSB”* | Version of the installed camera sensor board |
| | *“SMC”* | Version of the installed stepper motor controller |
| | *“DCB”* | Version of the installed display controller board |
| | *“Internal data format”* | Version of the internal data format |
| *“Device”* | *“Device serial number”* | Serial number of the device |
| | *“Sequence timestamp”* | Timestamp of the acquired image. This file name is used to store the corresponding raw data (sequence). |

### 10.2.4.5 Editing the Eye Status

Editing the eye status is only necessary if it was not defined during the examination.

If the eye status was not defined during the examination, the eye is defined as untreated by default, which is *“No surgery”* for the cornea status, *“Phakic”* for the lens status, and *“Vitreous only”* for the vitreous status. This means that the cornea has not been subject of refractive surgery up until the date of this examination and that this eye retains its natural crystalline lens and vitreous.

To change the eye status in the analysis window, please proceed as follows:

- Above the axial length section, click *“Eye status”*.

The context menu is displayed.

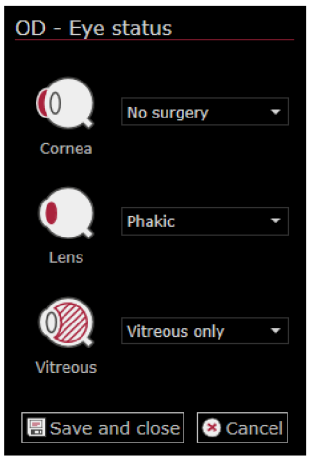


*Fig. 38: Eye status*

- Select the desired status for both eyes:

| Anatomic structure | Status |
|---|---|
| *“Cornea”* status | *“No surgery”* |
| | *“Post-refractive (myopic)”* |
| | *“Post-refractive (hyperopic)”* |
| | *“Post-surgery”* |
| *“Lens”* status | *“Phakic”* |
| | *“Phakic IOL”* |
| | *“Aphakic”* |
| | *“Pseudophakic”* |
| | *“Piggyback IOL”* |
| *“Vitreous”* status | *“Vitreous only”* |
| | *“Post-vitrectomy”* |
| | *“Silicone oil”* |
| | *“Gas in vitreous cavity”* |

- To save your changes, click *“Save and close”*.

The new status information will be saved in the HEYEX 2 database.

The context menu is closed and the displayed eye status is updated.

- Axial length values are only displayed for a *“Phakic”*, *“Aphakic”*, or *“Pseudophakic”* lens status and for a *“Vitreous only”*, or *“Post-vitrectomy”* vitreous status.
  Axial length values are not displayed for a *“Phakic IOL”*, or a *“Piggyback IOL”* lens status, and for *“Silicone oil”* or *“Gas in vitreous cavity”* vitreous status.
- Automatic lens segmentation is disabled for a lens status other than *“Phakic”*.

For the axial length measurements in non-phakic eyes, the following offsets are used. The offsets are added.

**Offsets used for axial length measurement**

| Eye status | Offset | Reference |
|---|---|---|
| *“Pseudophakic”* | 0.138 mm | According to *Wolfgang Haigis. Graefes Arch Clin Exp Ophthalmol. 2001 Aug; 239(8):589-98*. The used refractive indices are adapted to device-specific wavelength. |
| *“Aphakic”* | 0.215 mm | |

### 10.2.4.6 Camera Image and Color Map with Color Scale

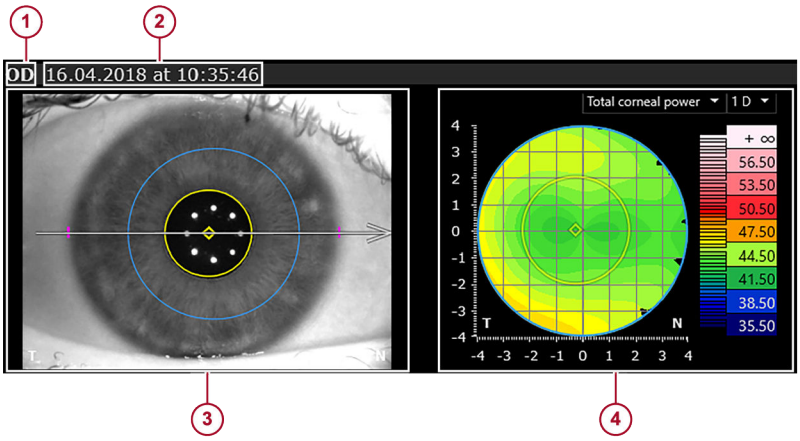


*Fig. 39: Camera image and color map*

1. Eye
2. Examination date and time
4. Camera image
3. Color map with color scale

The camera image is displayed along with a color map.

The region within the camera image that is confined by the blue circle corresponds to the data in the color map.

Corneal topography provides information on various curvature and shape characteristics of the cornea that help illustrate corneal astigmatism and irregularities, and the detection of corneal pathologies.

Curvature maps are available in D and mm.

The scaling depends on the type of the selected color map and the number of color steps configured in the settings.

**Displaying a color map**

- From the drop-down list, select one of the color maps for analysis.

To view more maps, select the *“Cornea single OD/OS”* or the *“Cornea OU”* view, if available. For further information, please refer to (➞ 9.2.4.5 “Color Map with Color Scale”, p. 76).

**Color maps**

| Color map | Description |
|---|---|
| Anterior axial curvature | This map visualizes the simulated keratometry based on the anterior corneal axial curvature. The conversion of anterior radii to keratometry values is performed according to the laws of Gaussian optics using the keratometric index of 1.3375. It does not account for the refractive effect and the radii of the posterior corneal surface. |
| Total corneal power | This map displays the power of the cornea, calculated using ray tracing. Ray tracing determines how parallel light beams are refracted according to the slope of cornea, the true refractive indices (nc = 1.376 and nah = 1.336), and the exact point of refraction. Each point on this map corresponds to a focal length, from which a corresponding refractive power can be calculated. |

**Displaying the OCT section image**

If the Cornea app has not been purchased but review of the OCT section image is desired, it is possible to display these OCT section images instead of a color map.

- From the drop-down list, select *“OCT section image”*.

### 10.2.4.7 OCT Section Image with Intensity Graph

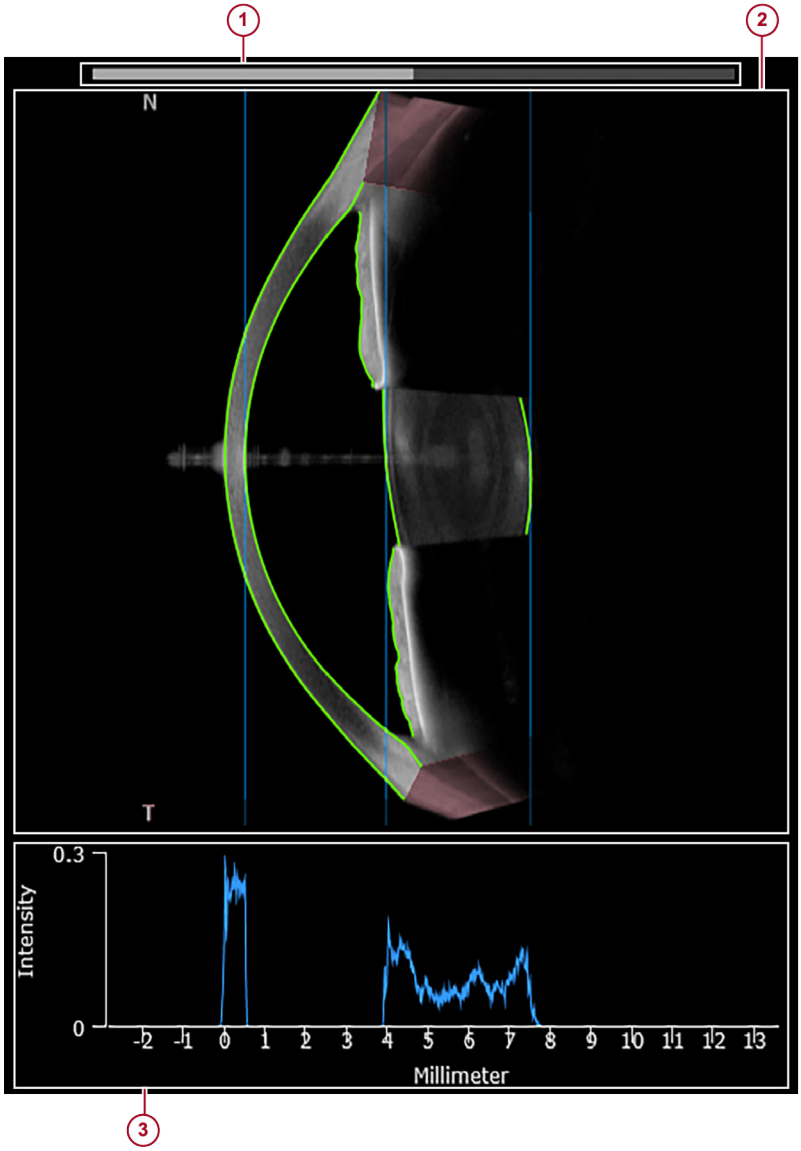


*Fig. 40: OCT section image with intensity graph*

1. Slider for adjusting image brightness and contrast
2. OCT section image with segmentation
3. Intensity graph

In the OCT section image, the green lines show the automatic segmentation of the anatomic boundaries.

The intensity graph shows the reflectivity of the cornea and lens along the line of sight.

- Carefully review the automatic segmentations.
- Ensure that the segmented regions correspond to the signals in the intensity graph.
- If the boundaries of one or more anatomic structures along the line of sight are not correctly detected, manually edit the blue lines to correctly represent these boundaries (➞ 10.2.4.7.1 “Editing Anatomic Boundaries”, p. 120).

#### 10.2.4.7.1 Editing Anatomic Boundaries

In the OCT section image, check that the boundaries of the posterior corneal surface as well as the anterior and posterior lens surfaces are correctly segmented along the line of sight.

- To adjust the anatomic boundaries and the associated parameters, double-click on one of the vertical lines on the OCT section image.

The segmentation editor is displayed.

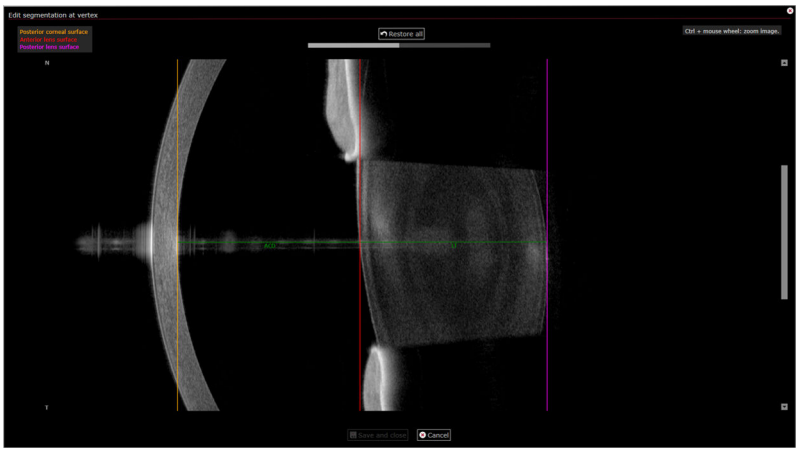


*Fig. 41: Segmentation editor*

The anatomic boundaries are color-coded as follows:

- Orange = posterior corneal surface
- Red = anterior lens surface
- Pink = posterior lens surface

- If one or more of the anatomic structures is not correctly segmented along the line of sight, drag-and-drop the vertical lines to the desired position.

The slider above the OCT section image is for adjusting image brightness and contrast.

**WARNING!**

**Carelessly adjusted image brightness and image contrast might lead to bad image quality**

Bad image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches.

- Carefully adjust image brightness and image contrast.

- Drag-and-drop the slider to the desired position and increase or decrease image brightness and contrast.
- To reset to the default values, double-click the slider.

- To save the changes, click *“Save and close”*.

The segmentation editor is closed and the AQD and lens thickness measurement values are updated. Next to the OCT section image, the following message is displayed:

- *“Segmentation(s) manually edited.”*

- To undo the changes, double-click one of the vertical lines on the OCT section image.

  The editor is displayed.

- To restore the automatic segmentation, click *“Restore all”* and then again *“Save and close”*.

### 10.2.4.8 Overlay Options

At the bottom of the *“Biometry OU”* view or in the *“More”* section, select the checkboxes of the following parameters to be superimposed on the images and/or color maps:

- *“Vertex”*
- *“Thinnest point x/y”*
- *“Pupil diameter”*
- *“Pupil center x/y (kappa)”*
- *“3 mm ring”*, indicating the values for *“K (steep)”* and *“K (flat)”*
- *“Segmentation”*
- *“WTW”*

For easy identification, each parameter has its own symbol. This symbol will be superimposed on the color map.

### 10.2.4.9 Axial Length

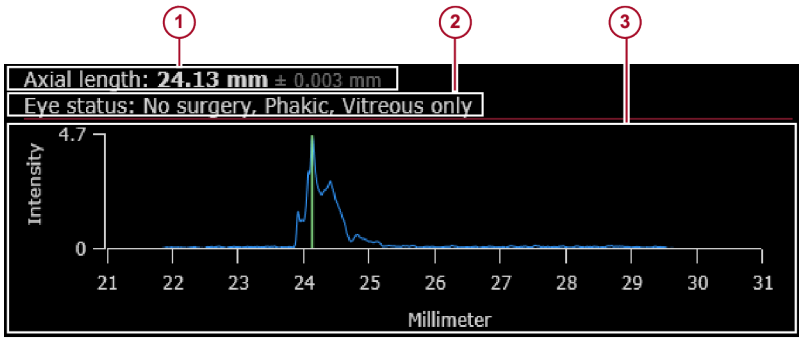


*Fig. 42: Axial length*

1. Axial length value with standard deviation
2. Eye status
3. Peak detection

The axial length is defined as the distance between the anterior corneal surface and the retinal pigment epithelium, along the line of sight.

The axial length is used for the IOL power calculation.

The profile shows the retinal peak detection. It is assumed that the highest peak represents the RPE.

> For non-pathological eyes with a clearly defined RPE peak, the standard deviation should be below 0.02 mm.

- Carefully review the retinal peak, the axial length measurement, and the standard deviation.

  The logic for the automatic peak detection and invalid signal warnings is as follows:

  - Axial length measurement is calculated on 3 subsets of data.
  - The algorithm checks how many measurements are within 0.05 mm of each other.
  - If all three measurements are within 0.05 mm, the mean and standard deviation for axial length is calculated. The three signals and peak positions are averaged to generate the graph seen in the profile.
  - If only two measurements are within 0.05 mm of each other, there are likely two peaks that have approximately the same height. In this case, the *“Info”* section indicates that the automatic peak detection failed. The signal is still averaged over all measurements but no axial length value is displayed. The maximum peak can be set manually using the axial length editor. After opening the editor, the initial position of the indicator will be on the automatically detected maximum peak.
  - If none of the three measurements were within 0.05 mm of each other, then the measurement failed. No axial length value and no graph is displayed. The only option is to manually enter the value (e.g. measured with a different device).

- If the automatic peak detection or the axial length measurement was not successful, reexamine the patient, or manually edit the axial length (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122).

#### 10.2.4.9.1 Editing the Axial Length

**Retinal peak not correctly detected**

If the automatic retinal peak detection does not correctly represent the RPE but this inaccuracy is evident, the peak should be manually corrected.

If multiple retinal peaks have been detected and a maximum retinal peak is not automatically defined or the marked peak does not correctly represent the RPE, then the correct maximum peak should be manually indicated.

- In the *“Axial length”* graph, double-click the vertical line indicating the RPE.

  The editor is displayed.

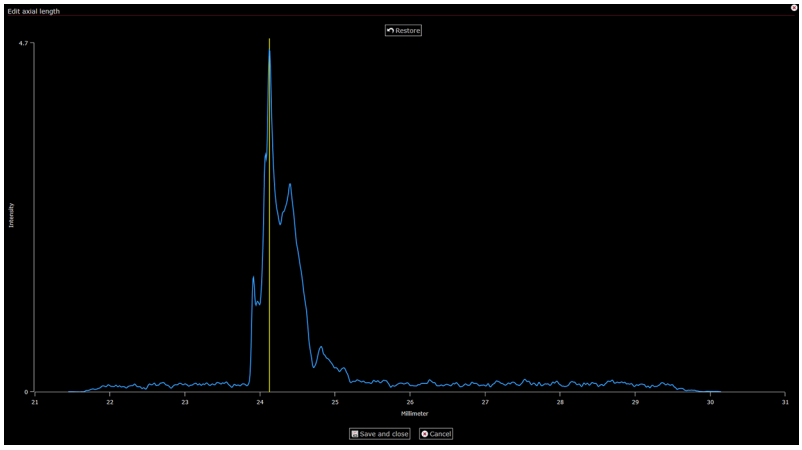


*Fig. 43: Axial length editor*

- Drag-and-drop the vertical line to the desired position or double-click the desired position.

- To confirm the changes, click *“Save and close”*.

  The following warning message is displayed:

- *“Axial length peak manually edited”*

**Axial length measurement not possible**

- If the axial length cannot be measured, click the *“Axial length”* value.

  The editor is displayed.

- Enter a new value and click *“Manual value”* to confirm the changes.

  The following warning message is displayed:

- *“Axial length value entered manually”*

> **Using axial length values from third-party devices**
>
> Manually entering an axial length value measured by a third-party device, e.g. using ultrasound, might cause a conflict with IOL formulas. Please be aware that the IOL formulas included in the ANTERION use optical biometry measurements to determine axial length.
>
> Using the ANTERION formulas in conjunction with third-party axial length measurements may lead to erroneous results.

**Restoring the calculated peak**

- To undo the manual edits applied to the retinal peak, double-click on the vertical line indicating the RPE.

  The editor is displayed.

- To restore the automatically detected retinal peak, click *“Restore”* and then *“Save and close”*.

**Restoring the calculated axial length value**

- To undo the manual edits applied to the axial length value, click the *“Axial length”* value.

  The editor is displayed.

- To restore the automatically calculated axial length, click *“Calculated value”*.

### 10.2.5 Analysis Window - *“Calculation OU”* View

#### 10.2.5.1 IOL Calculator

- Before applying the IOL calculation, ensure that the desired series have been selected, the eye status has been determined and all parameter values have been reviewed for both eyes in the *“Biometry OU”* view.
- Select the *“Calculation OU”* tab.

#### 10.2.5.1.1 Calculating Spheric IOLs

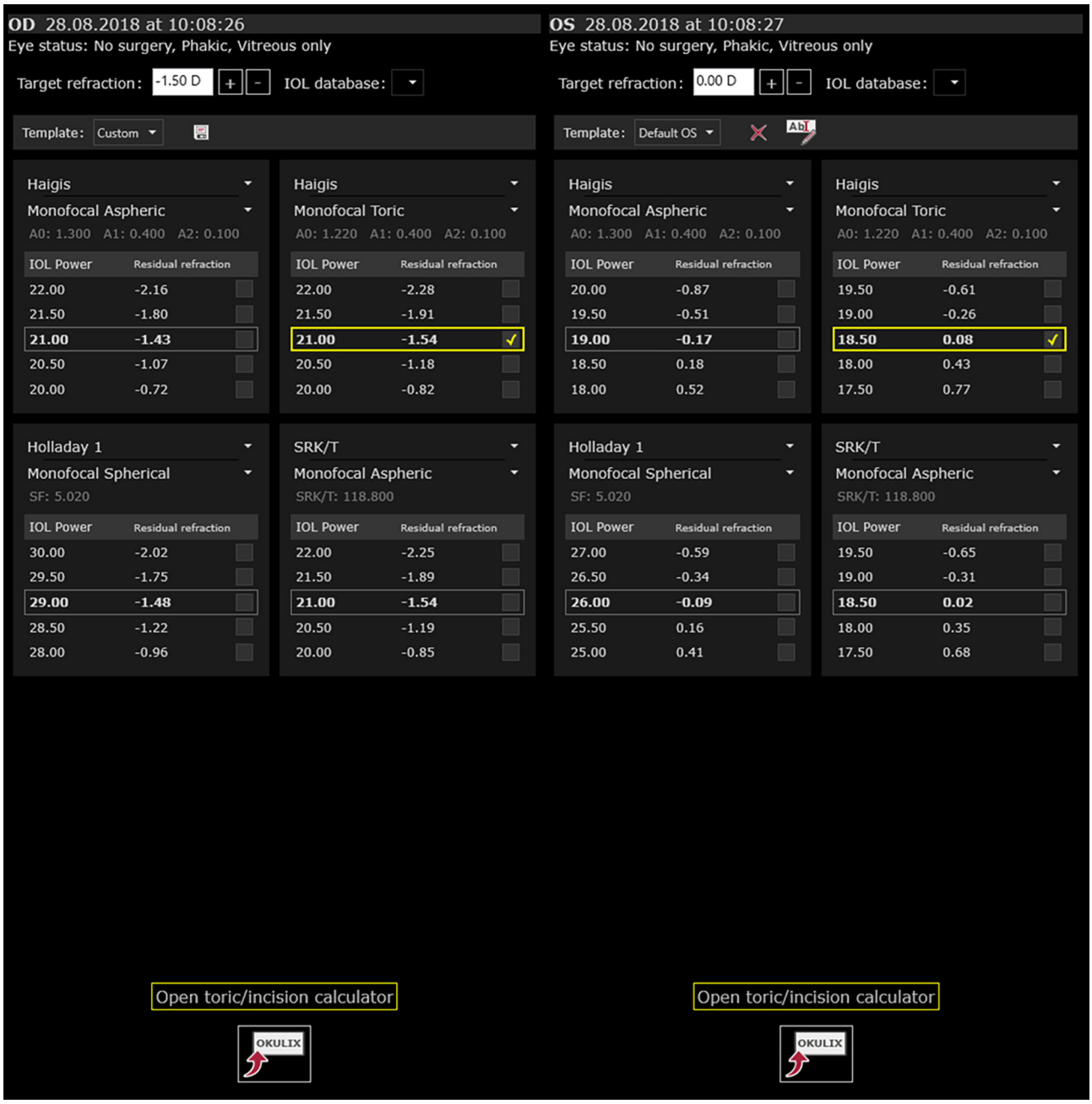


*Fig. 44: Calculating spheric IOLs window*

For further information on the formulas and IOL constants, please refer to (➞ “Formulas and IOL constants for IOL calculation”, p. 44).

**Spheric availability has to be configured first**

The IOL can only be calculated if the spheric availability range has been defined in the settings.

For further information, please refer to (➞ “Editing spheric and toric availability in the *“Master IOL database”*”, p. 40).

Please repeat the following procedure for both OD and OS. If the *“Calculation OU”* view is opened for the first time, no templates are saved.

- To determine the desired spherical equivalent target refraction in diopters, tap + or − next to the *“Target refraction”* field.
- Open the *“IOL database”* drop-down list and select the desired surgeon name.
- If available, open the *“Template”* drop-down list and select the desired entry.
- Alternatively, open the *“Formula”* drop-down list and select the desired entry.
- Alternatively, open the *“IOL”* drop-down list and select the desired entry.

The formula- and IOL-specific constants are displayed but cannot be edited.

The *“IOL power”* and *“Residual refraction”* values are automatically calculated.

**Highlighting recommended values in spheric IOL calculation**

The recommended values are highlighted within a gray frame.

- To recommend the minimum absolute deviation from the target refraction, select *“Minimum absolute deviation from IOL power”* for the option *“IOL auto-proposal mode (spheric)”* in the *“Cataract”* tab of the *“Default settings”*.
- To recommend the minimum positive deviation from the target refraction, select *“Minimum positive deviation from IOL power”* for the option *“IOL auto-proposal mode (spheric)”* in the *“Cataract”* tab of the *“Default settings”*.
- To recommend the minimum negative deviation from the target refraction, select *“Minimum negative deviation from IOL power”* for the option *“IOL auto-proposal mode (spheric)”* in the *“Cataract”* tab of the *“Default settings”*.

For further information, please refer to (➞ “ *“Cataract”* tab”, p. 38).

**Displaying optimal IOL power in spheric IOL calculation**

The optimal IOL power for achieving the selected target refraction values is displayed if in the *“Cataract”* tab of the *“Default settings”*, *“Yes”* has been selected for the option *“Show optimal IOL power (spheric)”*.

For further information, please refer to (➞ “ *“Cataract”* tab”, p. 38).

- Select the checkboxes associated with the desired *“IOL power”* and *“Residual refraction”* values.

  The selected values are highlighted within a yellow frame.

  If desired, the toric IOLs and incisions can now be calculated.

  The selected combination of parameters can be saved as a template. For further information, please refer to (➞ 10.2.5.2 “Saving as Templates”, p. 129).

### 10.2.5.1.2 Calculating Toric IOLs and Incisions

Before calculating the toric power and axis of an IOL, the spheric IOL power must be calculated first.

- Below the results for the spheric IOLs, click *“Open toric/incision calculator”*.

The advanced IOL calculator is displayed.


*Fig. 45: Calculating toric IOLs window*

- The following spherical data is displayed, but cannot be edited:
  - The target refraction entered for the spheric calculation
  - The formula selected for the spheric calculation
  - The IOL selected for the spheric calculation
  - The selected result for *“IOL power”* and *“Residual refraction”*

- Select the *“Astigmatism”*: *“Total corneal power”* (recommended) or *“Anterior axial curvature”*.

  For further information on how to configure the *“Default map type”*, please refer to (➞ “ *“Cataract”* tab”, p. 38).

- To set the *“Incision location”*, enter the desired value in degrees, use + or –, or drag and drop the green *“Incision location”* line on the camera image.
- To set the *“Surgically induced astigmatism”*, enter the desired value in D or use + or – to define the value.

  The automatically calculated *“IOL axis”* is displayed in degrees.
- To manually change the *“IOL axis”*, drag and drop the red dashed line on the camera image.

  To reset the *“IOL axis”*, click *“Automatic”*.
- Review the camera image.

  On the camera image, the IOL and IOL axis are superimposed, if in the *“Settings”*, *“Yes”* has been selected for the parameter *“IOL visible in toric calculator”* (➞ “ *“Cataract”* tab”, p. 38).

  On the camera image, the map is superimposed, if in the *“Settings”*, *“Yes”* has been selected for the parameter *“Map visible in toric calculator”* (➞ “ *“Cataract”* tab”, p. 38).
- Below the camera images, adjust the *“Map overlay opacity”* and the *“IOL overlay opacity”* using the sliders.

**Selecting the calculation result**

The table in the lower part of the screen shows the applied formula and the calculated values:

- ***“Toric IOL details”***
  - *“Cyl. IOL”*: Cylinder of IOL
  - *“Cyl. CP”*: Cylinder in corneal plane
  - *“Axis”*
- ***“Residual astigmatism”***
  - *“Cylinder”*
  - *“Axis (Steep)”*

**Highlighting recommended values in toric IOL calculation**

The recommended values are highlighted within a gray frame.

- To recommend values excluding an overcorrected post-incision astigmatism, select *“Forbid overcorrection (post-incision astigmatism must not be overcorrected by proposed IOL)”* for the option *“IOL auto-proposal mode (toric)”* in the *“Cataract”* tab of the *“Default settings”*.
- To recommend values including an overcorrected post-incision astigmatism, select *“Allow overcorrection (post-incision astigmatism might be overcorrected by proposed IOL)”* for the option *“IOL auto-proposal mode (toric)”* in the *“Cataract”* tab of the *“Default settings”*.

For further information, please refer to (➞ “ *“Cataract”* tab”, p. 38).

- Select the checkbox associated with the desired toric calculation values.

  The selected values are displayed within a blue frame.

- To confirm the selected parameters and return to the spheric calculator, click *“Back to spheric calculator”*.

**Warning messages**

Warning messages are displayed to indicate risks concerning the IOL calculation.

- To display further information, hover over the warning symbol.
  For further information on the warning messages, please refer to (➞ 14 “Troubleshooting”, p. 195).

  If the residual astigmatism is lower than 0.25 D, no warning messages are displayed concerning overcorrection, axes differences, and higher residual than pre-incision astigmatism.

### 10.2.5.2 Saving as Templates

In the *“Calculation OU”* view, each combination of parameters can be saved as a template.

Templates are saved in the HEYEX 2 database and are available for each client of the same tenant.

**Saving templates**

With each template change, the entry next to the *“Template”* drop-down list will automatically change to *“Custom”*. Next to the *“Template”* drop-down list, a disk symbol is displayed.

- To save the changes, click *“Save and close”*.

  The *“Save as”* window is displayed.

- In the *“Template name”* field, enter the name of the template.
- To confirm the new template, click *“Save and close”*.

  On all workstations in the network, the new template can now be selected from the *“Template”* drop-down list.

**Renaming templates**

Next to the *“Template”* drop-down list, a symbol for editing templates is displayed.

- To edit a template, click *“Rename”*.

  The *“Save as”* window is displayed.

- In the *“Template name”* field, enter the new name of the template.
- To confirm the changes, click *“Rename”*.

  The renamed template can now be selected from the *“Template”* drop-down list.

**Deleting templates**

Next to the *“Template”* drop-down list, a symbol for deleting templates is displayed.

- To delete a template, click *“Delete”*.

  A message will appear asking you whether you really want to delete the template.

- To confirm, click *“Yes”*.

  The template will be deleted and can no longer be selected from the *“Template”* drop-down list anymore.

### 10.2.5.3 Exporting IOL Calculation Data

You can export the topography and axial length data, relevant for IOL calculations. The exported data is converted an can be used with the third-party software *“Okulix”*.

- In the *“Calculation OU”* window, click *“Okulix”* .

  A message is displayed indicating whether the export was successful or failed.

  If in the *“Default Settings”* the *“Start OKULIX after export”* option is activated, the *“Okulix”* software starts automatically after export.

- If in the *“Default Settings”* the *“Start OKULIX after export”* option is deactivated, manually start the *“Okulix”* software.

# 11 *“Metrics”* App

## 11.1 Examining Patients

### 11.1.1 Starting Existing Orders

When starting the system the first time every day, or every 24 hours, the system test has to be performed. For further information on how to perform the system test, please refer to (➞ 8.3 “Performing the System Test”, p. 30).

The following procedure assumes that HEYEX 2 has been started, an order has been created, the navigator is open, and that the desired patient is selected.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

- Select the *“Examination”* tab in the ribbon bar.
- Click *“Start”* in the *“Examinations”* section.

  The *“Select examination”* window is displayed.
- Select the desired order and click *“Start examination”*.

  The acquisition window is displayed on the touch screen of the device.
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31) and select the desired examination application.

### 11.1.2 Adjusting the Internal Fixation Light

If the patient cannot see the internal fixation light clearly, its sharpness and brightness may be adjusted. Ask the patient whether the internal fixation light is clearly visible while the camera is adjusted.

Please note that the following settings must be adjusted for each eye separately.

Make sure that the patient is not distracted during fixation, e.g. by persons walking by.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.
- In order to adjust the brightness of the internal fixation light, tap **−** to decrease the brightness and **+** to increase the brightness in the *“Fixation light brightness”* section. The scale of the brightness ranges from 0 to 5, where 0 indicates that the fixation light is off, 1 indicates low brightness and 5 indicates high brightness of the fixation light. Increasing the brightness may be especially helpful for patients with cataracts.

- In order to adjust the sharpness of the internal fixation light, tap − in the *“Fixation light focus”* section to shift the fixation light focus to myopic correction and + to shift the fixation light focus to hyperopic correction. The scale of the focus ranges from -15 D to +15 D and can be adjusted in 0.5 D increments. Changing the internal fixation light focus may be especially helpful for patients with refractive errors, or to improve the axial length signal.

> **Storing the *“Fixation light focus”* settings**
> The *“Fixation light focus”* settings will be stored in the database.
>
> The settings are automatically used for future acquisitions performed on the same patient and eye.

### 11.1.3 Using the External Fixation Light

If the internal fixation light is not adequate for proper fixation, use the external fixation light to engage the fellow eye for fixation.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.

- To switch on the external fixation light, tap the light bulb symbol in the *“External fixation light”* section.

- Move the external fixation light so that the fixation of the patient's fellow eye is achieved with the external fixation light.

### 11.1.4 Aligning the Camera

**Display options** You can change the display of the acquisition window.

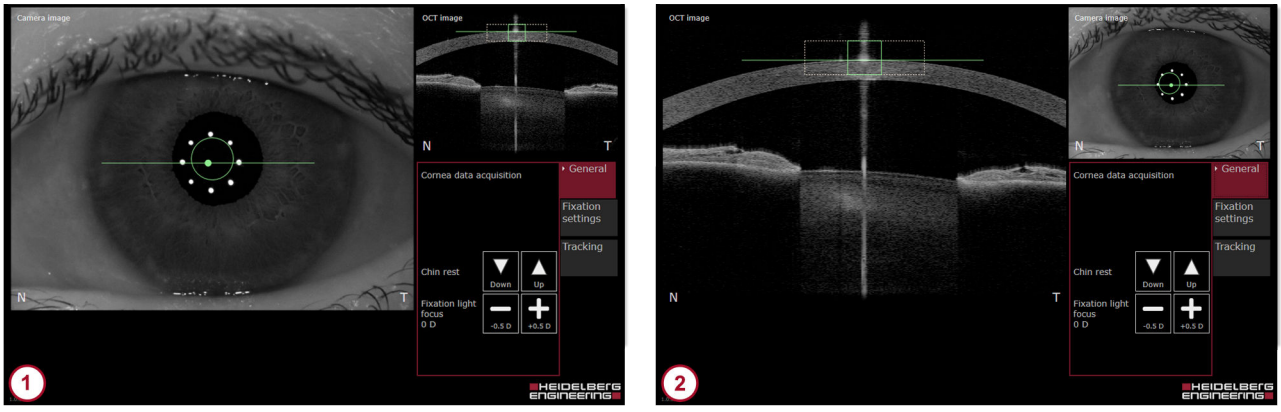


*Fig. 46: Display options*

① Large camera image
② Large OCT section image

By default, the camera image is shown enlarged in the acquisition window ① (Fig. 46).

- To enlarge the OCT section image in the acquisition window ② (Fig. 46), tap the OCT section image.
- To enlarge the camera image again ① (Fig. 46), tap the camera image.

For an optimal examination result, the alignment must be performed according to the following steps in sequence:

- Start with the lateral alignment of the camera and the eye (➞ “Aligning the camera image”, p. 133).
- When the lateral alignment is successfull, proceed with the axial alignment of the eye and the OCT scan pattern (➞ “Aligning the OCT section image”, p. 134).

**Aligning the camera image**

Use the joystick to align the camera so that the circle and the horizontal line are within the eight reflection points on the camera image.

The circle indicates the target position for the corneal vertex in the center of the camera image. The dot in the middle of the line indicates the location of the tracked corneal vertex, i. e. the center of the eight reflection points. The line indicates the lateral position of the live OCT section image.

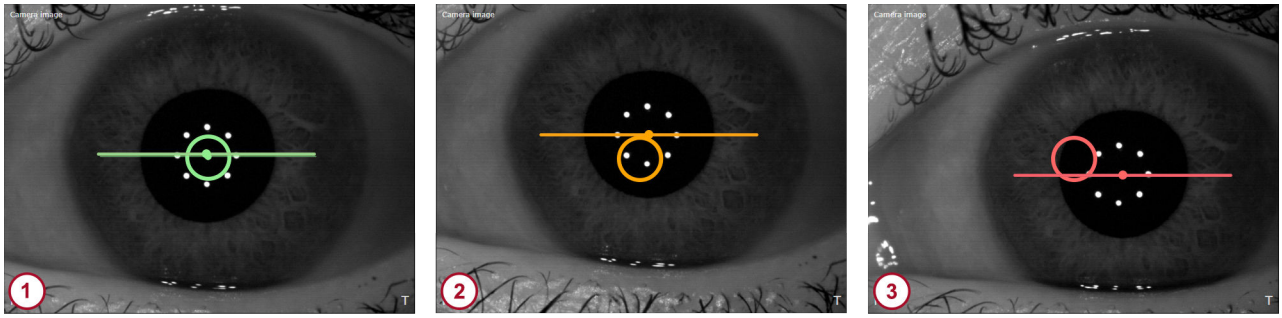


*Fig. 47: Aligning the camera image*

① Camera image correctly aligned
② Camera image acceptably aligned
③ Camera image not properly aligned

- Carefully move the camera towards the patient's eye.
- Move the camera slightly to the left and the right until the iris is visible within the camera image.
- During camera alignment, ask the patient whether the fixation light is bright and clearly visible. If not, readjust the fixation light (➞ 11.1.2 “Adjusting the Internal Fixation Light”, p. 131).
- Turn the joystick clockwise or counterclockwise until the circle and the horizontal line are within the eight reflection points on the camera image.

  If the camera is correctly aligned, the circle and the line turn green ① (Fig. 47). The image acquisition can be initiated.

  If the camera is acceptably aligned, the circle and the line are yellow ② (Fig. 47). While this quality indicator suggests that the alignment is acceptable, Heidelberg Engineering recommends to align the camera correctly ① (Fig. 47) for best results.

  If the camera is not properly aligned, the circle and the line are red ③ (Fig. 47). Image acquisition is not possible when the camera is not acceptably or correctly aligned. Readjust the camera until the image is acceptably or correctly aligned.

**Aligning the OCT section image**

Use the joystick to align the OCT section image so that the square and the horizontal line turn green.

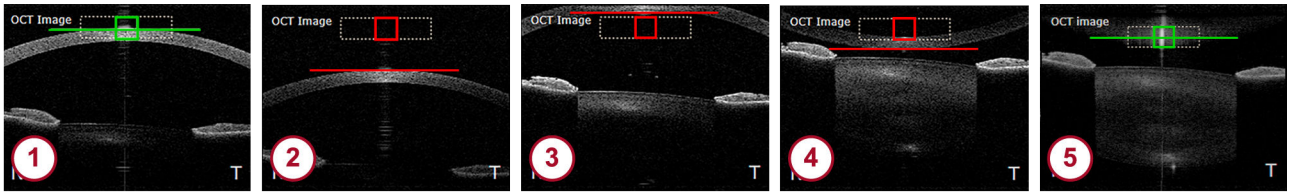


*Fig. 48: Aligning the OCT section image*

① OCT section image is correctly aligned
② Move the camera closer to the patient's eye
③ Move the camera away from the patient's eye
④ Move the camera away from the patient's eye
⑤ Move the camera away from the patient's eye

- Align the camera so that the cornea and the corneal reflex are within the dashed box.

  If the OCT section image is aligned correctly, the square and the line in the dashed box turn green ① (Fig. 48).

  If the camera is too far away from the patient's eye, the OCT section image will be below the dashed box ② (Fig. 48).

- Move the camera closer to the patient's eye.

  If the camera is too close to the patient's eye, the OCT section image will be above the dashed box ③ or flipped ④ (Fig. 48).

- Move the camera away from the patient's eye.

  If the camera is too close to the patient's eye and the cornea is flipped, the square and the line may erroneously turn green because the corneal vertex reflex is detected ⑤ (Fig. 48).

- If the camera is acceptably aligned, the square and the line in the dashed box are yellow. While this quality indicator suggests that the alignment is acceptable, Heidelberg Engineering recommends to align the camera correctly for best results.

- Move the camera away from the patient's eye until the cornea is displayed correctly ① (Fig. 48).

**Disabling tracking**

**WARNING!**

**Disabling tracking may cause inaccurate examination results**

Inaccurate examination results may lead to incorrect diagnostic conclusions resulting in incorrect therapeutic approaches.

- Always consider that examinations without the tracking function may be less accurate.

Unacceptable image alignment during the acquisition process (pressed joystick button) results in a message indicating that acquisition is not possible. This scenario could be present, for example, if the tracked corneal reflex on the camera image is unstable. In such instances, the camera should be realigned, or tracking should be disabled in order to continue the acquisition.

Tracking is disabled only for the current acquisition.

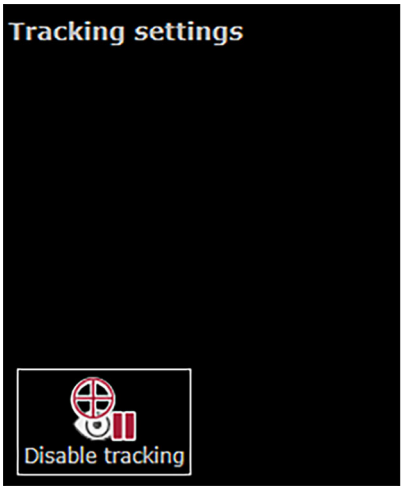


*Fig. 49: Disabling tracking*

- To switch off the tracking function, select the *“Tracking”* tab and click *“Disable tracking”* (Fig. 49).

  The alignment markers on the camera image and OCT section image turn blue.
- Manually align the camera image so that the eight reflection points are centered.
- Manually align the OCT section image so that the cornea is within the dashed box and the corneal vertex reflection is centered laterally.
- Start the examination.

  The aquisition quality parameters *“Motion”*, *“Fixation”* and *“Tear film and lid”* are not applicable and are indicated as *“n/a”*.

  *“Tracking off”* is displayed together with a warning symbol.

**No automatic quality indicators are available when tracking is disabled**

Examination results should be carefully reviewed for accuracy.

- Review all camera images for motion in the analysis window.
- Check the accuracy of the segmented boundaries within the OCT section images in the analysis window.

### 11.1.5 Acquiring Images

**Preparing the examination**

- Start an existing order (➞ 11.1.1 “Starting Existing Orders”, p. 131).
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31).

- Tap *“Metrics”* on the touch screen.

**Aligning the camera**

- To examine the right eye, move the camera to the left and use the eye occluder to cover the left eye.

  In the upper left corner of the touch screen, *“OD”* is displayed.
- When switching eyes during the acquisition process, pull the camera back to its farthest back position, then slide it to the left or right.
- To examine the left eye, move the camera to the right and use the eye occluder to cover the right eye.

  In the upper left corner of the touch screen, *“OS”* is displayed.
- Align the camera so that the camera image and the OCT section image are displayed correctly (➞ 11.1.4 “Aligning the Camera”, p. 132).

**Starting the examination**

- Ask the patient to blink.
- Readjust the camera, if needed.
- Ask the patient to refrain from blinking for a few seconds.
- Press the joystick button.

  Image acquisition starts.
- Keep the device as still as possible.

  The examination stops after a brief moment.

**Examination quality**

Immediately after the examination process is completed, the examination quality is checked. If the acquisition quality is acceptable or good, then the basic examination results are displayed after a brief moment.

- Check the examination quality (➞ 11.1.6 “Checking the Examination Quality”, p. 137).

  If the quality of the examination is not ideal or is compromised, then a message is displayed, indicating that one of the following quality parameters is not met:

  - *“Vertex out of alignment”*
  - *“Too strong movement”*
  - *“Cornea out of axial alignment”*
  - *“Possible blinking”*

  A window will appear, indicating the option to repeat the examination or to proceed to the analysis of the data.
- To discard the acquired data and repeat the examination, tap *“Repeat”*.

  The acquisition screen is displayed again.
- Realign the camera and repeat the examination.
- To proceed with analyzing the examination data, tap *“Proceed”*.

  The basic examination results are displayed after a brief moment.
- Check the examination quality (➞ 11.1.6 “Checking the Examination Quality”, p. 137).

### 11.1.6 Checking the Examination Quality

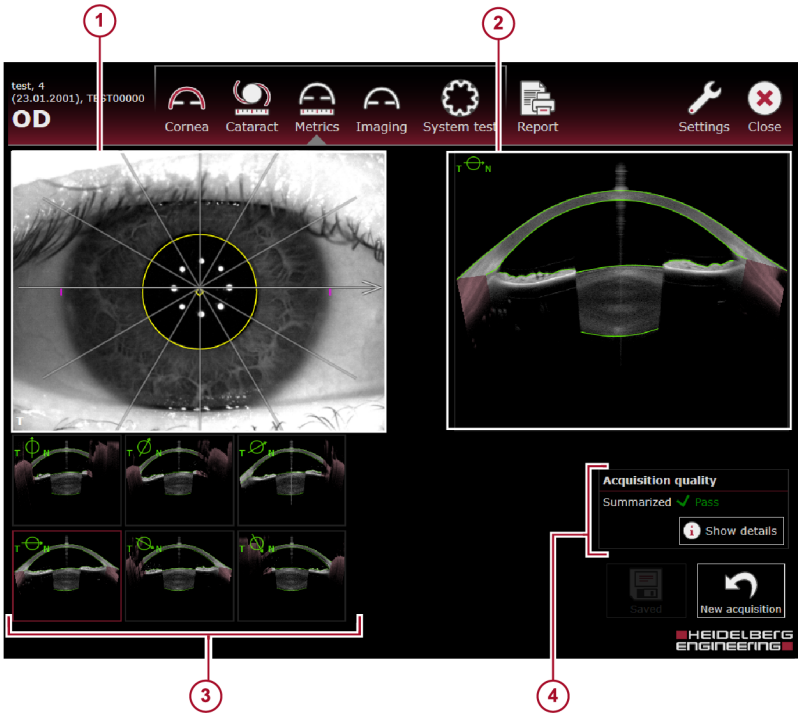


*Fig. 50: Basic examination results*

1. Camera image
2. OCT section image
3. OCT section images, the selected OCT section image is marked with a red frame, the direction of the scan is indicated by a symbol in the upper left corner
4. Acquisition quality parameters

By default, the summarized acquisition quality result is displayed and the details are hidden.

**Acquisition quality** ④

- To display the detailed acquisition quality results, click *“Show details”*.
- Check the acquisition quality parameters:
  - If *“Motion”* is yellow or red, then one or more of the following factors may have impacted the results during the acquisition process:
    - The corneal vertex was not correctly aligned, laterally.
    - The corneal vertex moved too much.
    - The corneal vertex was not correctly aligned, axially.
  - If *“Fixation”* is yellow or red, then the patient did not fixate properly during the acquisition process.
  - If *“Tear film and lid”* is yellow or red, then the corneal reflexes were compromised during the acquisition process due to one of the following reasons:
    - The patient did not open his or her eyes wide enough or blinked.
    - The patient has dry eyes.
    - The patient has abnormal corneal irregularities.

  i If any of the quality parameters are red, Heidelberg Engineering recommends reinstructing and reexamining the patient. If any of the quality parameters are yellow, Heidelberg Engineering recommends to carefully review the data and to decide on a case-by-case basis whether the quality of the data is acceptable or if a repeated examination is needed.

  - If *“Refraction correction”* is displayed, please refer to (➞ 11.1.6.1 “Message *“Refraction correction”*”, p. 139).
  - If *“Camera image segmentation”* is displayed, please refer to (➞ 11.1.6.2 “Message *“Camera image segmentation”*”, p. 139).
- To hide the detailed acquisition quality results, click *“Hide details”*.

**Camera image** ①

- Check that the camera image is sharp.
- Check that the reflection points are sharply displayed, circular in shape, and are displayed in a circular pattern.
- Check that the pupil and/or white-to-white boundaries are acceptably segmented on the IR camera image if these parameters are relevant.

  If the segmentation is not acceptable, Heidelberg Engineering recommends to repeat the measurements.

**OCT section images** ③

- Tap the OCT section image.

  The OCT section image is displayed enlarged ②.
- Review the segmentation of the OCT section images.
- If the corneal boundaries are not acceptably segmented on the OCT section image, Heidelberg Engineering recommends to reexamine the patient. Manual adjustments of the segmentation are possible in the analysis window (➞ 11.2.4.6 “Editing the Segmentation”, p. 159).
- Review the relevant anatomic structures.

  If analysis of anterior chamber angles is of interest, verify that the anterior chamber angles are clearly visible in most of the OCT section images.

  If analysis of the lens thickness is of interest, verify that the lens is clearly visible in most of the OCT section images.

 

**Acquiring additional images**

▸ To acquire additional images, tap ↶ *“New acquisition”*.

The examination window is displayed. Align the camera and reexamine the patient.

#### 11.1.6.1 Message *“Refraction correction”*

If the refraction correction failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Refraction correction”* status is displayed in red.
- In the OCT section images, the cornea is not segmented.
- In the color map, no information is displayed.

If the refraction correction failed, no measurements are possible. Heidelberg Engineering recommends reexamining the patient.

#### 11.1.6.2 Message *“Camera image segmentation”*

If the segmentation of the pupil failed, then the basic examination results are as follows:

- In the *“Acquisition quality”* section, the *“Camera image segmentation”* status is displayed in red.
- On the camera image, neither the pupil diameter nor the WTW distance are displayed.

The pupil diameter and the WTW distance will not be displayed in the analysis window. When this message appears, it should be decided on a case-by-case basis whether the examination should be accepted with compromised quality or a repeat examination is indicated.

## 11.2 Analyzing Examinations

The analysis window offers the following four views:

- *“Single OD/OS”*
- *“Multi”*

> **When analyzing examinations, always check all parameters for their plausibility**
> Cross-check all parameters with respect to the available reference data.

### 11.2.1 Opening Examinations in the Analysis Window

The following procedure assumes that HEYEX 2 has been started.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

- To open examinations in the analysis window, select the desired patient in the *“Patients”* list.

  All examinations are listed in the *“Examinations”* list.
- Select the desired examination.

  All series are displayed in the *“Series”* section.
- To display series as lists, select the *“Series”* tab at the bottom of the *“Series”* section.
- To display series as thumbnails, select the *“Series thumbnails”* tab at the bottom of the *“Series”* section.

  The following sections assume that the *“Series thumbnails”* tab has been selected.
- Double-click the desired thumbnail.

  The analysis window is displayed.

## 11.2.2 Analysis Workflow

### Step 1 – Reviewing the segmentation

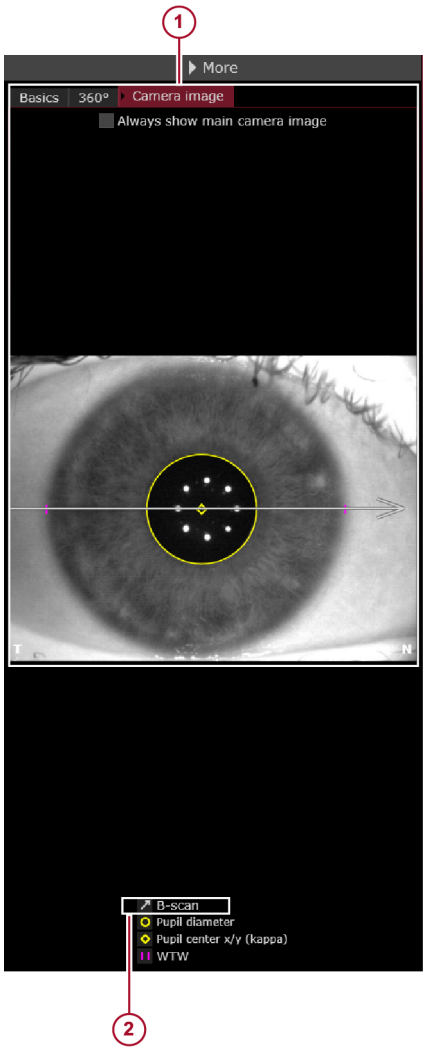


*Fig. 51: Reviewing the camera image*

① *“Camera image”* tab
② *“B-scan”* checkbox

- In the *“More”* section, select the *“Camera image”* tab ① (Fig. 51).
- Below the camera image, select the *“B-scan”* checkbox ② (Fig. 51).

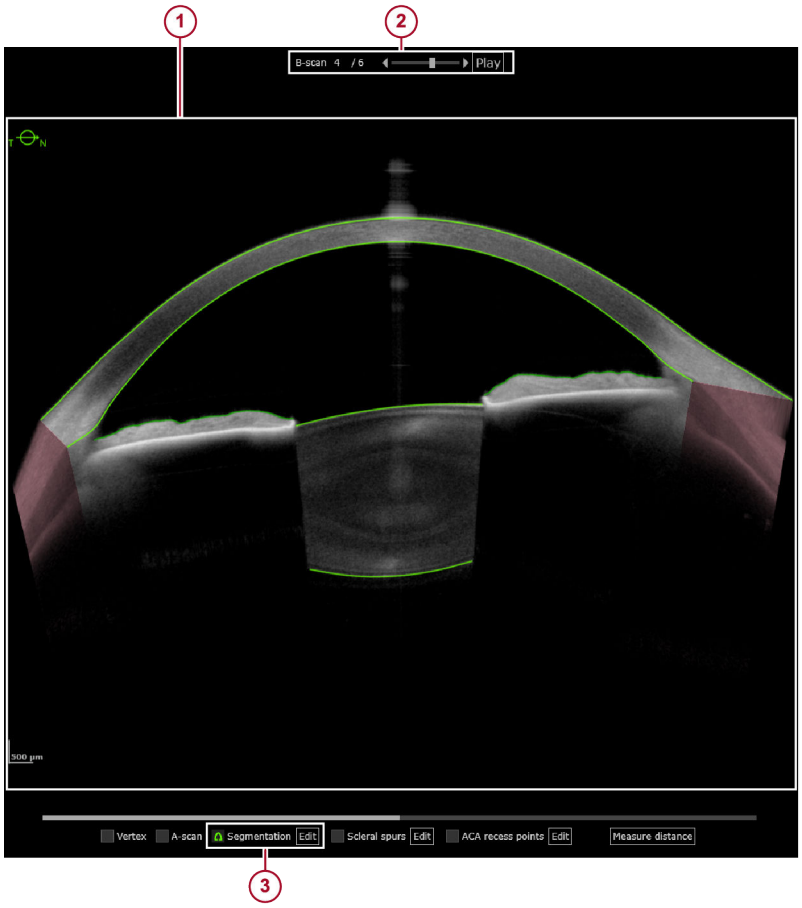


*Fig. 52: Reviewing the segmentation*

1. OCT section image
2. *“B-scan”* slider
3. *“Segmentation”* checkbox

- Below the OCT section image, check the *“Segmentation”* checkbox 3 (Fig. 52).
- Above the OCT section image 1 (Fig. 52), click either *“Play”* or click ◀ and ▶ 2 to manually scroll through the OCT section images.
- Verify that the relevant anatomic boundaries are correctly segmented.
- If measured parameters are affected by poor segmentation, manually correct the respective segmentation lines (➞ “Step 3 – Editing the segmentation”, p. 146).

  If the corneal boundaries are not acceptably segmented on the OCT section image, Heidelberg Engineering recommends to reexamine the patient. If reexamination of the patient is not possible for any reason, the data may be analyzed with suboptimal segmentation but these errors should be considered. Manual adjustments to the segmentation are also possible.

**Step 2 – Editing the scleral spur and anterior chamber angle recess points**

The anterior chamber angle measurements are displayed only after the required anatomical landmarks (e.g. the scleral spurs and anterior chamber angle recess points) have been identified on the OCT section image.

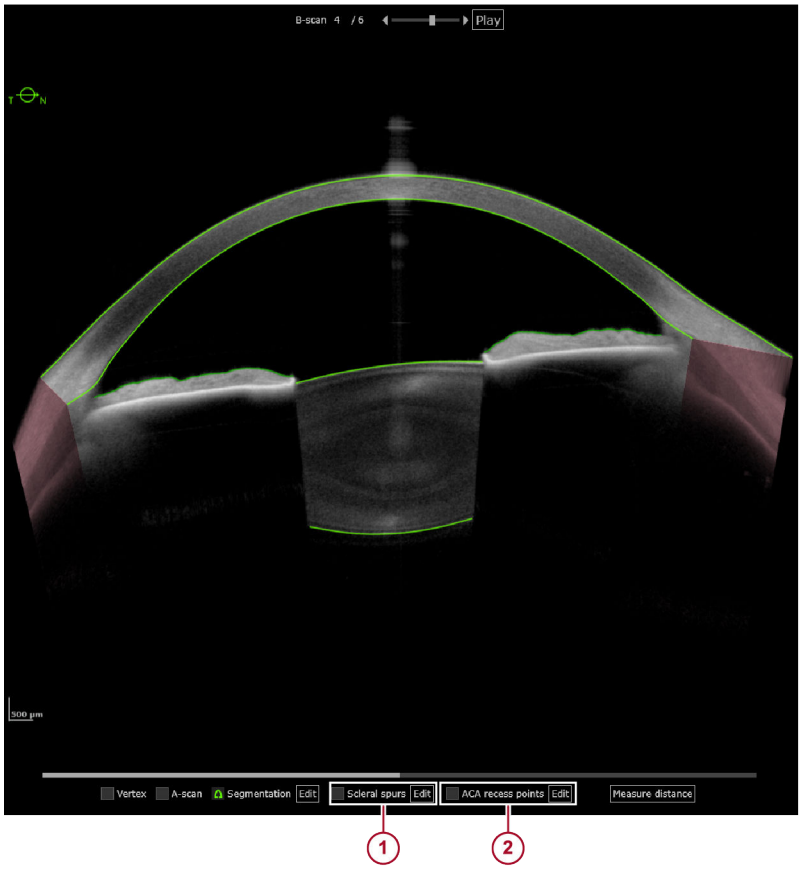


*Fig. 53: Editing scleral spurs or anterior chamber angle recess points*

① *“Scleral spurs”* checkbox
② *“ACA recess points”* checkbox

- To edit or identify the scleral spurs and/or anterior chamber angle recess points within an OCT section image, click *“Edit”* next to the *“Scleral spurs”* ① or *“ACA recess points”* ② checkboxes (Fig. 53).

  The segmentation editor is displayed. The OCT section image is divided into two parts.

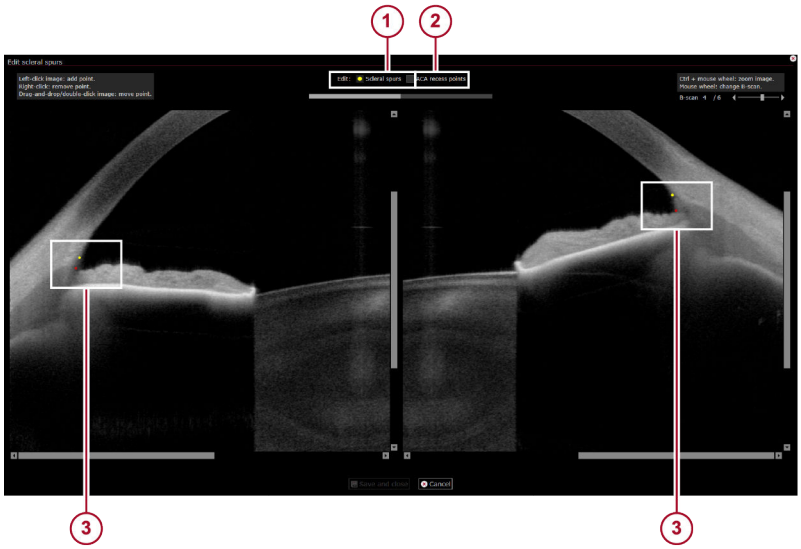


*Fig. 54: Segmentation editor for scleral spurs and anterior chamber angle recess points*

1. *“Scleral spurs”* checkbox
2. *“ACA recess points”* checkbox
3. Points representing the *“Scleral spurs”* and *“ACA recess points”*

- Mark both scleral spurs and anterior chamber angle recess points on all OCT section images, where the chamber angle is visible (Fig. 54).
- To save the changes, click *“Save and close”*.

  The segmentation editor is closed.
- In the *“More”* section, select the *“Basics”* tab.
- Check the checkboxes of the desired parameters to show them superimposed on the OCT section image.

- In the *“More”* section, select the *“360°”* tab.

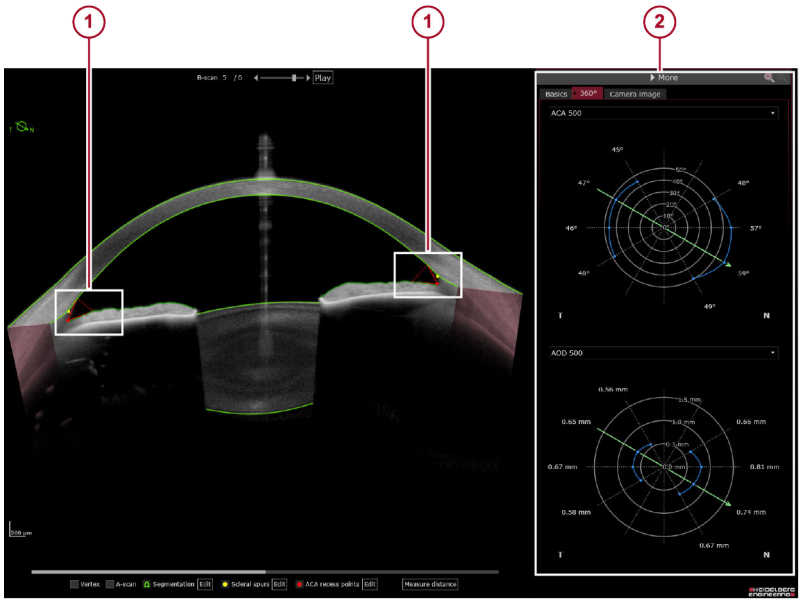


*Fig. 55: ACA, SSA, AOD, and TISA parameters*

(1) ACA, SSA, AOD, and TISA shown on the OCT section image
(2) ACA, SSA, AOD, and TISA shown on the 360° diagram

- Check the calculated ACA, SSA, AOD and TISA on the OCT section image and on the 360° diagram (Fig. 55).

  The calculation of these parameters is based on the segmentation lines for the posterior corneal surface and the anterior iris surface.

- If the calculation appears to be wrong or is missing, i. e. because the segmentation boundaries do not extend into the angle, adjust the segmentation accordingly (➞ “Step 3 – Editing the segmentation”, p. 146).

  For further information on how to edit the scleral spurs and the anterior chamber angle recess points, please refer to (➞ 11.2.4.7 “Editing the Scleral Spurs and Anterior Chamber Angle Recess Points”, p. 162).

### Step 3 – Editing the segmentation

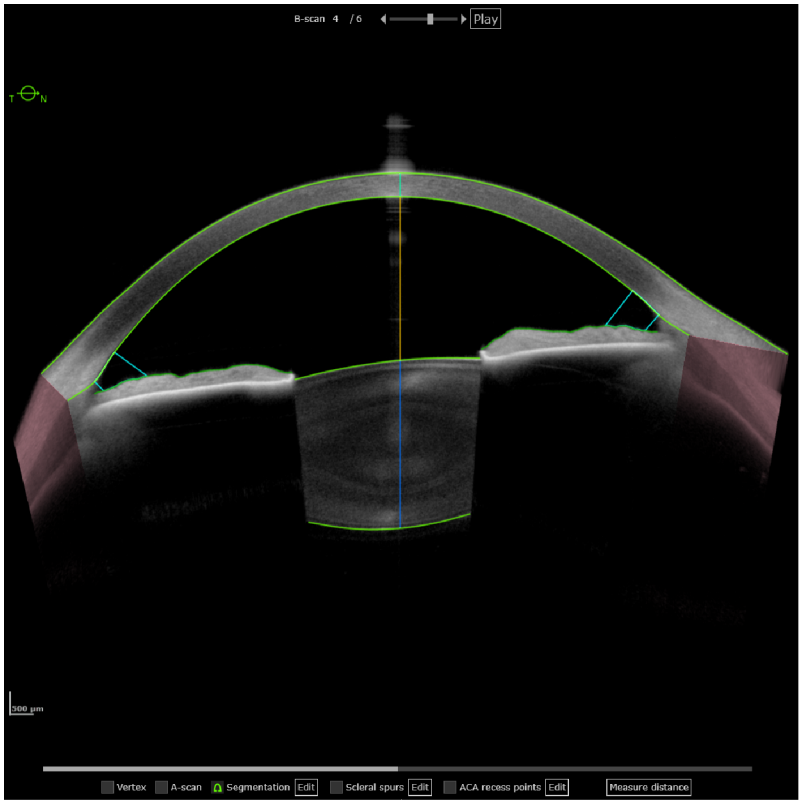


*Fig. 56: OCT section image with overlays: “CCT”, “Aqueous depth”, “TISA”, and “Lens thickness”*

- To superimpose the areas relevant for measurement, select the *“CCT”*, *“Aqueous depth”*, *“TISA”*, and *“Lens thickness”* overlays.
- If any of the measurements are affected by poor segmentation, correct the respective segmentation lines.
- Next to the *“Segmentation”* checkbox, click *“Edit”*.

  The segmentation editor is displayed.

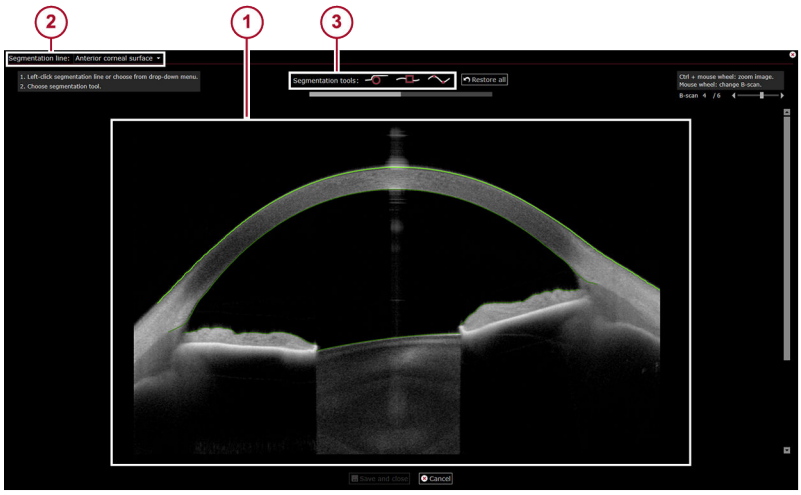


*Fig. 57: Segmentation editor*

① OCT section image
② *“Segmentation line”* drop-down list
③ *“Segmentation tools”*

- Either click the desired segmentation line on the OCT section image ① or select the desired anatomic structure to be edited from the *“Segmentation line”* drop-down list ② (Fig. 57).
- Use the offered segmentation tools ③ (Fig. 57) and click *“Save and close”* to confirm the changes.

  For further information on how to edit the segmentation, please refer to (➞ 11.2.4.6 “Editing the Segmentation”, p. 159).

### 11.2.3 Navigating through the Images

Depending on the application and view, different navigating options may be available.

**Navigating options**

| Section | Options | Description |
|---|---|---|
| General | Right-click anywhere in the window. | Switches the unit to mm or D.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |
| | Hover with the mouse cursor over the border of a section, e. g. the *“More”* section, in the analysis window. | The mouse cursor switches to ⟷.<br>Drag-and-drop to change the size. |
| | Click ▷. | Expands or retracts a section. |
| Camera image or color map | Hover with the mouse cursor over a camera image or map. | The value at the corresponding location on the map is displayed.<br>The x/y location of the mouse cursor is displayed on the upper right of the map.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |

| Section | Options | Description |
|---|---|---|
| OCT section image | Hover with the mouse cursor over the left or right end of the brightness and contrast slider. | The mouse cursor switches to ⟷.<br>Drag-and-drop the slider to change the image brightness of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Hover with the mouse cursor over the brightness and contrast slider. | The mouse cursor switches to ✋.<br>Move the slider to adjust the image contrast of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Click ⊞. | While holding down the left mouse button, draw a square on the OCT section image in order to zoom the selected region to its maximum size. |
| | Click ⊕ or ⊖.<br>Alternatively, press Ctrl and scroll the mouse wheel. | Incrementally zoom in or out on an OCT section image. |
| | Hover with the mouse cursor over the border of a zoomed OCT section image. | The mouse cursor switches to ⇔.<br>The automatic scroll function is activated. |
| | Press and hold the left mouse key. | Move the mouse to move the image. |
| | On the *“B-scan”* slider, click ◀ or ▶ to scroll through the OCT section images.<br>Alternatively, scroll through the OCT section images using the mouse wheel. | Shows the OCT section images. |
| | To show the OCT section images as a slide show, click *“Play”*. | Shows the OCT section images as a slide show. |
| A-scan | If the A-scan overlay is activated, hover with the mouse cursor over the green line representing the A-scan. | The mouse cursor switches to ⇔.<br>Drag-and-drop to move the A-scan. |

### 11.2.4 Analysis Window - *“Single OD/OS”* View

When the *“Single OD/OS”* view is opened, the series that was used for opening the analysis window is displayed. In the *“Select series”* section, select the desired series for analysis. When opening the *“Single OD/OS”* view for the first time, the scleral spurs, the anterior chamber angle recess points, and all of the corresponding information are not yet displayed. The scleral spurs and the anterior chamber angle recess points must first be manually identified in order to generate the analysis. For further information, please refer to (➞ 11.2.4.7 “Editing the Scleral Spurs and Anterior Chamber Angle Recess Points”, p. 162).

 


*Fig. 58: “Single OD/OS” view*

1. Patient information (➞ 11.2.4.1 “Patient Information”, p. 150)
2. *“Report”* button (➞ 13 “Reports”, p. 192)
3. *“Info”* button (➞ 11.2.4.4 “ *“Info”* Section”, p. 156)
4. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
5. *“Close”* button
6. *“Select series”* section (➞ 11.2.4.2 “ *“Select series”* Section”, p. 150)
7. OCT section image
8. Brightness and contrast slider
9. Overlay options checkboxes (➞ 11.2.4.5 “Overlay Options”, p. 158)
10. More section (➞ 11.2.4.3 “ *“More”* Section”, p. 150)
11. Control elements and overlay options checkboxes (➞ 11.2.4.5 “Overlay Options”, p. 158)

Colors of segmentation lines:

- Green line: The segmentation has been automatically calculated.
- Yellow line: The segmentation has been manually edited.
- Green dashed line: The segmentation has been interpolated.
- Yellow dashed line: The segmentation has been manually removed and then interpolated.

**Red areas in OCT section images refer to an extrapolated refraction correction**

The refraction correction in these areas is based on extrapolation of the surface boundaries and should be considered with caution for clinical use.

Measurements using freehand selections are not allowed in red areas.

### 11.2.4.1 Patient Information

The following information is displayed:

- Patient name
- Date of birth
- Patient ID
- Examination date and time
- Examined eye

### 11.2.4.2 *“Select series”* Section

In the *“Select series”* section, all series of the currently selected examination are displayed. The series are divided into OD and OS, and are sorted by examination date and time. The most current examination is on top of the list. The oldest examination is on the bottom of the list. The numbers next to the symbols of the application tabs indicate how many acquisitions the patient file series contains, in the corresponding acquisition application.

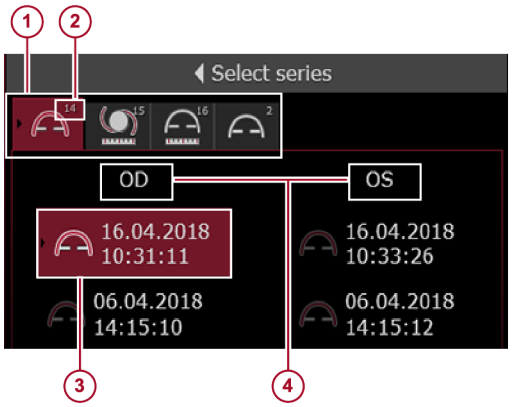


*Fig. 59: “Select series” section*

1. Application tabs
2. Number of series acquired with that application
3. Selected series
4. OD, OS

▶ To select a series for analysis, click the desired entry.

The results of the examination are automatically displayed.

### 11.2.4.3 *“More”* Section

***“Basics”* tab**

In the *“Basics”* tab of the *“More”* section, the following information is displayed.

The following parameters can be superimposed on the OCT section image.

***“Basics”* tab**

| Section | Entry | Description |
|---|---|---|
| *“Cornea”* | *“CCT”* | Central corneal thickness. This parameter indicates the perpendicular distance between the anterior and the posterior corneal surfaces, measured from the anterior corneal vertex. In the Metrics app, the displayed value is based on the average ± stdev of six individual B-scans. |
| | *“WTW”* | White-to-white distance. WTW is defined as the horizontal distance between the nasal and temporal limbus, measured on the camera image. |
| *“Anterior chamber”* | *“Aqueous depth”* | The aqueous depth is defined as the distance from the posterior corneal surface to the anterior lens surface, measured perpendicular to the anterior corneal surface and along the line of sight. |
| | *“Anterior chamber volume”* | For phakic eyes, the anterior chamber volume measurement is determined based on the following boundaries: corneal endothelium, anterior chamber angles (based on user-defined ACA points), anterior iris surface, and the anterior crystalline lens surface. The boundaries of the anterior chamber are calculated for each OCT section image. Each of these OCT section images is then rotated around an axis perpendicular to the anterior corneal surface at the anterior corneal vertex. Based on the average of this simulated data for all OCT section images, the anterior chamber volume is calculated. The anterior chamber volume measurement is not possible in aphakic or pseudophakic eyes. |
| | *“ACA distance”* | This parameter indicates the distance between two anterior chamber angles in one B-scan, measured from angle recess point to angle recess point. |
| | *“Spur-to-spur distance”* | This parameter is defined as the distance between one scleral spur to the other scleral spur within one B-scan. The scleral spur is an annular structure composed of collagen that is a protrusion of the sclera into the anterior chamber. |
| *“Anterior chamber angle T/N”** | *“ACA 500”* | This parameter indicates the angle measured at the conjunction of the line connecting the chamber angle recess point to the AOD 500 iris endpoint and the line connecting the chamber angle recess point to the AOD 500 corneal endpoint. This measurement is made for every clock hour position of the eye. |

| Section | Entry | Description |
|---|---|---|
| | *“SSA 500”* | This parameter indicates the angle measured at the conjunction of the line connecting the scleral spur to the AOD 500 iris endpoint and the line connecting the scleral spur to the AOD 500 corneal endpoint. This measurement is made for every clock hour position of the eye. |
| | *“AOD 500”* | This parameter indicates the perpendicular distance from a point on the posterior corneal surface that is 500 µm anterior to the scleral spur and the anterior surface of the iris. This measurement is made for every clock hour position of the eye. |
| | *“TISA 500”* | This parameter indicates the trapezoidal area that is defined by the following boundaries: AOD 500, the inner corneo-scleral wall and the perpendicular distance between the scleral spur and the iris. This measurement is made for every clock hour position of the eye. |
| | *“ACA 750”* | This parameter indicates the angle measured at the conjunction of the line connecting the chamber angle recess point to the AOD 750 iris endpoint and the line connecting the chamber angle recess point to the AOD 750 corneal endpoint. This measurement is made for every clock hour position of the eye. |
| | *“SSA 750”* | This parameter indicates the angle measured at the conjunction of the line connecting the scleral spur to the AOD 750 iris endpoint and the line connecting the scleral spur to the AOD 750 corneal endpoint. This measurement is made for every clock hour position of the eye. |
| | *“AOD 750”* | This parameter indicates the perpendicular distance from a point on the posterior corneal surface that is 750 µm anterior to the scleral spur and the anterior surface of the iris. This measurement is made for every clock hour position of the eye. |
| | *“TISA 750”* | This parameter indicates the trapezoidal area that is defined by the following boundaries: AOD 750, the inner corneo-scleral wall and the perpendicular distance between the scleral spur and the iris. This measurement is made for every clock hour position of the eye. |
| *“Lens”* | *“Lens thickness”* | This parameter is defined as the distance between the anterior and posterior lens surfaces, measured perpendicular to the anterior corneal surface and along the line of sight. |

| Section | Entry | Description |
|---|---|---|
| | *“Lens vault”* | This parameter is defined as the perpendicular distance between the anterior lens surface and the line derived from one scleral spur point to the opposite scleral spur point, within one B-scan. |
| *“Pupil”* | *“Pupil diameter”* | This parameter indicates the measured pupil diameter, derived from the camera image. |
| | *“Pupil center x/y (kappa)”* | This parameter indicates the x/y position of the center of the pupil, relative to the line of sight. |

* Next to *“Anterior chamber angle”*, the clock hour position of the current B-scan is indicated. The AOD, SSA, AQD, and TISA values refer to the indicated clock hour position.

**Example:** The clock hour position of the *“Anterior chamber angle”* is 10h / 4h.

The *“ACA 500”* values are 47° / 59°.

To read: 47° is the *“ACA 500”* value at the 10h position. 59° is the *“ACA 500”* value at the 4h position.

***“360°”* tab** If the scleral spurs and the anterior chamber angle recess points have been set in the displayed OCT section image, the ACA, AOD, and TISA 360° diagrams can be selected from the drop-down menu. Every diagram shows the parameter values of the corresponding OCT section image.

In the *“360°”* tab of the *“More”* section, the following information is displayed.

***“360°”* tab**

| Section | Entry | Description |
|---|---|---|
| | *“ACA 500”* | This parameter indicates the angle measured at the conjunction of the line connecting the chamber angle recess point to the AOD 500 iris endpoint and the line connecting the chamber angle recess point to the AOD 500 corneal endpoint. This measurement is made for every clock hour position of the eye. |
| | *“SSA 500”* | This parameter indicates the angle measured at the conjunction of the line connecting the scleral spur to the AOD 500 iris endpoint and the line connecting the scleral spur to the AOD 500 corneal endpoint. This measurement is made for every clock hour position of the eye. |

| Section | Entry | Description |
|---|---|---|
| | *“AOD 500”* | This parameter indicates the perpendicular distance from a point on the posterior corneal surface that is 500 µm anterior to the scleral spur and the anterior surface of the iris. This measurement is made for every clock hour position of the eye. |
| | *“TISA 500”* | This parameter indicates the trapezoidal area that is defined by the following boundaries: AOD 500, the inner corneo-scleral wall and the perpendicular distance between the scleral spur and the iris. This measurement is made for every clock hour position of the eye. |
| | *“ACA 750”* | This parameter indicates the angle measured at the conjunction of the line connecting the chamber angle recess point to the AOD 750 iris endpoint and the line connecting the chamber angle recess point to the AOD 750 corneal endpoint. This measurement is made for every clock hour position of the eye. |
| | *“SSA 750”* | This parameter indicates the angle measured at the conjunction of the line connecting the scleral spur to the AOD 750 iris endpoint and the line connecting the scleral spur to the AOD 750 corneal endpoint. This measurement is made for every clock hour position of the eye. |
| | *“AOD 750”* | This parameter indicates the perpendicular distance from a point on the posterior corneal surface that is 750 µm anterior to the scleral spur and the anterior surface of the iris. This measurement is made for every clock hour position of the eye. |
| | *“TISA 750”* | This parameter indicates the trapezoidal area that is defined by the following boundaries: AOD 750, the inner corneo-scleral wall and the perpendicular distance between the scleral spur and the iris. This measurement is made for every clock hour position of the eye. |

### *“Camera image”* tab

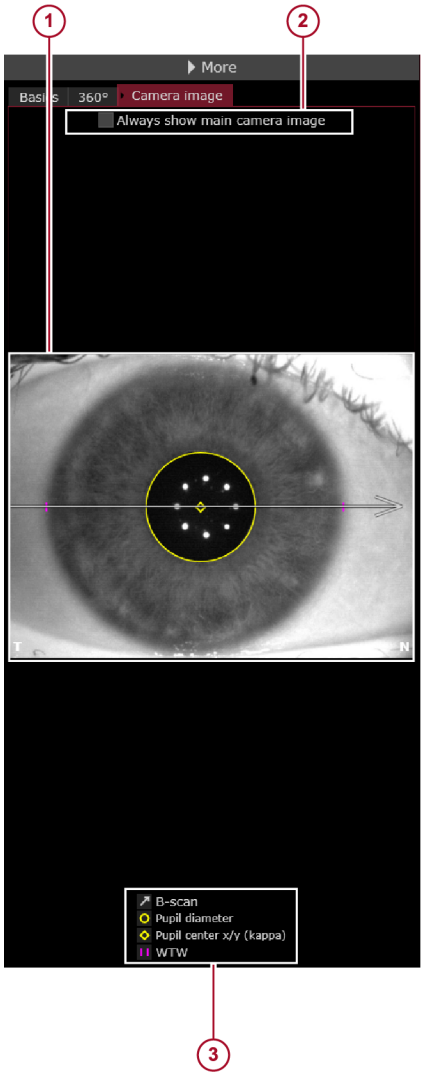


*Fig. 60: “Camera image” tab*

① Camera image
② *“Always show main camera image”* checkbox
③ Overlay options checkboxes

The following overlays ③ can be superimposed on the camera image ① (Fig. 60):

- B-scan
- Pupil diameter
- Pupil center x/y (kappa)
- WTW

For easy identification, each parameter has its own symbol. This symbol will be superimposed on the color map.

**Showing the main camera image**

- To display the corresponding camera image of the OCT section images when scrolling through the OCT section images, leave the *“Always show main camera image”* checkbox ② (Fig. 60) unchecked.
- To always display the main camera image, select the *“Always show main camera image”* checkbox ① (Fig. 60).

#### 11.2.4.4 *“Info”* Section

By clicking the *“Info”* button at the top of the analysis window, the *“Info”* tab is displayed in the *“More”* section. The following information is displayed:

***“Info”* tab**

| Section | Entry | Description |
|---|---|---|
| *“Eye”* | *“Eye”* | Examined eye, OD or OS |
| | *“Cornea status”* | This parameter indicates whether an eye underwent corneal refractive surgery. |
| | *“Lens status”* | This parameter indicates the presence or absence of the eye's natural crystalline lens and, if applicable, the type of implanted artificial lens. |
| | *“Vitreous status”* | This parameter indicates whether there is a history of surgical intervention to the vitreous. |
| *“Acquisition”* | *“Mode”* | Indication of the used acquisition application |
| | *“Date”* | Examination date |
| | *“Time”* | Examination time |
| | *“Operator”* | Name of the operator that examined the patient |
| | *“System test”* | This parameter indicates whether the system test was valid, outdated, or failing at the time of the acquisition. |
| | *“Fixation light focus”* | Internal fixation light focus is an acquisition setting that allows for fixation light sharpness adjustments, based on an eye's refraction. |
| | *“Int. fix. light brightness”* | Internal fixation light brightness is an acquisition setting that allows for fixation light brightness adjustments, based on patients needs. |
| *“Acquisition quality”* Display of parameters depends on the application of the currently loaded scan. | *“Motion”* | Acquisition quality parameter indicating whether eye movements impacted the quality of the acquired scan(s). |
| | *“Fixation”* | Acquisition quality parameter indicating whether excessive fixation loss was presented during acquisition. |
| | *“Tear film and lid”* | Acquisition quality parameter indicating whether the eyelid(s) and/or the tear film impacted the quality of the acquired image(s). |
| | *“Camera image segmentation”* | Acquisition quality parameter indicating whether the camera image segmentation necessary for pupil diameter and WTW distance calculation succeeded. |

| Section | Entry | Description |
|---|---|---|
| | *“Refraction correction”* | Acquisition quality parameter indicating whether the automatic refraction correction necessary for accurate calculation of measurements succeeded. |
| | *“Required data points”* | Acquisition quality parameter indicating whether a minimum of data points within the central 3 mm zone was calculated. |
| | *“Axial length measurement”* | Acquisition quality parameter indicating whether the axial length measurement could be automatically determined. |
| | *“Tracking”* | Acquisition quality parameter indicating whether tracking was activated or not. Tracking is a technique that uses the camera image to detect eye movements during image acquisition, ensuring that each acquired OCT B-scan is centered on the corneal vertex. |
| *“Camera images”* | *“No. of images”* | This parameter indicates the number of images within a series. |
| | *“Main image”* | This parameter indicates the ID of the camera image that is used for calculation of WTW and pupil diameter. This is the camera image with the median pupil diameter. It is displayed when the option “Always show main camera image” is activated. |
| | *“Size”* | Size of the image in pixels |
| *“OCT section images”* | *“No. of images”* | This parameter indicates the number of images within a series. |
| | *“Scan length/No. of A-scans”* | This parameter indicates the scan length and the number of A-scans for the raw OCT section images. |
| | *“Lateral scaling”* | Pixel scaling in lateral direction of raw OCT section images. |
| | *“Axial scaling”* | Pixel scaling in axial direction of raw OCT section images. |
| *“Component versions”* | *“HEYEX (changed by)”* | Version of the HEYEX 2 software used for the most recent changes |
| | *“VWM (changed by)”* | Version of the viewing module used for the most recent changes |
| | *“AQM”* | Version of the acquisition module used for this examination |
| | *“SSC”* | Version of the installed scanning service controller |
| | *“FPGA (SSC)”* | Version of the installed field programmable gate array |
| | *“MCC”* | Version of the installed master component controller |

| Section | Entry | Description |
|---|---|---|
| | *“EPC”* | Version of the installed external periphery controller |
| | *“CSB”* | Version of the installed camera sensor board |
| | *“SMC”* | Version of the installed stepper motor controller |
| | *“DCB”* | Version of the installed display controller board |
| | *“Internal data format”* | Version of the internal data format |
| *“Device”* | *“Device serial number”* | Serial number of the device |
| | *“Sequence timestamp”* | Timestamp of the acquired image. This file name is used to store the corresponding raw data (sequence). |

#### 11.2.4.5 Overlay Options

- At the bottom of the *“Single OD/OS”* or the *“Multi”* view or in the *“Basics”* and the *“Camera image”* tab of the *“More”* section, select the checkboxes of all parameters to be superimposed on the OCT section images and/or the camera images.

Overlay options available below the OCT section images:

- *“Vertex”*
- *“A-scan”*
  The A-scan shows the refraction correction and considers refraction at different locations and with respect to the different refractive indices.
- *“Segmentation”*
- *“Scleral spurs”*
- *“ACA recess points”*

Overlay options available in the *“Basics”* tab of the *“More”* section:

- *“CCT”*
- *“Aqueous depth”*
- *“Anterior chamber volume”*
  The anterior chamber volume is based on all OCT section images where the anterior chamber angle recess points have been set, and will only be superimposed on these images. The value is displayed if in one of the B-scans the ACA recess points have been set.
- *“ACA distance*”*
- *“Spur-to-spur distance*”*
- *“ACA 500*”*
- *“SSA 500*”*
- *“AOD 500*”*
- *“TISA 500*”*
- *“ACA 750*”*
- *“SSA 750*”*
- *“AOD 750*”*
- *“TISA 750*”*

- *“Lens thickness”*
- *“Lens vault*”*

  * All values refer to the currently displayed OCT section image.

  Overlay options available in the *“Camera image”* tab of the *“More”* section:

- *“B-scan”*
- *“Pupil diameter”*
- *“Pupil center x/y (kappa)”*
- *“WTW”*

  For easy identification, each parameter has its own symbol. This symbol will be superimposed on the color map.

#### 11.2.4.6 Editing the Segmentation

▸ Below the OCT section image, click *“Edit”* next to the *“Segmentation”* box.

The segmentation editor is displayed, showing the currently selected OCT section image.

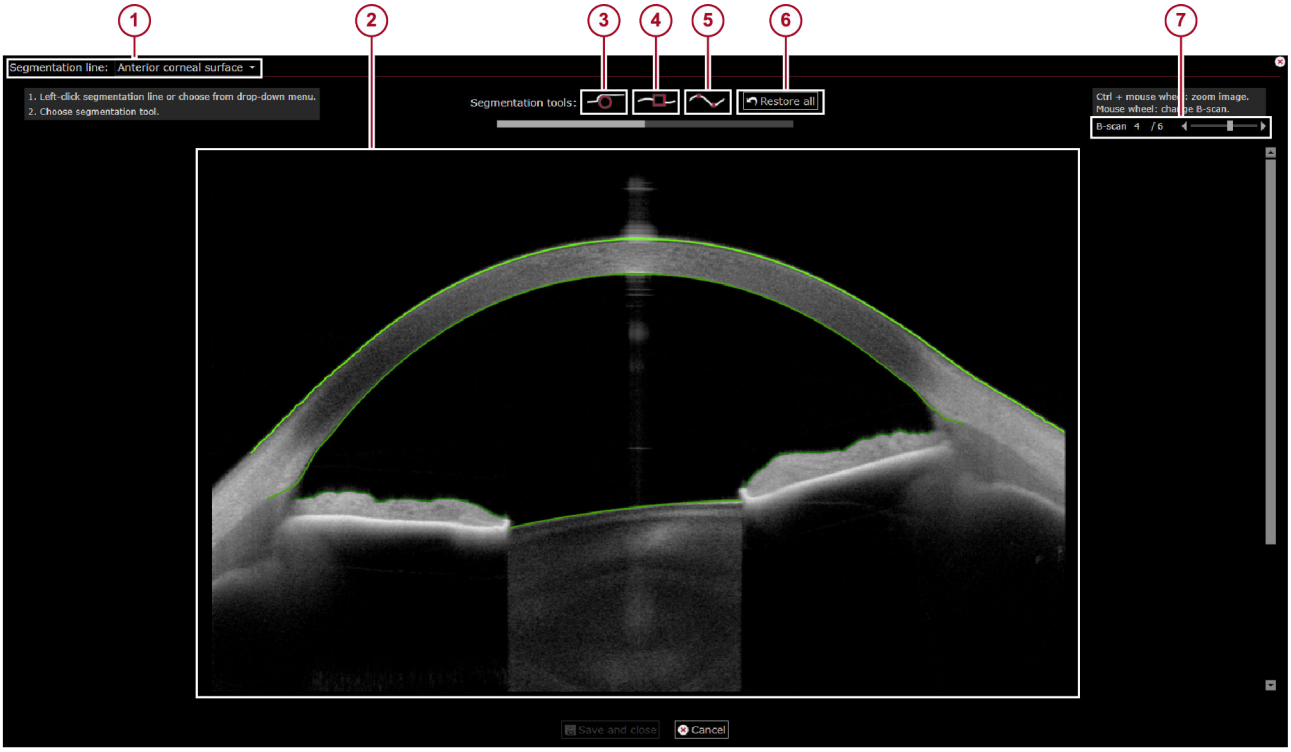


*Fig. 61: Editing the segmentation*

① *“Segmentation line”* drop-down list
② OCT section image
③ *“Segmentation tools”*: Circle tool
④ *“Segmentation tools”*: Eraser tool
⑤ *“Segmentation tools”*: Node editing tool
⑥ *“Restore all”* button
⑦ *“B-scan”* slider

▶ Either click the desired segmentation line or select the desired anatomic structure to be edited from the *“Segmentation line”* drop-down list ① (Fig. 61):

- *“Anterior corneal surface”*
- *“Posterior corneal surface”*
- *“Iris”*
- *“Anterior lens surface”*
- *“Posterior lens surface”*

Above the OCT section image, the following *“Segmentation tools”* (Fig. 61) become active:

- Circle tool ③
- Eraser ④
- Node editing tool ⑤

**Circle tool**

- Click  .

  The mouse cursor turns into a red circle.
- Move the mouse to the desired position on the segmentation line.
- To change the circle diameter, press  on the keyboard and scroll the mouse wheel.
- To correct the segmentation line, press and hold the left mouse button and move the mouse in the desired direction.

  The edited segmentation line turns yellow.
- To confirm the changes, click  again.
- To save the changes, click *“Save and close”* below the OCT section image.

  The segmentation editor is closed and the OCT section image is updated. The following message is displayed:
  - *“Segmentation(s) manually edited.”*

**Eraser**

With the eraser, parts of the segmentation line can be deleted.

- Click  .

  The mouse cursor turns into a red square.
- Move the mouse to the desired position on the segmentation line.
- To change the size of the square, press  on the keyboard and scroll the mouse wheel.
- To delete a part of the segmentation line, press and hold the left mouse button and move the mouse in the desired direction.
- To confirm the changes, click  again.
- To save the changes, click *“Save and close”* below the OCT section image.

  The segmentation editor is closed and the OCT section image is updated. The following message is displayed:
  - *“Segmentation(s) manually edited.”*

**Node editing tool**

With the node editing tool, the nodes of a segmentation line that define a smoothed line can be modified. At least three nodes are required to define a segmentation line.

- Click  .

  The segmentation line turns yellow and shows red nodes.
- Drag-and-drop a red node to the desired position.
- To add a node, double-click a desired position in the image.

  A new node is displayed.
- To delete a node, right-click the desired node.
- To delete multiple nodes, click and hold the left mouse button and move the mouse cursor over the desired nodes.

  The selected nodes are color-coded pink.
- Right-click a selected node.

  A message will be displayed asking you whether you really want to delete the selected nodes.

- To confirm, click *“Yes”*.
- To complete the changes, click  again.
- To save the changes, click *“Save and close”* below the OCT section image.

  The segmentation editor is closed and the OCT section image is updated. The following message is displayed:

  - *“Segmentation(s) manually edited.”*

***“Restore all”* function**

With the *“Restore all”* function, all manual changes can be undone and the segmentation can be restored to the automatic results.

- If manual changes are not acceptable, click *“Restore all”*.

  The manual changes of all OCT section images are automatically reset.

### 11.2.4.7 Editing the Scleral Spurs and Anterior Chamber Angle Recess Points

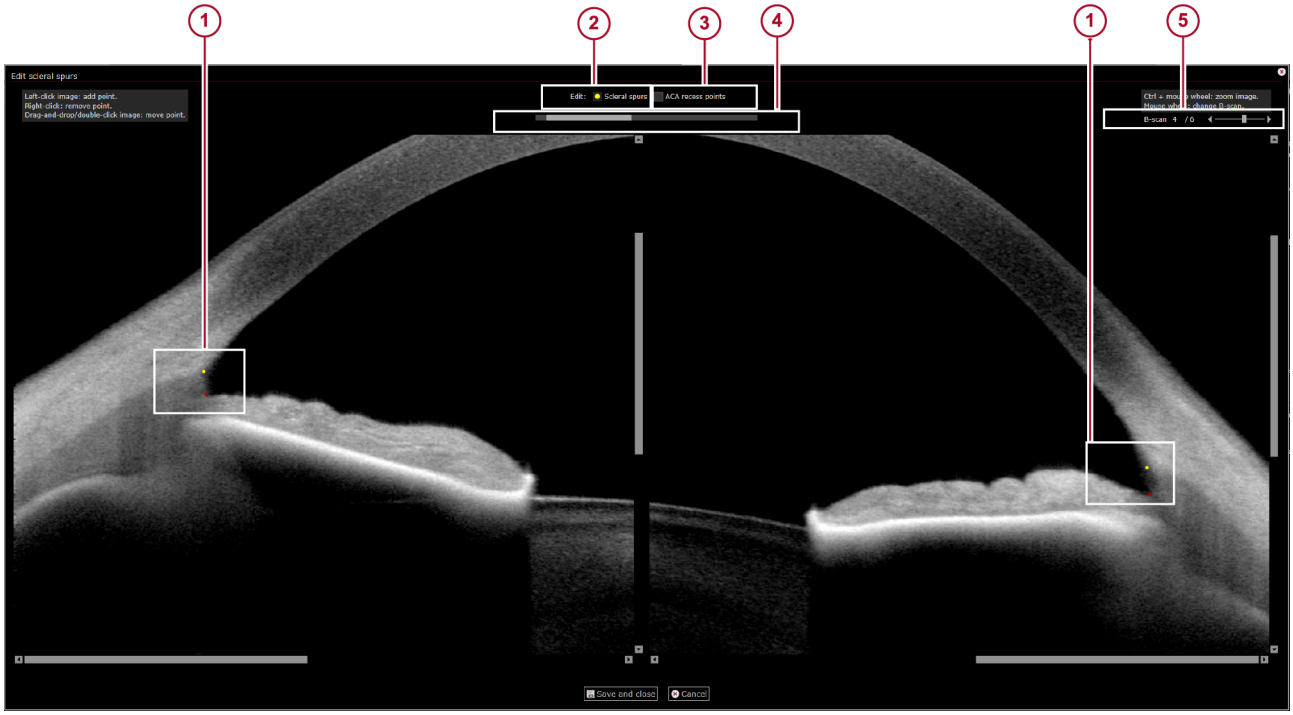


*Fig. 62: Editing the scleral spurs and ACA recess points*

① Yellow points representing the *“Scleral spurs”* and red points representing the *“ACA recess points”*
② *“Edit: Scleral spurs”*
③ *“Edit: ACA recess points”*
④ Brightness and contrast slider
⑤ *“B-scan”* slider

The anterior chamber angle measurements are only displayed after both scleral spurs and anterior chamber angle recess points have been manually marked on the OCT section images.

- To edit the scleral spurs and/or the anterior chamber angle recess points, click *“Edit”* next to the *“Scleral spurs”* or *“ACA recess points”* boxes.

  The segmentation editor is displayed. The OCT section image is divided into two parts.

**Editing the scleral spurs**

- To mark and edit the scleral spurs, select the *“Scleral spurs”* checkbox ② (Fig. 62) above the OCT section image.

  Alternatively, press the *“S”* key on the keyboard.
- Left-click the desired position in the left and the right anterior chamber angle.

  A yellow point is displayed in each anterior chamber angle ① (Fig. 62).
- To move the markers of the scleral spur to another location, drag-and-drop the yellow points to the desired location, or double-click the desired location.
- To delete the markers of the scleral spur, right-click the yellow points.

**Editing the anterior chamber angle recess points**

- To mark and edit the anterior chamber angle recess points, select the *“ACA recess points”* checkbox ③ (Fig. 62) above the OCT section image.

  Alternatively, press the *“A”* key on the keyboard.
- Left-click the desired position in the left and the right anterior chamber angle.

  A red point is displayed in each anterior chamber angle recess point ① (Fig. 62).
- To move the markers of the anterior chamber angles to another location, drag-and-drop the red points to the desired location, or double-click the desired location.
- To delete the markers of the anterior chamber angle recess points, right-click the red points.
- To save the changes, click *“Save all points”*.

  The segmentation editor is closed. If the *“Scleral spurs”* and *“ACA recess points”* checkboxes below the OCT section image are checked, both anatomic structures are now superimposed on the OCT section image. Furthermore, all parameters offered in the *“Basics”* tab of the *“More”* section can now be superimposed on the OCT section image. However, the *“ACA distance”* and the *“Spur-to-spur distance”* can only be displayed if the respective anatomic structures have been demarcated on both sides of the OCT section image.

**Calculating the parameter values**

The following values are always calculated automatically:

- *“CCT”*
- *“WTW”*
- *“Aqueous depth”*
- *“Lens thickness”*

The calculated values, except WTW, are the mean values of the six OCT section images and their standard deviation.

All other parameters are calculated after having set the scleral spurs and anterior chamber angle recess points for the respective OCT section image.

### 11.2.4.8 Measuring Distances

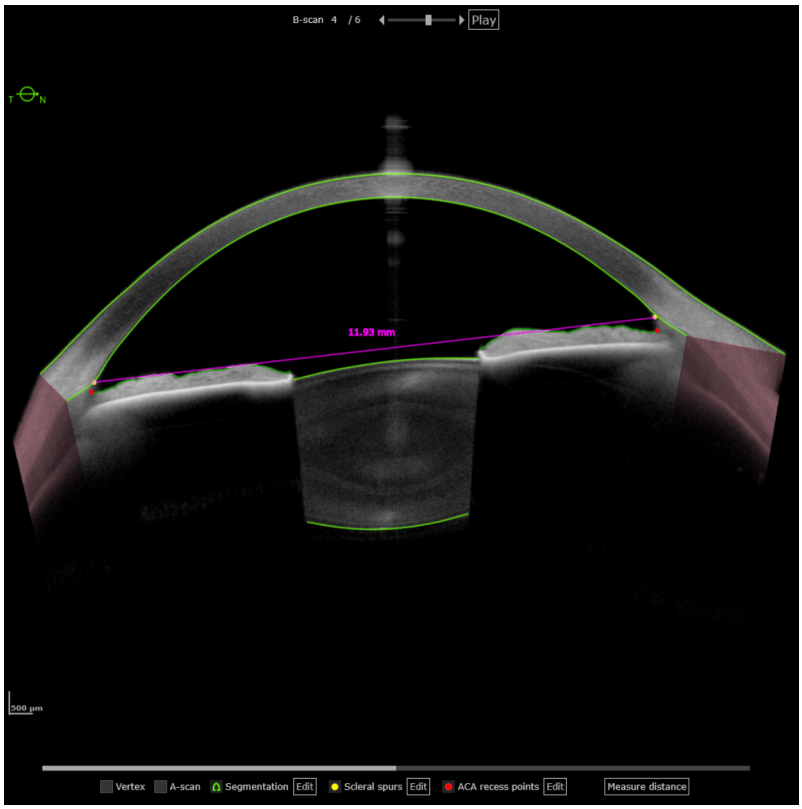


*Fig. 63: Measuring distances on OCT section images*

To measure distances in the OCT section image, the *“Measure distance”* overlay is available. Results are always displayed in mm.

- Below the OCT section image, click *“Measure distance”*.
- Click where the start point of the measurement tool should be positioned.
- Click where the end point of the measurement tool should be positioned.

  The measuring line is displayed in pink.

  The value of the measured distance is displayed in mm.
- To change the position of the overlay, drag-and-drop it to the desired position.
- To change the length of the overlay, hover with the mouse cursor over the start or the end point of the line and drag-and-drop it to the desired position.
- To measure the corneal thickness on a certain point of the cornea, double-click the desired location.

  The measuring line is displayed in pink.

  The value of the measured thickness is displayed in µm.
- To delete the overlay, right-click it.

Measurements are only correct if all boundaries have been segmented correctly, i.e. measurements inside the lens are only accurate if the lens segmentation is correct.

Manual distance measurements are not saved.

It is possible to save manual distance measurements in HEYEX 2, as a report.

### 11.2.5 Analysis Window - *“Multi”* View

Either four or six OCT section images can be displayed on the screen at the same time.

The number of displayed OCT section images is represented by the following symbols:

- ⊞ - Four OCT section images
- ⊞ - Six OCT section images

For easy orientation, the direction of each OCT section image is indicated by a small icon.


*Fig. 64: “Multi” view*

1. Patient information (➞ 11.2.4.1 “Patient Information”, p. 150)
2. *“Report”* button (➞ 13 “Reports”, p. 192)
3. *“Info”* button (➞ 11.2.4.4 “ *“Info”* Section”, p. 156)
4. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
5. *“Close”* button
6. *“Select series”* section (➞ 11.2.4.2 “ *“Select series”* Section”, p. 150)
7. OCT section images
8. Brightness and contrast slider
9. Overlay options checkbox (➞ 11.2.4.5 “Overlay Options”, p. 158)
10. Viewing options buttons, number of displayed images
11. *“More”* section (➞ 11.2.4.3 “ *“More”* Section”, p. 150)

**Red areas in OCT section images refer to an extrapolated refraction correction**

The refraction correction in these areas is based on extrapolation of the surface boundaries and should be considered with caution for clinical use.

Measurements using freehand selections are not allowed in red areas.

# 12 *“Imaging”* App

## 12.1 Examining Patients

### 12.1.1 Starting Existing Orders

When starting the system the first time every day, or every 24 hours, the system test has to be performed. For further information on how to perform the system test, please refer to (➞ 8.3 “Performing the System Test”, p. 30).

The following procedure assumes that HEYEX 2 has been started, an order has been created, the navigator is open, and that the desired patient is selected.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

- Select the *“Examination”* tab in the ribbon bar.
- Click *“Start”* in the *“Examinations”* section.

  The *“Select examination”* window is displayed.
- Select the desired order and click *“Start examination”*.

  The acquisition window is displayed on the touch screen of the device.
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31) and select the desired examination application.

### 12.1.2 Using a Scan Pattern

The *“Imaging”* app provides four scan patterns. For each scan pattern, you can personalize the scan parameters.

Personalized scan parameters can be saved as presets (➞ 12.1.4 “Using Presets”, p. 171).

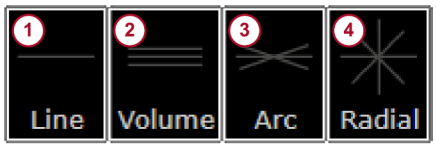


*Fig. 65: Scan patterns*

① Line scan
② Volume scan
③ Arc scan
④ Radial scan

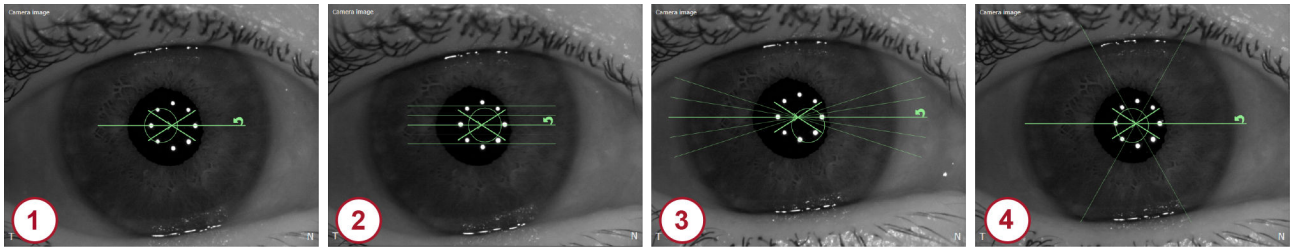


*Fig. 66: Scan pattern overlays on camera image*

① Line scan
② Volume scan
③ Arc scan
④ Radial scan

- Select a scan pattern (Fig. 65).
- Select the *“Pattern details”* tab.

  The scan settings are displayed.

- To set the individual scan parameters, tap — to decrease the value and + to increase the value (→ “Scan patterns and settings”, p. 169). The — or + button is shown grayed as soon as you reach the lowest or the highest possible value.

**Scan patterns and settings**

| | Line scan ① | Volume scan ② | Arc scan ③ | Radial scan ④ |
|---|---|---|---|---|
| *“Volume height”*: Height between first and last scan | - | 0.5 mm - 7.5 mm | - | - |
| *“Scan arc”*: Angle between first and last scan | - | - | 5° - 90° | - |
| *“B-scan number”*: Number of single B-scans | 1 | 3 - 65 | 3 - 65 | 3 - 65 |
| *“B-scan length”*: Length of B-scans | 5 mm - 16.5 mm | 5 mm - 16.5 mm | 5 mm - 16.5 mm | 5 mm - 16.5 mm |
| *“B-scan angle”*: 0° or 90° rotation angle | 0° or 90° | 0° or 90° | 0° or 90° | 0° or 90° |
| *“Scan resolution level”*: Number of A-scans per B-scan | 256<br>512<br>768<br>1024 | 256<br>512<br>768<br>1024 | 256<br>512<br>768<br>1024 | 256<br>512<br>768<br>1024 |
| *“Average B-scans”*: Repetition of each B-scan for averaging | 1<br>2<br>4<br>8 | 1<br>2<br>4<br>8 | 1<br>2<br>4<br>8 | 1<br>2<br>4<br>8 |

The potential for memory overload and the acquisition time depends on the number of acquired B-scans and how many times each B-scan is averaged.

A message is displayed indicating that the image acquired with the selected parameters will exceed the memory limits.

- Align the camera image and the OCT section image (→ 12.1.7 “Aligning the Camera”, p. 173).

### 12.1.3 Positioning a Scan

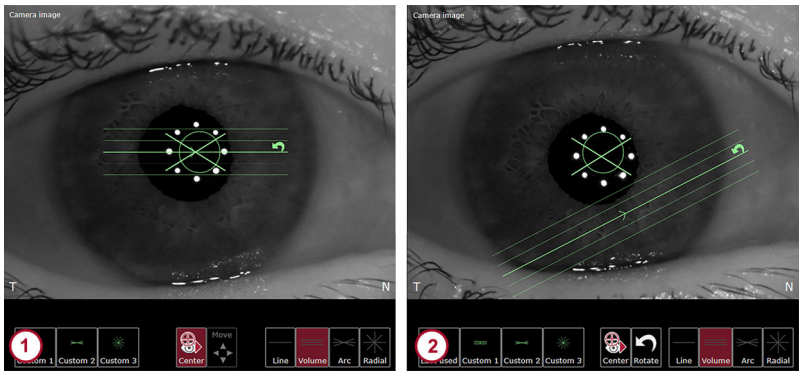


*Fig. 67: Example: volume scan pattern*

① Centered scan
② Off-centered scan

The *“Imaging”* app allows for the acquisition of scans that are either centered on an eye's corneal vertex or on off-centered locations. This may be necessary e.g. in case of corneal lesion or surgical outcome surveillance.

By default, scan patterns are centered on the eye's corneal vertex ① (➞ p. 170). This is indicated by the highlighted *“Center”* symbol. Scan patterns can be rotated and modified in length via the overlay on the touch screen.

- To allow for use of off-centered scans ② (➞ p. 170), tap *“Center”* .

  The *“Center”* button is deactivated and grayed out.

  It is now possible to either rotate, modify the scan length, or to move the scan pattern to an off-centered location.

  The *“Move”* button is now activated by default and can be toggled with the *“Rotate”* button.

  The symbol on the scan pattern indicates that the scan can be rotated and the length can be changed.

  The symbol on the scan pattern indicates that the scan can be moved.

**Setting scan parameters**

- To align the scan horizontally or vertically, tap *“0°”* or *“90°”* respectively in the *“B-scan angle”* section of the *“Pattern details”* tab.
- To change the *“B-scan length”*, tap — to decrease the length or + to increase the length.
- Alternatively, when the rotation mode is active , drag the end of the scan pattern to the desired length.

  The length values are automatically adjusted in the *“B-scan length”* section.
- To change the *“B-scan number”*, tap — to decrease the number or + to increase the number.
- To change the *“Volume height”* of a volume scan, tap — to decrease the height or + to increase the height.
- To change the *“Scan arc”* of an arc scan, tap — to decrease the value or + to increase the value.

**Rotating a scan**

- To change the scan angle, verify that the ↶ symbol on the scan pattern indicates that rotation is possible.
- Tap and drag the end of the scan pattern to the desired scan angle.

  The angle value is automatically adjusted in the *“B-scan angle”* section.

**Moving a scan**

- To activate the off-centered scan, tap *“Center”* .

  The *“Center”* button is deactivated and grayed out.
- Tap *“Move”* .

  The *“Rotate”* button is now displayed.
- Verify that the ✣ symbol on the scan pattern indicates that movement is possible.
- To define the desired scan position on the camera image, tap the position where the center of the scan pattern should be placed.

### 12.1.4 Using Presets

You can save up to three personalized scan patterns as presets.


*Fig. 68: Presets*

① Last used scan pattern and preset
② Customized preset

The *“Last used”* button ① (Fig. 68) is only available after the first image acquisition of the current session.

The *“Custom 1”*, *“Custom 2”*, and *“Custom 3”* buttons ② (Fig. 68) are saved for this workstation.

**Saving a preset**

- To save the defined scan settings, tap and hold *“Custom 1”*, *“Custom 2”*, or *“Custom 3”*.

  A message is displayed at the bottom of the acquisition window indicating that the pattern preset has been saved.

  The symbol of the saved scan pattern is displayed on the preset button.
- To overwrite a preset, repeat the saving procedure.

**Using a preset**

- To reuse the last scan pattern, tap *“Last used”*.
- To use one of the three customized presets, tap *“Custom 1”*, *“Custom 2”*, or *“Custom 3”*.

### 12.1.5 Adjusting the Internal Fixation Light

If the patient cannot see the internal fixation light clearly, its sharpness and brightness may be adjusted. Ask the patient whether the internal fixation light is clearly visible while the camera is adjusted.

Please note that the following settings must be adjusted for each eye separately.

Make sure that the patient is not distracted during fixation, e.g. by persons walking by.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.
- In order to adjust the brightness of the internal fixation light, tap − to decrease the brightness and + to increase the brightness in the *“Fixation light brightness”* section. The scale of the brightness ranges from 0 to 5, where 0 indicates that the fixation light is off, 1 indicates low brightness and 5 indicates high brightness of the fixation light. Increasing the brightness may be especially helpful for patients with cataracts.
- In order to adjust the sharpness of the internal fixation light, tap − in the *“Fixation light focus”* section to shift the fixation light focus to myopic correction and + to shift the fixation light focus to hyperopic correction. The scale of the focus ranges from -15 D to +15 D and can be adjusted in 0.5 D increments. Changing the internal fixation light focus may be especially helpful for patients with refractive errors, or to improve the axial length signal.

**Storing the *“Fixation light focus”* settings**

The *“Fixation light focus”* settings will be stored in the database.

The settings are automatically used for future acquisitions performed on the same patient and eye.

### 12.1.6 Using the External Fixation Light

If the internal fixation light is not adequate for proper fixation, use the external fixation light to engage the fellow eye for fixation.

- Select the *“Fixation settings”* tab.

  The *“Fixation settings”* parameters are displayed.
- To switch on the external fixation light, tap the light bulb symbol in the *“External fixation light”* section.
- Move the external fixation light so that the fixation of the patient's fellow eye is achieved with the external fixation light.

**Example: Visualization of paracentral structures**

In the *“Imaging”* app, the external fixation light should be used for image acquisition of paracentral structures, e.g. the sclera. In this case, the tracking function should be disabled. For further information on how to disable the tracking function, please refer to (➞ “Disabling tracking”, p. 176).

 

### 12.1.7 Aligning the Camera

**Display options** You can change the display of the acquisition window.

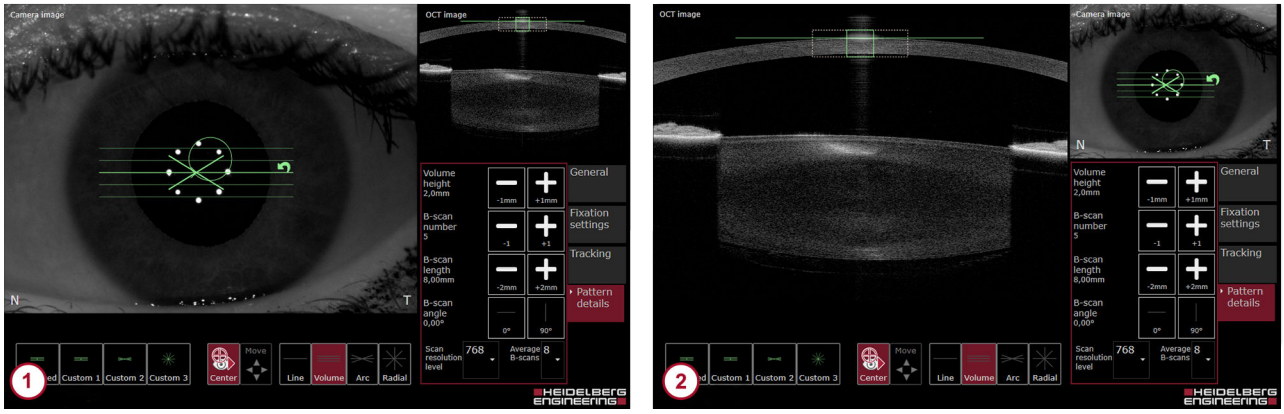


*Fig. 69: Display options*

① Large camera image
② Large OCT section image

By default, the camera image is shown enlarged in the acquisition window ① (➞ “Display options”, p. 173).

- To toggle between the enlarged camera image ① and the enlarged OCT section image ② (➞ “Display options”, p. 173), tap the OCT section image.

ℹ Tapping the camera image in the *“Imaging”* app rotates or moves the scan pattern.

For optimal examination results, the alignment must be performed according to the following steps in sequence:

- Start with the lateral alignment of the camera and the eye (➞ “Aligning the camera image”, p. 174).
- When the lateral alignment is successfull, proceed with the axial alignment of the eye and the OCT scan pattern (➞ “Centered scan”, p. 175).

**Aligning the camera image**

The circle overlay indicates the target position for the corneal vertex in the center of the camera image. The cross-shaped overlay indicates the location of the tracked corneal vertex, i. e. the center of the eight reflection points. The highlighted line indicates the lateral position of the live OCT section image.

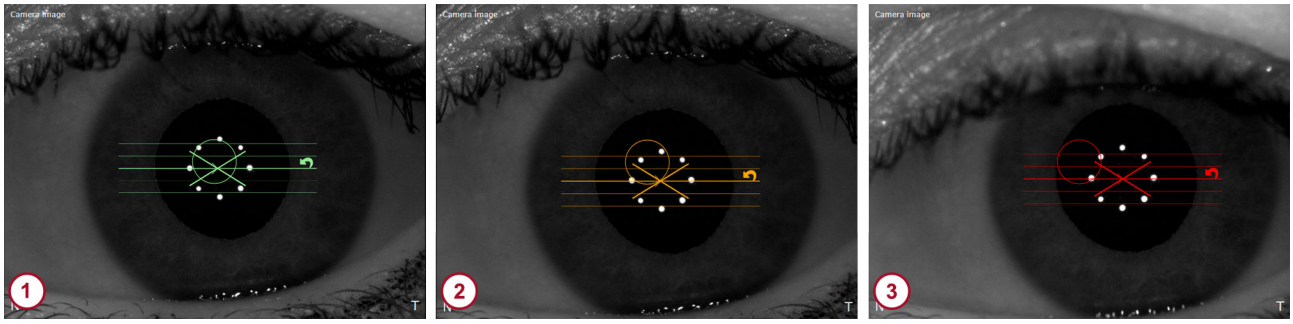


*Fig. 70: Aligning the camera image - Example: volume scan*

① Camera image correctly aligned
② Camera image acceptably aligned
③ Camera image not properly aligned

- Carefully move the camera towards the patient's eye.
- Move the camera slightly to the left and the right until the iris is visible within the camera image.
- During camera alignment, ask the patient whether the fixation light is bright and clearly visible. If not, readjust the fixation light (➞ 12.1.5 “Adjusting the Internal Fixation Light”, p. 171).
- Turn the joystick clockwise or counterclockwise until the cross-shaped overlay is close to the center of the circle overlay (Fig. 70).

  If the camera is correctly aligned, the cross-shaped and circle overlays, and the scan pattern turn green ① (Fig. 70). The image acquisition can be initiated.

  If the camera is acceptably aligned, the cross-shaped and circle overlays, and the scan pattern are yellow ② (Fig. 70). While this quality indicator suggests that the alignment is acceptable, Heidelberg Engineering recommends to align the camera correctly ① (Fig. 70) for best results.

  If the camera is not properly aligned, the cross-shaped and circle overlays, and the scan pattern are red ③ (Fig. 70). Image acquisition is not possible when the camera is not acceptably or correctly aligned. Readjust the camera until the image is acceptably or correctly aligned.

### Aligning the OCT section image

**Centered scan**

By default, the scan pattern is aligned with the corneal vertex in order to facilitate the acquisition of a centered scan.

- Use the joystick to align the OCT section image so that the square and the horizontal line turn green.

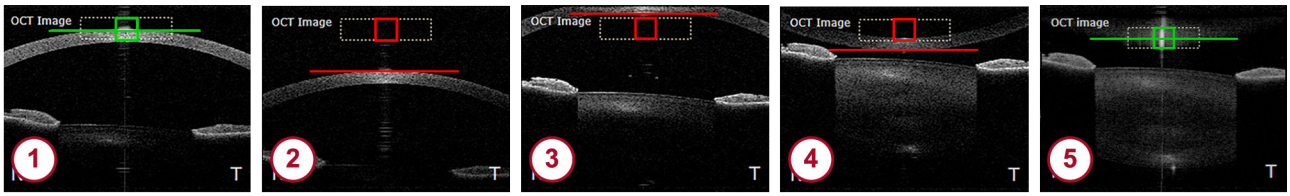


*Fig. 71: Aligning the OCT section image for a centered scan*

① OCT section image is correctly aligned
② Move the camera closer to the patient's eye
③ Move the camera away from the patient's eye
④ Move the camera away from the patient's eye
⑤ Move the camera away from the patient's eye

- Align the camera so that the cornea and the corneal reflex are within the dashed box.

  If the OCT section image is aligned correctly, the square and the line in the dashed box turn green ① (Fig. 71).

  If the camera is too far away from the patient's eye, the OCT section image will be below the dashed box ② (Fig. 71).

- Move the camera closer to the patient's eye.

  If the camera is too close to the patient's eye, the OCT section image will be above the dashed box ③ or flipped ④ (Fig. 71).

- Move the camera away from the patient's eye.

  If the camera is too close to the patient's eye and the cornea is flipped, the square and the line may erroneously turn green because the corneal vertex reflex is detected ⑤ (Fig. 71).

- Move the camera away from the patient's eye until the cornea is displayed correctly ① (Fig. 71).

**Off-centered scan**

For an off-centered scan, the scan pattern is not aligned with the center of the cornea. For further information, please refer to (➞ 12.1.3 “Positioning a Scan”, p. 170).

- Use the joystick to align the OCT section image so that the square and the horizontal line turn green.

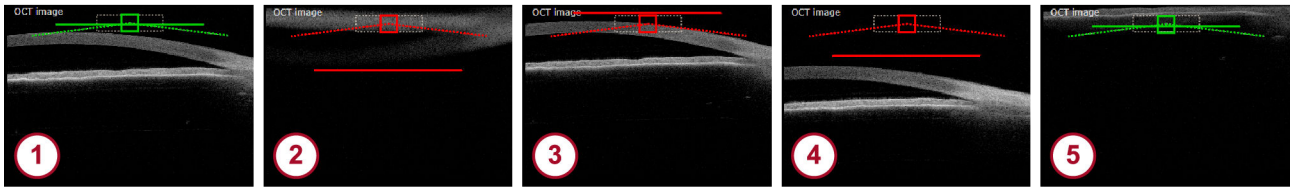


*Fig. 72: Aligning the OCT section image for an off-centered scan*

① OCT section image is correctly aligned
② Move the camera closer to the patient's eye
③ Move the camera away from the patient's eye
④ Move the camera away from the patient's eye
⑤ Move the camera away from the patient's eye

- For off-centered scans, the horizontal line represents the axial position of the cornea at the corneal vertex, which is not visible in the live OCT image. In this case, align the horizontal line with the dashed box until the square and the line in the dashed box turn green. The cornea in the live OCT image is not necessarily within the dashed box in this case.

  If the OCT section image is aligned correctly, the square and the line in the dashed box turn green ① (Fig. 72).

  If the camera is too far away from the patient's eye, the OCT section image will be below the dashed box ② (Fig. 72).

- Move the camera closer to the patient's eye.

  If the camera is too close to the patient's eye, the OCT section image will be above the dashed box ③ or flipped ④ (Fig. 72).

- Move the camera away from the patient's eye.

  If the camera is too close to the patient's eye and the cornea is flipped, the square and the line may erroneously turn green because the corneal vertex reflex is detected ⑤ (Fig. 72).

- Move the camera away from the patient's eye until the cornea is displayed correctly ① (Fig. 72).

**Disabling tracking**

**WARNING!**

**Disabling tracking may cause inaccurate examination results**

Inaccurate examination results may lead to incorrect diagnostic conclusions resulting in incorrect therapeutic approaches.

- Always consider that examinations without the tracking function may be less accurate.

Unacceptable image alignment during the acquisition process (pressed joystick button) results in a message indicating that acquisition is not possible. This scenario could be present, for example, if the tracked corneal reflex on the camera image is unstable. In such instances, the camera should be realigned, or tracking should be disabled in order to continue the acquisition.

Tracking is disabled only for the current acquisition.

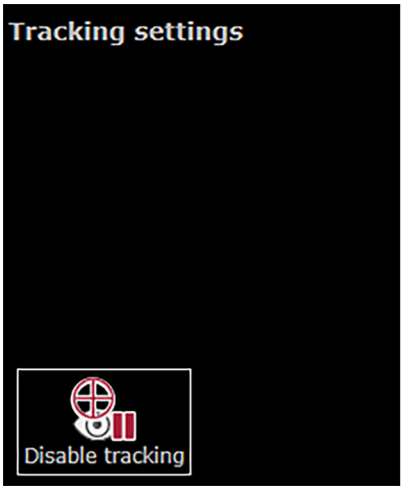


*Fig. 73: Disabling tracking*

- To switch off the tracking function, select the *“Tracking”* tab and click *“Disable tracking”* (Fig. 73).

  The alignment markers on the camera image and OCT section image turn blue.
- Manually align the camera image so that the eight reflection points are centered.
- Manually align the OCT section image so that the cornea is within the dashed box and the corneal vertex reflection is centered laterally.
- Start the examination.

  The aquisition quality parameters *“Motion”*, *“Fixation”* and *“Tear film and lid”* are not applicable and are indicated as *“n/a”*.

  *“Tracking off”* is displayed together with a warning symbol.

**No automatic quality indicators are available when tracking is disabled**

Examination results should be carefully reviewed for accuracy.

- Review all camera images for motion in the analysis window.
- Check the accuracy of the segmented boundaries within the OCT section images in the analysis window.

### 12.1.8 Acquiring Images

**Preparing the examination**

- Start an existing order (➞ 12.1.1 “Starting Existing Orders”, p. 167).
- Prepare the patient (➞ 8.5 “Preparing the Patient”, p. 31).

- Tap *“Imaging”* on the touch screen.

**Aligning the camera**

- To examine the right eye, move the camera to the left and use the eye occluder to cover the left eye.

  In the upper left corner of the touch screen, *“OD”* is displayed.
- When switching eyes during the acquisition process, pull the camera back to its farthest back position, then slide it to the left or right.
- To examine the left eye, move the camera to the right and use the eye occluder to cover the right eye.

  In the upper left corner of the touch screen, *“OS”* is displayed.
- Align the camera so that the camera image and the OCT section image are displayed correctly (➞ 12.1.7 “Aligning the Camera”, p. 173).

**Starting the examination**

- Ask the patient to blink.
- Readjust the camera, if needed.
- Ask the patient to refrain from blinking for a few seconds.
- Press the joystick button.

  Image acquisition starts.
- Keep the device as still as possible.

  The examination stops after a brief moment.

**Examination quality**

Immediately after the examination process is completed, the examination quality is checked. If the acquisition quality is acceptable or good, then the basic examination results are displayed after a brief moment.

- Check the examination quality (➞ 12.1.9 “Checking the Examination Quality”, p. 179).

  If the quality of the examination is not ideal or is compromised, then a message is displayed, indicating that one of the following quality parameters is not met:

  - *“Vertex out of alignment”*
  - *“Too strong movement”*
  - *“Cornea out of axial alignment”*
  - *“Possible blinking”*

  A window will appear, indicating the option to repeat the examination or to proceed to the analysis of the data.
- To discard the acquired data and repeat the examination, tap *“Repeat”*.

  The acquisition screen is displayed again.
- Realign the camera and repeat the examination.
- To proceed with analyzing the examination data, tap *“Proceed”*.

  The basic examination results are displayed after a brief moment.
- Check the examination quality (➞ 12.1.9 “Checking the Examination Quality”, p. 179).

 

### 12.1.9 Checking the Examination Quality

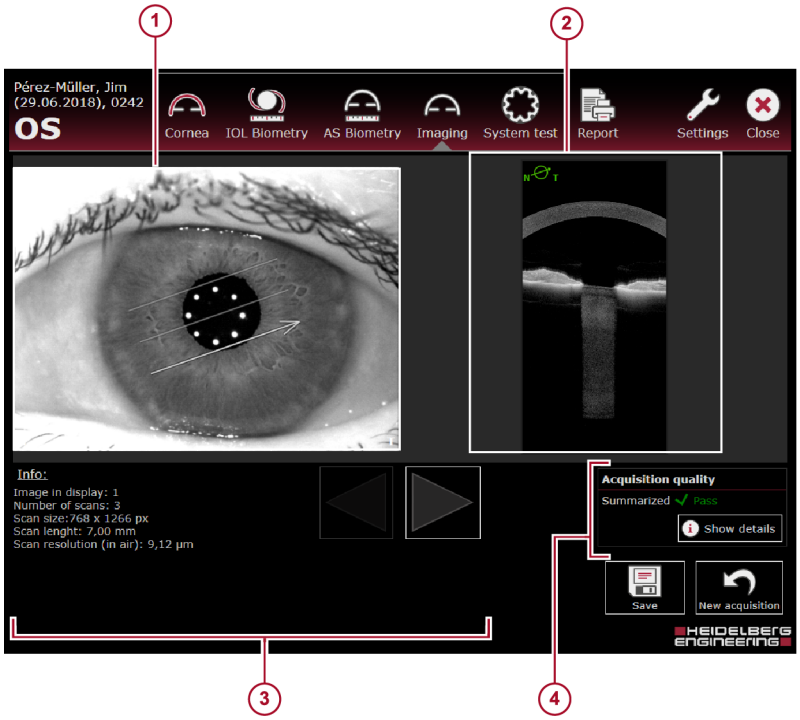


*Fig. 74: Basic examination results*

1. Camera image
2. OCT section image, the direction of the scan is indicated by a symbol in the upper left corner
3. Details of the displayed image and the applied scan pattern, ▶ and ◀ button to scroll through the images or play the images as a movie
4. Acquisition quality parameters

By default, the summarized acquisition quality result is displayed and the details are hidden.

**Acquisition quality** ④

- To display the detailed acquisition quality results, click *“Show details”*.
- Check the acquisition quality parameters:
  - If *“Motion”* is yellow or red, then one or more of the following factors may have impacted the results during the acquisition process:
    - The corneal vertex was not correctly aligned, laterally.
    - The corneal vertex moved too much.
    - The corneal vertex was not correctly aligned, axially.
  - If *“Fixation”* is yellow or red, then the patient did not fixate properly during the acquisition process.
  - If *“Tear film and lid”* is yellow or red, then the corneal reflexes were compromised during the acquisition process due to one of the following reasons:
    - The patient did not open his or her eyes wide enough or blinked.
    - The patient has dry eyes.
    - The patient has abnormal corneal irregularities.

  i If any of the quality parameters are red, Heidelberg Engineering recommends reinstructing and reexamining the patient. If any of the quality parameters are yellow, Heidelberg Engineering recommends to carefully review the data and to decide on a case-by-case basis whether the quality of the data is acceptable or if a repeated examination is needed.
- To hide the detailed acquisition quality results, click *“Hide details”*.

**Showing the images**

- To scroll through the images, tap the ▶ or ◀ button.
- To play the images as a movie, hold the ▶ or ◀ button.

**Camera image** ①

- Check that the camera image is sharp.
- Check that the reflection points are sharply displayed, circular in shape, and are displayed in a circular pattern.

**OCT section images** ③

- Review the OCT section images.
- Check that the orientation of the *“T/N”* symbol in the upper left corner of the OCT section image corresponds to the orientation of the highlighted line in the scan pattern superimposed on the camera image.
- Review the relevant anatomic structures.

  Depending on OCT scan pattern adjustments, the OCT section images allow the visualization of different anatomic structures.
- Verify that the structures of interest are clearly visible in most of the OCT section images.

**i** Refraction correction and parameter measurements are not applicable to images acquired in the *“Imaging”* app.

**Acquiring additional images**

- To acquire additional images, tap ↶ *“New acquisition”*.

  The examination window is displayed. Align the camera and reexamine the patient.

## 12.2 Analyzing Examinations

The analysis window offers the following two views:

- *“Single OD/OS”*
- *“Multi”*

> The *“Imaging”* app only allows for review of OCT section images and camera images.

### 12.2.1 Opening Examinations in the Analysis Window

The following procedure assumes that HEYEX 2 has been started.

For further information on working with HEYEX 2, please refer to the HEYEX 2 User Manual.

- To open examinations in the analysis window, select the desired patient in the *“Patients”* list.

  All examinations are listed in the *“Examinations”* list.
- Select the desired examination.

  All series are displayed in the *“Series”* section.
- To display series as lists, select the *“Series”* tab at the bottom of the *“Series”* section.
- To display series as thumbnails, select the *“Series thumbnails”* tab at the bottom of the *“Series”* section.

  The following sections assume that the *“Series thumbnails”* tab has been selected.
- Double-click the desired thumbnail.

  The analysis window is displayed.

### 12.2.2 Navigating through the Images

Depending on the application and view, different navigating options may be available.

**Navigating options**

| Section | Options | Description |
|---|---|---|
| General | Right-click anywhere in the window. | Switches the unit to mm or D.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |
| | Hover with the mouse cursor over the border of a section, e. g. the *“More”* section, in the analysis window. | The mouse cursor switches to ⟷.<br>Drag-and-drop to change the size. |
| | Click ›. | Expands or retracts a section. |
| Camera image or color map | Hover with the mouse cursor over a camera image or map. | The value at the corresponding location on the map is displayed.<br>The x/y location of the mouse cursor is displayed on the upper right of the map.<br>Not applicable for *“Imaging”* and *“Metrics”* app. |

| Section | Options | Description |
|---|---|---|
| OCT section image | Hover with the mouse cursor over the left or right end of the brightness and contrast slider. | The mouse cursor switches to ⟷.<br>Drag-and-drop the slider to change the image brightness of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Hover with the mouse cursor over the brightness and contrast slider. | The mouse cursor switches to ✋.<br>Move the slider to adjust the image contrast of the OCT section image.<br>To reset to the default values, double-click the slider. |
| | Click ⊞. | While holding down the left mouse button, draw a square on the OCT section image in order to zoom the selected region to its maximum size. |
| | Click ⊕ or ⊖.<br>Alternatively, press Ctrl and scroll the mouse wheel. | Incrementally zoom in or out on an OCT section image. |
| | Hover with the mouse cursor over the border of a zoomed OCT section image. | The mouse cursor switches to ◇▷.<br>The automatic scroll function is activated. |
| | Press and hold the left mouse key. | Move the mouse to move the image. |
| | On the *“B-scan”* slider, click ◀ or ▶ to scroll through the OCT section images.<br>Alternatively, scroll through the OCT section images using the mouse wheel. | Shows the OCT section images. |
| | To show the OCT section images as a slide show, click *“Play”*. | Shows the OCT section images as a slide show. |
| A-scan | If the A-scan overlay is activated, hover with the mouse cursor over the green line representing the A-scan. | The mouse cursor switches to ◁◇▷.<br>Drag-and-drop to move the A-scan. |

### 12.2.3 Analysis Window - *“Single OD/OS”* View


*Fig. 75: “Single OD/OS” view*

1. Patient information (➞ 12.2.3.1 “Patient Information”, p. 184)
2. *“Report”* button (➞ 13 “Reports”, p. 192)
3. *“Info”* button (➞ 12.2.3.4 “ *“Info”* Section”, p. 186)
4. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
5. *“Close”* button
6. *“Select series”* section (➞ 12.2.3.2 “ *“Select series”* Section”, p. 185)
7. OCT section image
8. Overlay options checkboxes (➞ 12.2.3.5 “Overlay Options”, p. 189)
9. *“More”* section (➞ 12.2.3.3 “ *“More”* Section”, p. 186) with camera image, scan pattern details, and overlay options checkboxes (➞ 12.2.3.5 “Overlay Options”, p. 189)

Refraction correction and parameter measurements are not applicable to images acquired in the *“Imaging”* app.

#### 12.2.3.1 Patient Information

The following information is displayed:

- Patient name
- Date of birth
- Patient ID
- Examination date and time
- Examined eye

### 12.2.3.2 *“Select series”* Section

In the *“Select series”* section, all series of the currently selected examination are displayed. The series are divided into OD and OS, and are sorted by examination date and time. The most current examination is on top of the list. The oldest examination is on the bottom of the list. The numbers next to the symbols of the application tabs indicate how many acquisitions the patient file series contains, in the corresponding acquisition application.

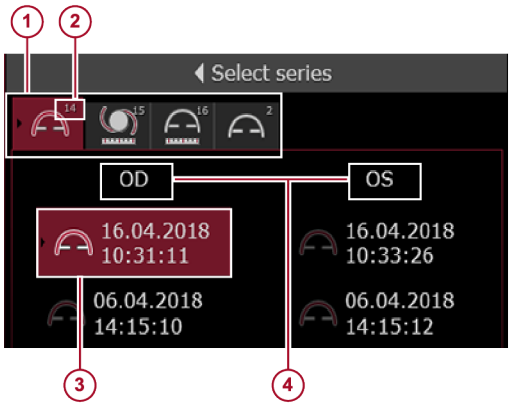


*Fig. 76: “Select series” section*

1. Application tabs
2. Number of series acquired with that application
3. Selected series
4. OD, OS

- To select a series for analysis, click the desired entry.

  The results of the examination are automatically displayed.

### 12.2.3.3 *“More”* Section

#### *“Camera image”* tab

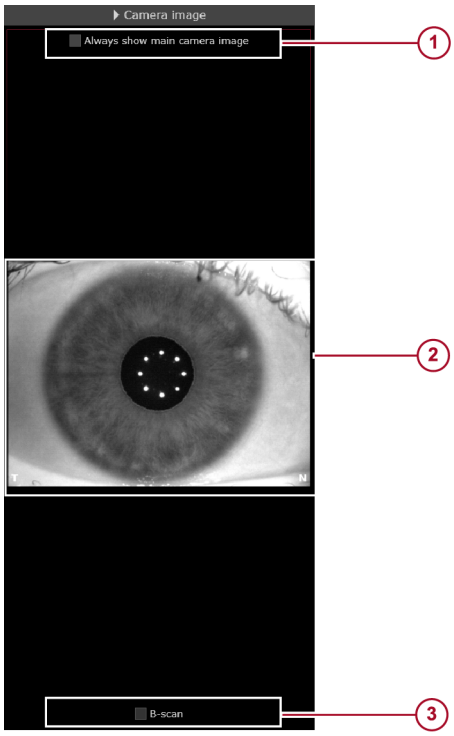


*Fig. 77: “Images” tab*

① *“Always show main camera image”* checkbox
② Camera image
③ Overlay options checkbox

In the *“Imaging”* app, the *“Camera image”* tab is always displayed.

The following overlay can be superimposed on the camera image ③ (Fig. 77):

- *“B-scan”*

**Showing the main camera image**

- To display the corresponding camera image of the OCT section images when scrolling through the OCT section images, leave the *“Always show main camera image”* checkbox ① (Fig. 77) unchecked.
- To always display the main camera image, select the *“Always show main camera image”* checkbox ① (Fig. 77).

### 12.2.3.4 *“Info”* Section

By clicking the *“Info”* button at the top of the analysis window, the *“Info”* tab is displayed in the *“More”* section. The following information is displayed:

#### *“Info”* tab

| Section | Entry | Description |
|---|---|---|
| *“Eye”* | *“Eye”* | Examined eye, OD or OS |
| | *“Cornea status”* | This parameter indicates whether an eye underwent corneal refractive surgery. |

| Section | Entry | Description |
|---|---|---|
| | *“Lens status”* | This parameter indicates the presence or absence of the eye's natural crystalline lens and, if applicable, the type of implanted artificial lens. |
| | *“Vitreous status”* | This parameter indicates whether there is a history of surgical intervention to the vitreous. |
| *“Acquisition”* | *“Mode”* | Indication of the used acquisition application |
| | *“Date”* | Examination date |
| | *“Time”* | Examination time |
| | *“Operator”* | Name of the operator that examined the patient |
| | *“System test”* | This parameter indicates whether the system test was valid, outdated, or failing at the time of the acquisition. |
| | *“Fixation light focus”* | Internal fixation light focus is an acquisition setting that allows for fixation light sharpness adjustments, based on an eye's refraction. |
| | *“Int. fix. light brightness”* | Internal fixation light brightness is an acquisition setting that allows for fixation light brightness adjustments, based on patients needs. |
| *“Acquisition quality”* Display of parameters depends on the application of the currently loaded scan. | *“Motion”* | Acquisition quality parameter indicating whether eye movements impacted the quality of the acquired scan(s). |
| | *“Fixation”* | Acquisition quality parameter indicating whether excessive fixation loss was presented during acquisition. |
| | *“Tear film and lid”* | Acquisition quality parameter indicating whether the eyelid(s) and/or the tear film impacted the quality of the acquired image(s). |
| | *“Camera image segmentation”* | Acquisition quality parameter indicating whether the camera image segmentation necessary for pupil diameter and WTW distance calculation succeeded. |
| | *“Refraction correction”* | Acquisition quality parameter indicating whether the automatic refraction correction necessary for accurate calculation of measurements succeeded. |
| | *“Required data points”* | Acquisition quality parameter indicating whether a minimum of data points within the central 3 mm zone was calculated. |
| | *“Axial length measurement”* | Acquisition quality parameter indicating whether the axial length measurement could be automatically determined. |

| Section | Entry | Description |
|---|---|---|
| | *“Tracking”* | Acquisition quality parameter indicating whether tracking was activated or not. Tracking is a technique that uses the camera image to detect eye movements during image acquisition, ensuring that each acquired OCT B-scan is centered on the corneal vertex. |
| *“Camera images”* | *“No. of images”* | This parameter indicates the number of images within a series. |
| | *“Main image”* | This parameter indicates the ID of the camera image that is used for calculation of WTW and pupil diameter. This is the camera image with the median pupil diameter. It is displayed when the option “Always show main camera image” is activated. |
| | *“Size”* | Size of the image in pixels |
| *“OCT section images”* | *“No. of images”* | This parameter indicates the number of images within a series. |
| | *“Scan length/No. of A-scans”* | This parameter indicates the scan length and the number of A-scans for the raw OCT section images. |
| | *“Lateral scaling”* | Pixel scaling in lateral direction of raw OCT section images. |
| | *“Axial scaling”* | Pixel scaling in axial direction of raw OCT section images. |
| *“Component versions”* | *“HEYEX (changed by)”* | Version of the HEYEX 2 software used for the most recent changes |
| | *“VWM (changed by)”* | Version of the viewing module used for the most recent changes |
| | *“AQM”* | Version of the acquisition module used for this examination |
| | *“SSC”* | Version of the installed scanning service controller |
| | *“FPGA (SSC)”* | Version of the installed field programmable gate array |
| | *“MCC”* | Version of the installed master component controller |
| | *“EPC”* | Version of the installed external periphery controller |
| | *“CSB”* | Version of the installed camera sensor board |
| | *“SMC”* | Version of the installed stepper motor controller |
| | *“DCB”* | Version of the installed display controller board |
| | *“Internal data format”* | Version of the internal data format |

| Section | Entry | Description |
|---|---|---|
| *“Device”* | *“Device serial number”* | Serial number of the device |
| | *“Sequence timestamp”* | Timestamp of the acquired image. This file name is used to store the corresponding raw data (sequence). |

#### 12.2.3.5 Overlay Options

At the bottom of the *“Single OD/OS”* view or in the *“More”* section, select the checkboxes of all parameters to be superimposed on the OCT section images and/or the camera images in the *“More”* section:

- *“A-scan”*
- *“B-scan”*

#### 12.2.3.6 Scrolling Through Images and Adjusting Brightness and Contrast

**Scrolling through the images**

The slider above the OCT section image ⑦ (Fig. 75) shows the number of OCT section images and the currently displayed image.

- To scroll through the OCT section images, use the *“B-scan”* slider.
- Alternatively, scroll through the OCT section images using the mouse wheel.
- To show the OCT section images as a slide show, click *“Play”*.

**Adjusting brightness and contrast**

The slider below the OCT section image ⑦ (Fig. 75) is for adjusting image brightness and contrast.

⚠ **WARNING! Carelessly adjusted image brightness and image contrast might lead to bad image quality.** Bad image quality may lead to incorrect diagnostic conclusions which may result in incorrect therapeutic approaches. Carefully adjust image brightness and image contrast.

- Drag-and-drop the slider to the desired position and increase or decrease the image brightness and contrast.
- To reset to the default values, double-click the slider.

### 12.2.3.7 Measuring Distances

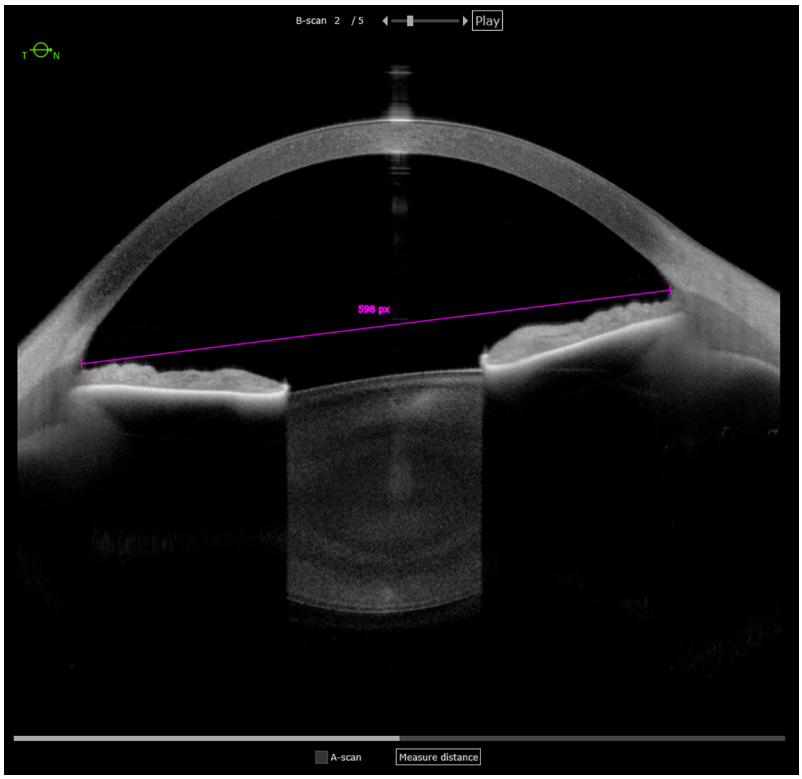


*Fig. 78: Measuring distances on OCT section images*

To measure distances in the OCT section image, the *“Measure distance”* overlay is available. Results are always displayed in pixels.

> **i** In the *“Imaging”* app, pixels are measured because refraction correction is not applied.

- Below the OCT section image, click *“Measure distance”*.
- Click where the start point of the measurement tool should be positioned.
- Click where the end point of the measurement tool should be positioned.

  The measuring line is displayed in pink.

  The value of the measured distance is displayed in pixels.
- To change the position of the overlay, drag-and-drop it to the desired position.
- To change the length of the overlay, hover with the mouse cursor over the start or the end point of the line and drag-and-drop it to the desired position.
- To delete the overlay, right-click it.

Manual distance measurements are not saved.

### 12.2.4 Analysis Window - *“Multi”* View

When opening the *“Multi”* view for the first time, the series used for opening the analysis window is displayed. In the *“Select series”* section, select the desired series for viewing.


*Fig. 79: “Multi” view*

1. Patient information (➞ 12.2.3.1 “Patient Information”, p. 184)
2. *“Report”* button (➞ 13 “Reports”, p. 192)
3. *“Info”* button (➞ 12.2.3.4 “ *“Info”* Section”, p. 186)
4. *“Settings”* and *“Default settings”* buttons (➞ 8.7 “Preparing the Analysis”, p. 33)
5. *“Close”* button
6. *“Select series”* section (➞ 12.2.3.2 “ *“Select series”* Section”, p. 185)
7. OCT section images (➞ 12.2.3.6 “Scrolling Through Images and Adjusting Brightness and Contrast”, p. 189)
8. Brightness and contrast slider (➞ 12.2.3.6 “Scrolling Through Images and Adjusting Brightness and Contrast”, p. 189)
9. *“More”* section (➞ 12.2.3.3 “ *“More”* Section”, p. 186) with camera image, scan pattern details, and overlay options checkboxes (➞ 12.2.3.5 “Overlay Options”, p. 189)

Refraction correction and parameter measurements are not applicable to images acquired in the *“Imaging”* app.

# 13 Reports

The following reports are available for printing from the acquisition window or the HEYEX 2 context menu:

**Acquisition window**

| Acquisition application | Report |
|---|---|
| *“Cornea”* | *“Cornea single report”* |
| | *“Cornea compact report”* |
| | *“Cornea refractive I report”* |
| | *“Cornea refractive II report”* |
| | *“Cornea keratoconus report”* |
| | *“Cornea elevation report”* |
| | *“Cornea wavefront report”* |
| *“Cataract”* | *“Cataract biometry and calculation single report”*<br>Prior to choosing a calculation template for printing a report from the acquisition window, an IOL calculation template has to be created in the analysis window. For further information on how to create an IOL calculation template, please refer to (➞ 10.2.5.2 “Saving as Templates”, p. 129). |
| *“Metrics”* | *“Metrics multi report”* |
| *“Imaging”* | *“Imaging single report”*<br>*“Imaging multi report”* |

The analysis window allows printing each customized view as report.

The following default reports are available for printing from the analysis window:

**Analysis window**

| Acquisition Application | Viewing option | Report |
|---|---|---|
| *“Cornea”* | *“Single OD/OS”* and *“Multi”* | *“Cornea single report”* |
| | | *“Cornea compact report”* |
| | | *“Cornea refractive I report”* |
| | | *“Cornea refractive II report”* |
| | | *“Cornea keratoconus report”* |
| | | *“Cornea elevation report”* |
| | | *“Cornea wavefront report”* |
| | *“Both eyes”* | *“Cornea OU report”* |
| | *“Follow-up”* | *“Cornea follow-up report”* |

| Acquisition Application | Viewing option | Report |
|---|---|---|
| | *"Multi"* | *"Custom report"*<br>A saved custom template can be selected as a report. For further information on how to customize a template in the *"Multi"* view, please refer to (➞ 9.2.7.2 "Customizing Templates", p. 86). |
| *"Cataract"* | *"Biometry OU"* | *"Cataract biometry OU report"* |
| | *"Calculation OU"* | *"Cataract spheric IOL calculation OU report"* |
| | | *"Cataract toric IOL calculation OU report"* |
| *"Metrics"* | *"Single OD/OS"* | *"Metrics single report"* |
| | *"Multi"* | *"Metrics multi report"* |
| *"Imaging"* | *"Single OD/OS"* | *"Imaging single report"* |
| | *"Multi"* | *"Imaging multi report"* |

## 13.1 Using Reports

**HEYEX 2**

- In HEYEX 2, select the desired patients and examinations in the *"Examinations"* list, or the desired series in the *"Series"* list.
- Right-click a selected examination or series.

  The context menu is displayed.
- In the examinations' context menu, select *"Batch functions* ► *ANTERION* ► *Print"*.

  In the series' context menu, select *"Print"*.

**Acquisition or analysis window**

- In the menu bar of the acquisition or analysis window, select *"Report"*.

  The preview window is displayed.

### 13.1.1 Previewing Reports

- If multiple reports or custom templates are offered for an examination, select the desired report or template from the drop-down list in the upper left corner of the displayed report.

  For further information on how to create a template, please refer to (➞ 9.2.7.2 "Customizing Templates", p. 86) or (➞ 10.2.5.2 "Saving as Templates", p. 129).
- To zoom into the report, click *"Zoom in"*.
- To zoom out of the report, click *"Zoom out"*.
- To view the entire document, click *"Whole page"*.
- To close the preview window, click *"Close"*.

### 13.1.2 Saving Reports

The following two options are available for saving reports:

- Saving reports as *"*.pdf"* files
- Saving reports as DICOM reports

▶ If multiple reports or custom templates are offered for an examination, select the desired report or template from the drop-down list in the upper left corner of the displayed report.

For further information on how to create a template, please refer to (➞ 9.2.7.2 "Customizing Templates", p. 86) or (➞ 10.2.5.2 "Saving as Templates", p. 129).

▶ To save the report as a *"*.pdf"* file in the Windows Explorer, click *"Save as"*.

The *"Save as"* window is displayed.

▶ Select a storage location and click *"Save"* to confirm.

▶ To save the report as a DICOM report in HEYEX 2, click *"Save in HEYEX"*.

The report is saved and displayed in the *"Reports/Documents"* tab of the *"Series"* section.

▶ To close the preview window, click *"Close"*.

### 13.1.3 Printing Reports

The following two options are available for printing reports:

- The *"Quick print"* option allows to print the report shown on the upper right part of the report window, using the default printer.
- Select *"Print"* to open the Windows print dialog for configuration before printing the report

▶ On the right side of the preview window, open the *"Printer"* drop-down list and select the desired printer.

▶ If multiple reports or custom templates are offered for an examination, select the desired report or template from the drop-down list in the upper left corner of the displayed report.

For further information on how to create a template, please refer to (➞ 9.2.7.2 "Customizing Templates", p. 86) or (➞ 10.2.5.2 "Saving as Templates", p. 129).

▶ To print the report immediately, click *"Quick print"*.

▶ To open the print dialog before printing the report, click *"Print"*.

The *"Print"* window is displayed.

▶ Select the desired printer.

▶ To start printing, click *"Print"*.

▶ To close the preview window, click *"Close"*.

# 14 Troubleshooting

## 14.1 Acquisition Window

| Error description | Cause | Action |
|---|---|---|
| *“AQM20: Internal software error”* | An internal software error occurred. | Contact your Heidelberg Engineering partner. |
| *“AQM21: Internal software error”* | An internal software error occurred. | Contact your Heidelberg Engineering partner. |
| *“AQM23: Could not create log file”* | Log file path or files have not been created correctly. | Contact your Heidelberg Engineering partner. |
| *“AQM24: Device infrastructure error”* | Necessary software components (e.g. TDI drivers or runtimes) are missing or were found in a wrong software revision. | Contact your Heidelberg Engineering partner. |
| *“AQM25: Requested image will exceed memory limits.”* | The selected image parameters will produce an image that exceeds the memory limits of the used system. | Contact your Heidelberg Engineering partner. |
| *“AQM32: General acquisition error”* | The acquisition has been interrupted due to an internal software error. | Switch the device off and on again. If the problem persists, contact your Heidelberg Engineering partner. |
| *“AQM38: Examination not accessible”* | An internal software error occurred. | Contact your Heidelberg Engineering partner. |
| *“AQM39: Examination protocol error”* | An internal software error occurred. | Contact your Heidelberg Engineering partner. |
| *“AQM47: Acquired data set could not be saved”* | The system does not offer enough free memory for saving examination data. | Upgrade your system with more memory. |
| *“AQM54: Please move camera unit to OD or OS position”* | The acquisition cannot be started or continued. | To examine the right eye, move the camera to the left. To examine the left eye, move the camera to the right. |
| *“AQM56: Imaging light source power too low”* | The light source power of the device is too low. | The message may appear after starting the device and disappears when the device has warmed up. If the message persists, contact your Heidelberg Engineering partner. |
| *“AQM62: System time appears to be invalid”* | The system time appears to be invalid in comparison to *“User.cf”* and *“Sphere.cf”*. | Contact your Heidelberg Engineering partner. |
| *“AQM79: Examination will be cancelled soon due to user inactivity”* | The message appears if the user is not active for 15 minutes or longer during patient alignment. The software returns to the start screen. | Select an acquisition app and continue. |
| *“CAL”*: Messages starting with the error code *“CAL”*. | Errors are described in the log files. | Contact your Heidelberg Engineering partner. |

| Error description | Cause | Action |
|---|---|---|
| *"GEN"*: Messages starting with the error code *"GEN"* | Errors having different causes, e.g. related to the hardware. | Switch the device off. Remove the power supply. Switch the device on again.<br>If the problem persists, contact your Heidelberg Engineering partner. |
| *"Acquisition quality"*<br>▪ *"Vertex out of alignment"*<br>▪ *"Too strong movement"*<br>▪ *"Cornea out of axial alignment"*<br>*"Do you want to repeat the acquisition or proceed?"* | Acquisition quality is reduced. The reasons are highlighted yellow and marked with a safety symbol. | Decide on a case-by-case basis, if you tap *"Repeat"* to discard and repeat the examination or *"Proceed"* to safe the examination and continue with analysis.<br>Always keep the patient history in mind when making the decision. |
| *"Acquisition quality"*<br>▪ *"Possible blinking"*<br>*"Do you want to repeat the acquisition or proceed?"* | Acquisition quality is reduced because the patient blinked during examination. *"Possible blinking"* is highlighted yellow and marked with a safety symbol. | Decide on a case-by-case basis, if you tap *"Repeat"* to discard and repeat the examination or *"Proceed"* to safe the examination and continue with analysis.<br>Always keep the patient history in mind when making the decision. |
| *"Axial length measurement"* | During examination, the axial length could not be automatically determined. For further information, please refer to (➞ 10.1.8.3 "Message *"Axial length measurement"*", p. 100). | Correct the retinal peak in the analysis window or enter the axial length value manually.<br>For further information, please refer to (➞ 10.2.4.9.1 "Editing the Axial Length", p. 122). |
| *"Camera image segmentation"* | The segmentation of pupil failed. The *"WTW"* and *"Pupil size"* parameters will not be available. For further information, please refer to (➞ 9.1.6.3 "Message *"Camera image segmentation"*", p. 56). | Decide on a case-by-case basis, if you accept the reduced acquisition quality or if you want to repeat the examination. |
| *"Device connection error"* | An error occurred during device connection. | Switch the device off. Remove the power supply. Switch the device on again.<br>If the problem persists, contact your Heidelberg Engineering partner. |
| *"Refraction correction"* | The refraction correction failed. No measurements are possible. For further information, please refer to (➞ 9.1.6.1 "Message *"Refraction correction"*", p. 56). | If the refraction correction failed, no measurements are possible. Heidelberg Engineering recommends reexamining the patient. |
| *"Required data points"* | The patient did not open his or her eyes wide enough during examination. For further information, please refer to (➞ 9.1.6.2 "Message *"Required data points"*", p. 56). | Reinstruct and reexamine the patient. |
| *"Scan performed despite failed system test. Examination results may be inaccurate!"* | You examined a patient although *"System test outdated. Please conduct system test."* is displayed in the acquisition window. | Perform a system test now. |

| Error description | Cause | Action |
|---|---|---|
| *"System test error"* | An error during system test occurred. | Repeat the system test.<br>If the problem persists, contact your Heidelberg Engineering partner. |
| *"System test outdated. Please conduct system test."* | The message will tell you when you performed the last successful system test. If you do not perform the system test now, examination results may be inaccurate. | Tap *"System test"* to perform a new system test now. If you cancel this message, *"System test outdated. Please conduct system test."* will be displayed in the acquisition window. |
| *"The current examination is not complete. If you leave the examination now the data will be lost. Press "Return" to return to the examination. Press "Discard" to discard the examination and proceed. "* | You closed the acquisition window before the examination was completed. | Tap either *"Return"* to complete the examination or *"Discard"* to discard the examination. |
| *"Tracking off"* | You disabled tracking manually due to patient's strong eye movements or for other reasons. Acquisition quality will be reduced. | Carefully review all examination results for accuracy.<br>Review all camera images for motion in the analysis window.<br>Check the accuracy of the segmented boundaries within the OCT section images in the analysis window. |

## 14.2 Analysis Window

### 14.2.1 *"Cornea"* App

| Error description | Cause | Action |
|---|---|---|
| *"1: Poor acquisition quality. Examination results may be inaccurate! See Info page for more details."* | One or more of the acquisition quality parameters were displayed in red, or tracking was disabled during the acquisition. | Decide on a case-by-case basis if the acquired data should be analyzed. Keep in mind that the examination results may be inaccurate. |
| *"2: Refraction correction not applied. No measurements in µm possible."* | During examination, the refraction correction failed. No measurement data is available. | If possible, repeat the examination. |

### 14.2.2 *"Cataract"* App

| Error description | Cause | Action |
|---|---|---|
| *"1: Poor acquisition quality. Examination results may be inaccurate! See Info page for more details."* | One or more of the acquisition quality parameters were displayed in red, or tracking was disabled during the acquisition. | Decide on a case-by-case basis if the acquired data and corresponding analysis should be used. Keep in mind that the examination results may be inaccurate. |
| *"2: Refraction correction not applied. No IOL calculations possible."* | During examination, the refraction correction failed. No measurement data is available and, therefore, IOL calculation is not possible. | If possible, repeat the examination. |

| Error description | Cause | Action |
|---|---|---|
| *"3: Segmentation(s) manually edited."* | Segmentation lines were manually edited. | Examination results may be inaccurate. |
| *"4: Post-incision astigmatism would be overcorrected by this IOL."* | The association of the incision location, induced surgical astigmatism and selected IOL may overcorrect the pre-incision astigmatism after surgery. | Select a different IOL or incision location to avoid corneal astigmatism overcorrection. |
| *"5: The residual astigmatism axis differs from the pre-incision astigmatism axis!"* | The calculated residual axis is lower or higher than the pre-incision astigmatism axis. | Configure a difference between the pre-incision axis and the residual axis of 5° or 10° for the *"Show warnings for toric calculator"* option.<br>For further information, please refer to (➞ " *"Cataract"* tab", p. 38). |
| *"6: The residual astigmatism would be higher than the pre-incision astigmatism!"* | Taking into account the selected toric IOL and surgically induced astigmatism, the residual astigmatism would be higher than the pre-incision astigmatism. | Select a different IOL or incision location to avoid inducing more corneal astigmatism. |
| *"8: Manual IOL alignment. Please mind residual astigmatism."* | The automatic suggested alignment has been changed manually. | Mind the residual astigmatism. |
| *"9: Poor axial length acquisition quality. IOL calculations may be inaccurate!"* | The examination quality is poor due to poor fixation or macular pathologies. | Reexamine the patient, if possible. If it is not possible to acquire images of higher quality, then keep in mind that the examination results may be inaccurate. |
| *"10: ACD parameter missing. IOL formula cannot be applied."* | ACD information is missing and the selected formula uses this parameters for IOL calculation. | Either select a different IOL formula or reexamine the patient to receive ACD information. |
| *"11: Camera image segmentation failed."* | The camera image segmentation failed due to poor fixation or important changes in the anterior segment anatomy.<br>The pupil diameter and pupil center parameters, and the WTW values will be missing. | Reexamine the patient, if possible. If reexamination is not possible, decide as to whether the acquired data and the corresponding analysis can be used reliably. |
| *"13: Parameters might be less accurate or missing due to selected eye status."* | Changes in the anterior segment anatomy may affect the segmentation and parameter calculation.<br>Axial length values are not displayed for a *"Phakic IOL"*, or a *"Piggyback IOL"* lens status, and for *"Silicone oil"* or *"Gas in vitreous cavity"* vitreous status.<br>Automatic lens segmentation is disabled for a lens status other than *"Phakic"*. | Examination results may be inaccurate. |

| Error description | Cause | Action |
|---|---|---|
| *“14: System test older than 1 day. Examination results may be inaccurate!”* | Every 24 hours, the device must pass through a system test in order to ensure that certain technical specifications are verified to be accurate and reconfigured, if necessary. | Perform a system test. Heidelberg Engineering recommends that the system test is initiated prior to use of the device. |
| *“15: System test older than 30 days. Examination results may be inaccurate!”* | Every 24 hours, the device must pass through a system test in order to ensure that certain technical specifications are verified to be accurate and reconfigured, if necessary. | Perform a system test. Heidelberg Engineering recommends that the system test is initiated prior to use of the device. |
| *“16: Scan performed despite failed system test. Examination results may be inaccurate!”* | Every 24 hours, the device must pass through a system test in order to ensure that certain technical specifications are verified to be accurate and reconfigured, if necessary. | Perform a system test. Heidelberg Engineering recommends that the system test is initiated prior to use of the device. |
| *“18: IOL formula is not recommended for the selected eye status.”* | The selected IOL formula is not recommended for the selected eye status. | Select a different IOL formula for calculating the IOL. |
| *“19: Ambiguous peak. Please manually select a peak by double-clicking the axial length diagram or enter the axial length value directly.”* | During examination, two or more retinal peaks have been detected. | Select a peak or enter the axial length value manually. For further information, please refer to (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122). |
| *“20: Insufficient retinal signal. Please enter the axial length value manually.”* | During examination, no retinal signal could be detected. | Enter the axial length value manually. For further information, please refer to (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122). |
| *“21: Axial length value entered manually.”* | A manually entered axial length value is used for IOL calculation instead of the value calculated by ANTERION. | Verify that the entered value is compatible with the IOL formulas used by ANTERION. For further information, please refer to (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122). |
| *“22: Axial length peak manually edited.”* | A manually changed axial length peak is used for IOL calculation instead of the value calculated by ANTERION. | Verify that the changed peak is compatible with the IOL formulas used by ANTERION. For further information, please refer to (➞ 10.2.4.9.1 “Editing the Axial Length”, p. 122). |
| *“OKULIX export failed.”* | The write access on the target drive may be limited or missing. | Contact your Heidelberg Engineering partner. |
| *“Import master IOL database failed”* | If the master IOL database import fails, the *“AccessDatabaseEngine_X64”* may be missing. | To install the missing files, double-click *“C:\Heyex\Service \AccessDatabaseEngine_X64.exe”*. |

### 14.2.3 *“Metrics”* App

| Error description | Cause | Action |
|---|---|---|
| *“1: Poor acquisition quality. Examination results may be inaccurate! See Info page for more details.”* | One or more of the acquisition quality parameters were displayed in red, or tracking was disabled during the acquisition. | Decide on a case-by-case basis if the acquired data should be analyzed. Keep in mind that the examination results may be inaccurate. |
| *“2: Refraction correction not applied. No measurements in µm possible.”* | During examination, the refraction correction failed. No measurement data is available and, therefore, IOL calculation is not possible. | If possible, repeat the examination. |
| *“3: Segmentation(s) manually edited.”* | Segmentation lines were manually edited. | Examination results may be inaccurate. |

 

# 15 Index

 

 