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Additional Information

VisualEyes™ 505

Micromedical
by Interacoustics

Interacoustics

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Table of Contents

1 Basics to Perform Tests

1.1 Moving through VisualEyes™

VisualEyes™ 505 software suite is compatible with both touch capable (Figure 1.1.1) and standard (non-touch) computer systems. Maneuvering through the software can be done by touch, mouse, keyboard, foot pedal and remote control.

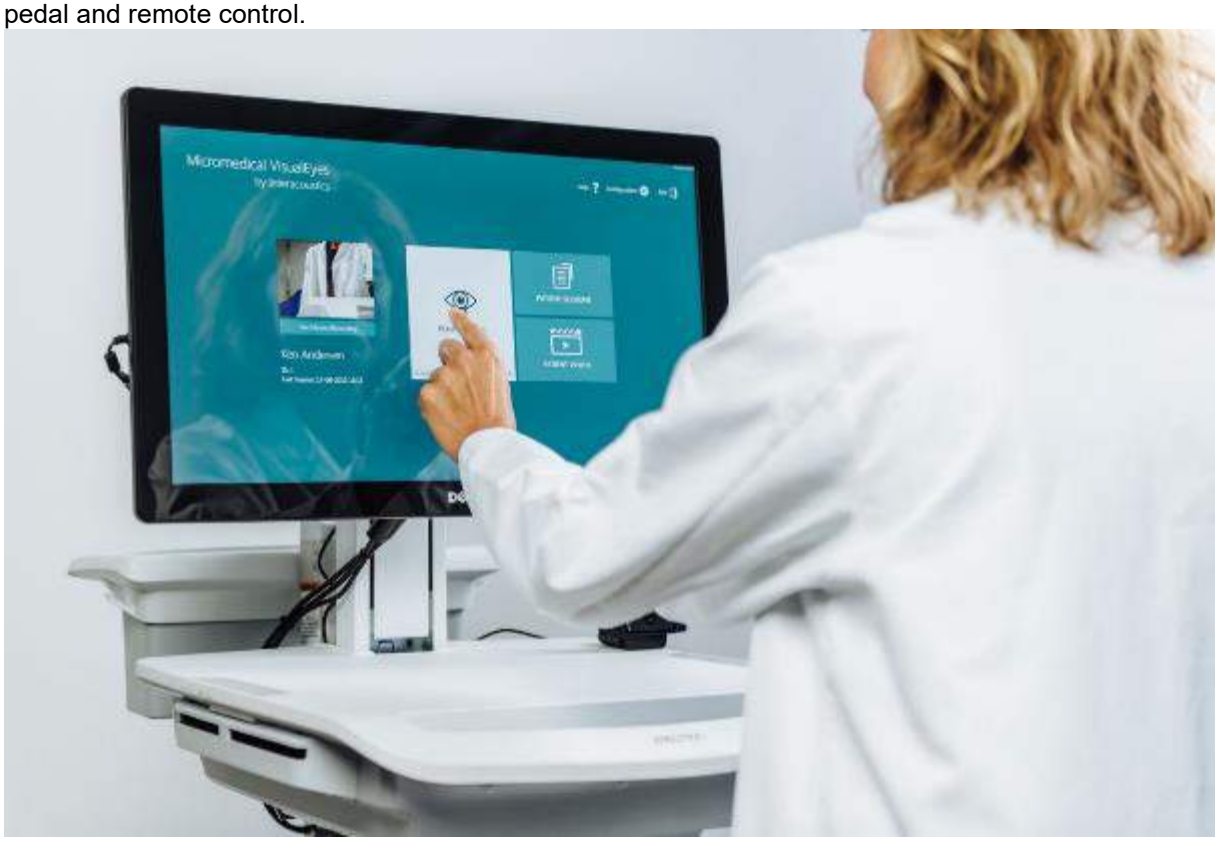


Figure 1. 1. 1 Touch user interface

1.2 Begin testing

To begin the testing process, from the main screen select the **Begin Testing** button (Figure 1. 2. 1). The software will enter the first test of the selected or default protocol. The protocol used can be changed by using the drop-down box below the Begin Testing button. VisualEyes™ 505 systems use the default "VisualEyes™ 505" protocol preconfigured (Video Frenzel, spontaneous nystagmus).

The test battery can be customized with additional tests being compatible with other additional components such as VORTEQ™ IMU / VORTEQ™ rate sensor with VLink or EyeSeeCam.

- Dix Hallpike Advanced
- Lateral head roll
- Dynamic Visual Acuity (DVA)
- ESC vHIT

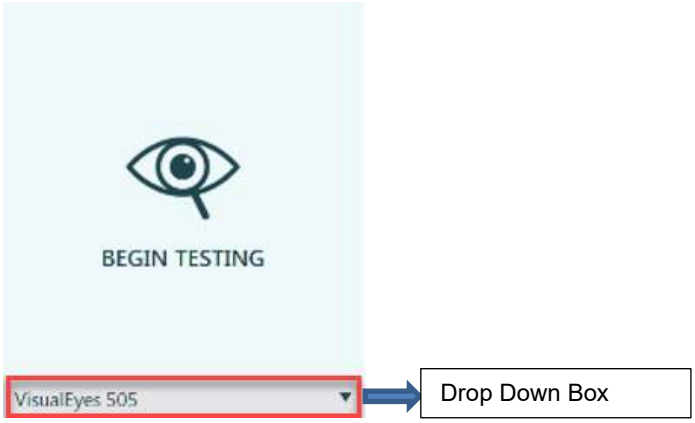


Figure 1. 2. 1 Begin Testing button with protocol selected

The software further allows creating and customizing other protocols as desired by the clinician and or need for a particular patient. The process of creating custom protocols can be found in Chapter 9 Protocols and test settings.

To return to the main screen during testing, click or touch the Home button (Figure 1. 2. 2). This will allow the user to access System Default Settings to change settings (e. g. switch the fixation light side), Protocol Management for adding tests or change protocols from below the Begin Testing button.

Figure 1. 2. 2 Home button

1.3 Starting a test

Tests can be started in multiple ways:

- Click the **Start** button on the Test Screen. This option is available for all tests.
- Press the **Enter** button on the RF Remote (if available). Ideal for starting the test when not at the computer. This option is available for all VNG tests. Rotational chair tests do not respond to the RF Remote's **Enter** button as a patient safety measure.
- Press the **Goggles Switch** on the side of the goggles. The Top mount camera goggles switch is ideal for starting the test when at the patient's side such as in Dix-Hallpike and Positional tests.
- Press the **foot pedal** (if available). Ideal for starting the test when not at the computer. This option is available for all tests. Care should be taken if using the foot pedal with the reclining chair that the foot pedal is far enough away from the reclining chair for the operator to not be injured from the chair in rotation.

Moving through the screens

- Test menu ☰ which is in the right up corner of test navigation bar allows a user to view current test session.
- Home button will return to the main screen
- The up-arrow button will exit current subtest and go to the individual subtest summary screen (Figure 1. 3. 1)
- The settings icon which is present next to up-arrow allows a user to adjust the parameter for the test temporarily. (Figure 1. 3. 1)
- Remote control will navigate the buttons in pop up message windows, allowing the user to respond to pop up messages with the remote control

Restarting the test:
Tests can be restarted using the Esc key on the keyboard or the RF Remote. While the test is running, the Esc key or ESC key on the RF Remote will abort the data collection and clear the data already collected.

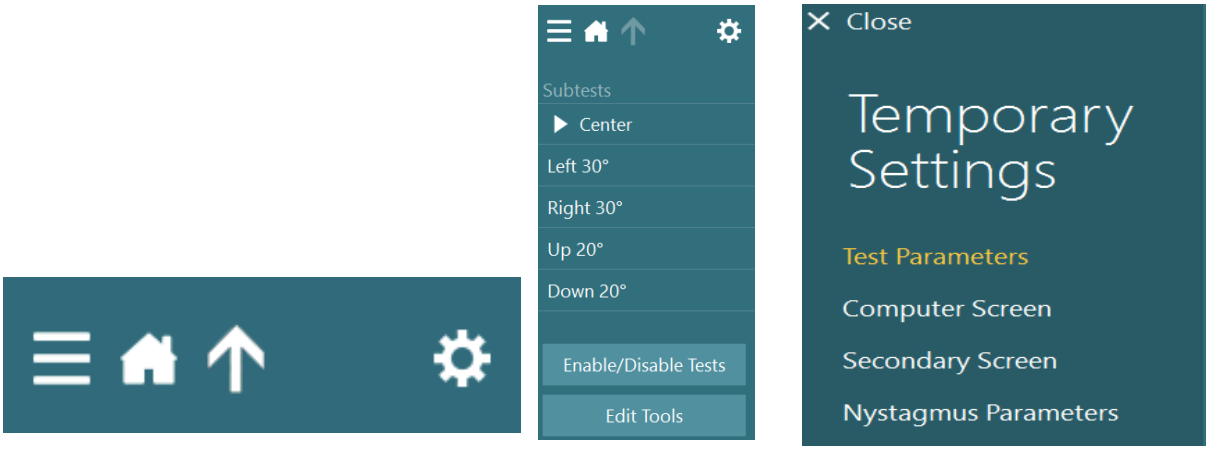


Figure 1. 3. 1 Test Navigation Bar, Test summary with all subtests if applicable, Temporary setting option (left to right)

Caution
No other PC programs should be running or minimized while testing the patient with the software. This can interfere with the running of the VisualEyes™ Software.

1.4 Session tree

Clicking icon will display the list of tests in the current session. The test listed in yellow is the active test. Tests that have been completed are given either a green checkmark or a red diamond depends on the test results. This also means those are the tests with data In case the operator decides to change the test result, she/he can manually change the green checkmark into a red diamond with green pencil and vice versa by clicking or touching the that icon in the menu (Figure 1. 4. 1). Clicking or touching the test title will navigate to the desired test.

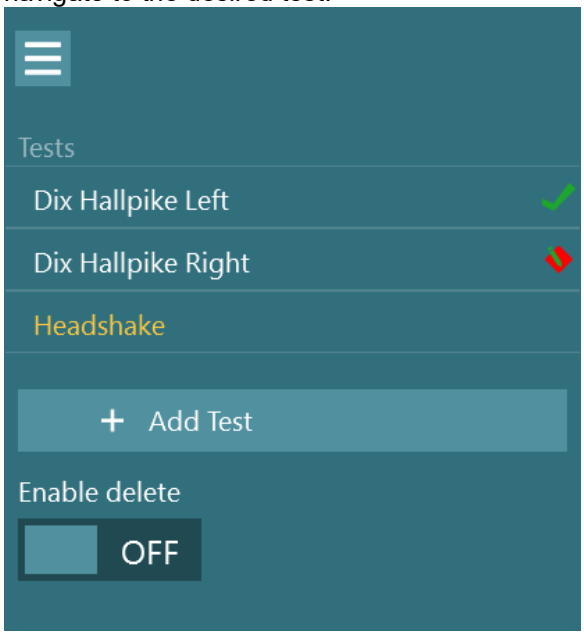


Figure 1. 4. 1 Session tree displaying tests completed

1.5 Eye image adjustment

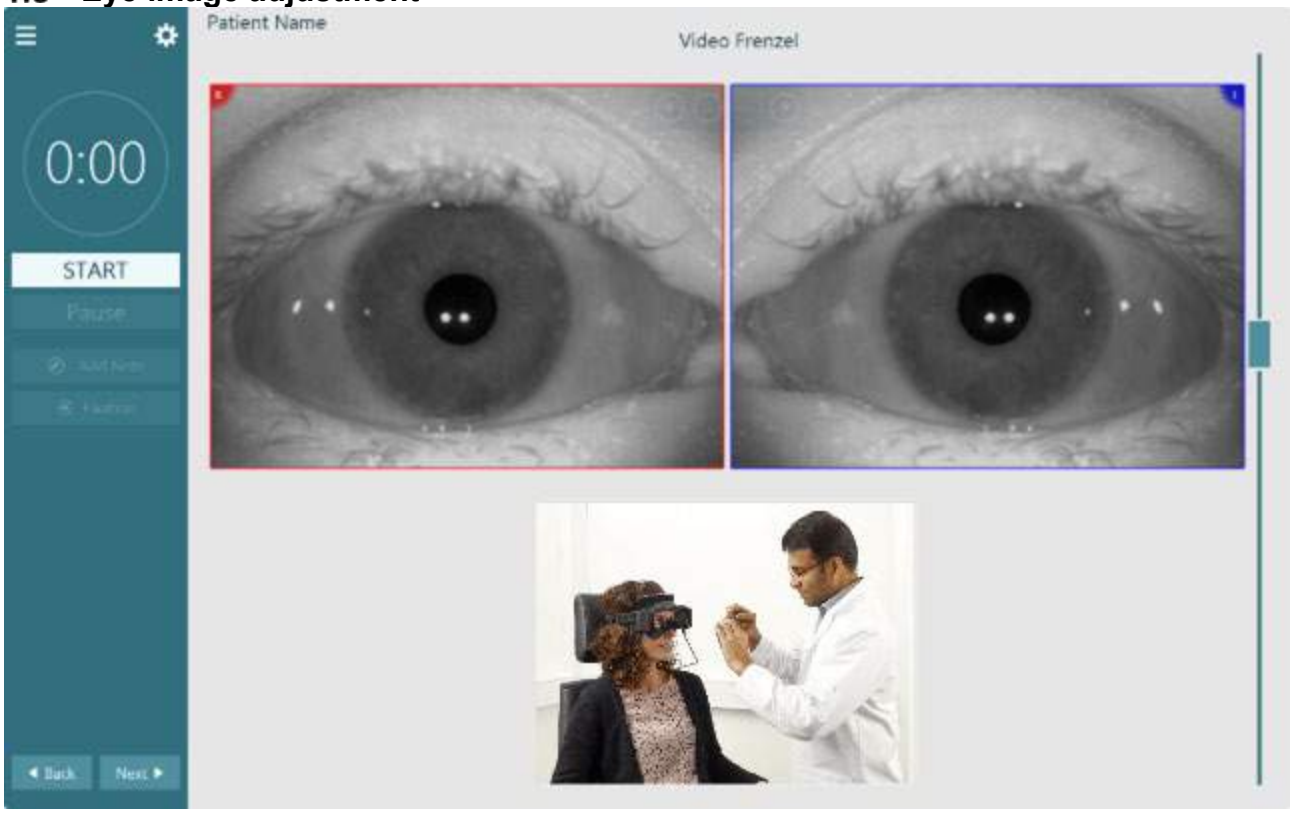


Figure 1. 5. 1 Test screen display (Video Frenzel)

To user can see the patient's eye image, as soon as **Begin Testing** option is selected from the main menu display. This will open the first test and the image of the patients eyes (Figure 1. 5. 1) will appear in the upper portion of the user display. Prior to starting the testing procedure, it is desirable that the eye images are aligned (horizontally/vertically) so that the pupil is centered in the observed eye image.

Looking at the display screen of the eyes, one should be able to see the inner canthus right eye in the right side of the image (red outlined eye image), and the eye corner of the left eye should be immediately next to it (blue outlined eye image). There are also letters in the top corners indicating L- Left and R- Right.

NOTICE Prior to launching VisualEyes™ make sure that the cameras are connected If the user couldn't view the eye image it indicates that cameras are disconnected and an informational status will be displayed as shown in the Figure 1. 5. 2.

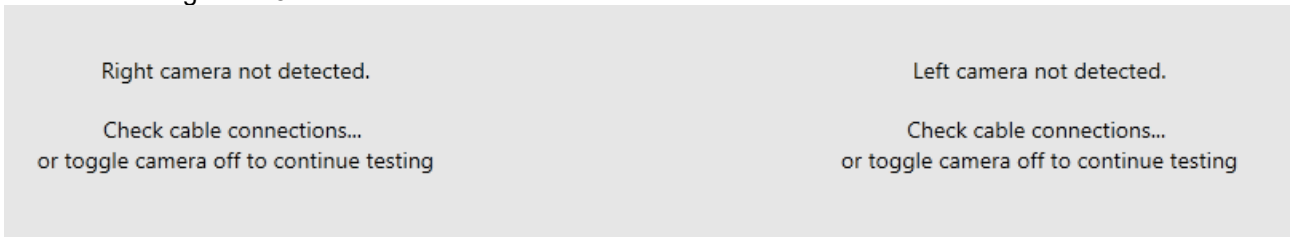


Figure 1. 5. 2 Disconnected camera/s warning

This can happen any one or both the cameras, in that case check the camera cables to make a solid connection between the camera and the computer.

How to adjust eye image using Side-Mounted Camera Goggles
Horizontal and vertical pupil position in the video image can be adjusted by moving the camera within the camera cabinet. To do so, use the knobs fixed to the side of the camera (side-mounted camera goggles) modules (Figure 1. 5. 3).

Figure 1. 5. 3 Adjustment knobs for side mount camera for regulating image and focus

1. The upper knob regulates the image in the vertical plane.
2. The left knob adjusts the image in the horizontal plane.
3. The center knob adjusts the focus of the image.

The mirrors can also be rotated inward by holding the mirror edges. A gentle inward rotation of mirrors can help to adjust for smaller faces and narrow inner-canthal spaces (e. g. with children). When the mirrors are rotated, the image may need to be re-centered and may need focus adjustment. (Figure 1. 5. 4).

Figure 1. 5. 4 Mirror adjustment for smaller faces narrow inner canthal spaces

How to adjust eye image using Top-Mounted Camera Goggles

When the top-mount camera goggles are used, the user can see a ‘Center eyes’ icon in the screen where the eye images are displayed. By clicking or touching the center eyes icon (Figure 1. 5. 5), the eye images will be centered.

Figure 1. 5. 5 Center eyes button

Front-Mounted Camera Goggles

Position the front mounted camera unit on the viewport with the fixation light at the top center (Figure 1. 5. 6). Use the ball and socket mechanism on the camera unit to aim the camera and center the eye image approximately in the software. Next, with one hand on the back of the patient’s head, push in gently on the camera to lock it in place. Lock the cable in the clip on top of the goggles.

Figure 1. 5. 6 Placement of Front Mount Camera in Goggles

How to adjust eye image using EyeSeeCam camera Goggles

When the ESC camera goggles are used, move the whole camera unit to adjust the camera images in the screen (Figure 1. 5. 7).

Figure 1. 5. 7 ESC cameras adjustment knobs for regulating image

1.6 Focus adjustment

VisualEyes™ 505 requires a focused eye image for the pupil tracker to locate the pupil center to optimally record the eye movements. The pupil center is marked with a crosshair (Figure 1. 6. 1).

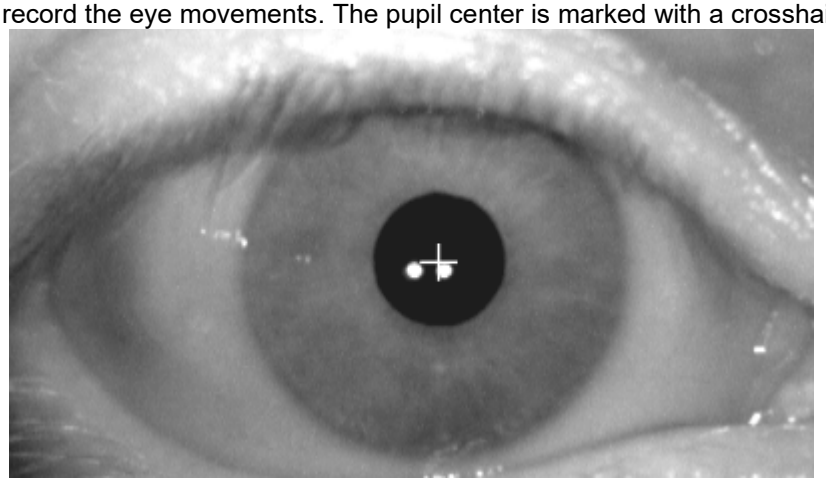


Figure 1. 6. 1 Focused eye image (crosshair)

The camera image can be focused by adjusting the focus knob on each camera (Figure 1. 6. 2). Each image must be adjusted separately. Turn the knob clockwise or counterclockwise while watching the image on the screen. Stop turning the knob when the image is clear and the eye appears to be in focus.

If the image is not optimally focused, the pupil tracker may fail to adequately record the eye movements which may lead to poor results.

NOTICE *This crosshair will also be present in the review videos for easier discrimination between abnormalities and technical difficulties.*

Figure 1. 6. 2 Adjustment control for focusing eye image on each camera

1.7 Eye image contrast adjustment

The VisualEyes™ 505 system automatically adjusts the threshold (contrast), in order to display an optimized eye image. Nevertheless, in some cases it might be necessary to adjust the threshold. In these cases, turn off the automatic threshold adjustment before starting recording or even during recording by clicking the threshold adjustment button (Figure 1. 7. 1). The button will be shown when the user touches the eye image or places the mouse over the eye images.

Figure 1. 7. 1 Threshold adjustment button

Scrollbars will appear for left and right eyes. Using these scrollbars, adjust the threshold for better contrast anytime it is required. This is done separately for the left and the right eye (Figure 1. 7. 2). To reset back to automatic threshold click the  icon below each slider.

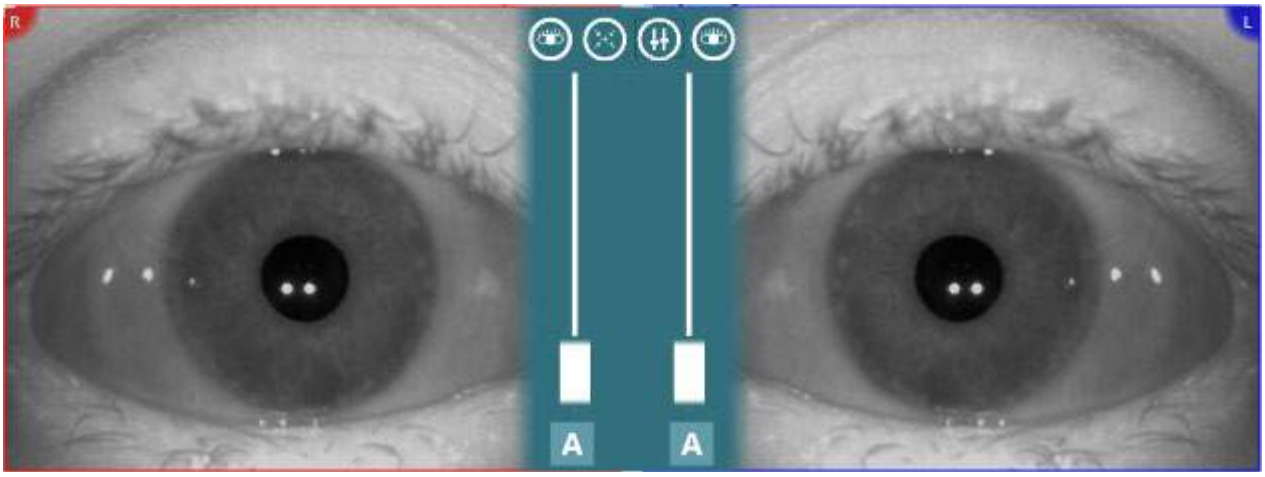


Figure 1. 7. 2 Scrollbars for threshold adjustment

1.8 Monocular vs binocular eye recordings

VisualEyes™ 505 system can record in either monocular (one camera) or binocular (two cameras) mode. Monocular mode may be beneficial for those occasions where you need to run a single eye test because one eye may be unable to be tested (i. e. artificial eye or severe ptosis). A specific eye can be selected by clicking on the desired right/left eye icon (Figure 1. 8. 1, Figure 1. 8. 2, Figure 1. 8. 3).


Figure 1. 8. 1 Eye selection menu

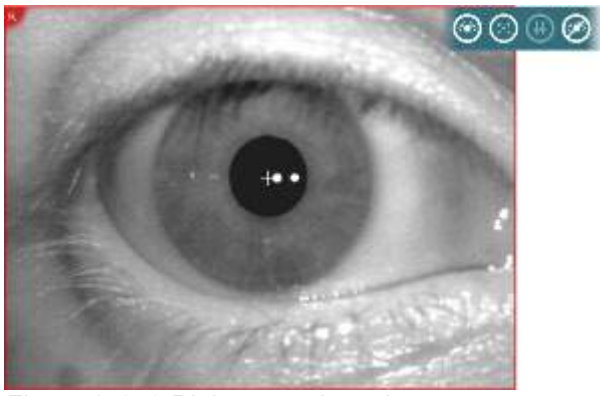


Figure 1. 8. 2 Right eye selected

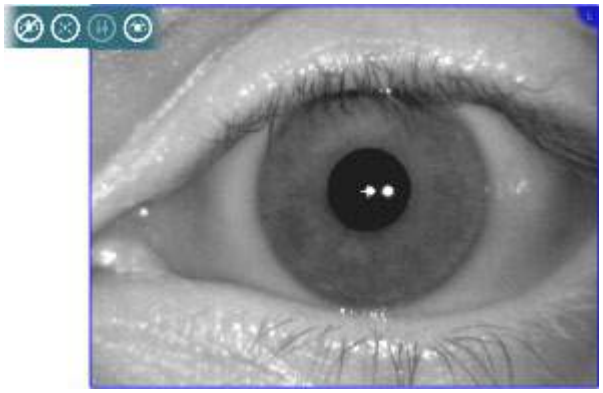


Figure 1. 8. 3 Left eye selected

1.9 Eye tracker Selection

VisualEyes™ 505 system can utilize different tracking methods depending on the test performed and the patient's eyes. The crosshair button in the eye tools menu allows the user to change the eye tracker when needed.

- Curve Tracker – Standard eye tracker using a curve recognition algorithm for isolating the pupil outline
- IPM Tracker – Blob analysis eye tracker for locating the pupil center for high speed VHIT tracking
- Convex Hull Tracker – Eye tracker with geometric compensation for torsion tracking. Also recommended for large pupil tracking e. g. with pediatric testing.
- EyeSeeCam Tracker – Eye tracker used with EyeSeeCam camera for high speed VHIT tracking (exclusive for ESC and it preslected, so no need to select anything in the software)

When the test is complete, the eye tracker will be listed in the Temporary Settings for reference.

1.10 Common test functions

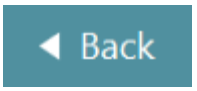
The following basic test functions apply to all tests within VisualEyes™ 505 system.

Start – Begins the testing procedure (video and eye trace recordings).

Stop – Stops the testing procedure (video and eye trace recordings).

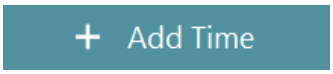
Next – Moves onto next test/subtest in the protocol.

Back – Moves back one test/subtest in the protocol.



Timer - During testing (all tests) the timer will display how much time has elapsed or remains in the current test based on Count Style. Based on the default system settings, the timer will provide audible beeps and voice prompts at indicated intervals to prompt the examiner and provide audible feedback for the elapsed or remaining time in the test. To change these settings, see the section 10. 4 Test type settings.

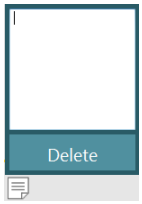
Add Time - Further time may be added to the test during the procedure by pressing the **Add Time** button. This will add a further 30 seconds (default) to the time remaining on the counter.



1.11 Add Note

One can insert a note at a specific point in the raw trace, during or after testing by selecting **Add Note** (Figure 1. 11. 1). This can also be used as an event marker to identify a unique event within the recording.

The time at which the note is inserted is shown with the symbol  The text for note taking is limited to 33 characters. It will be hidden in the traces, but will be uncovered when hovering over or clicking on the note symbol. When printing the test in the report, the note added will be displayed after the graphical printouts. The user can also delete the note using delete option which is seen under the note.



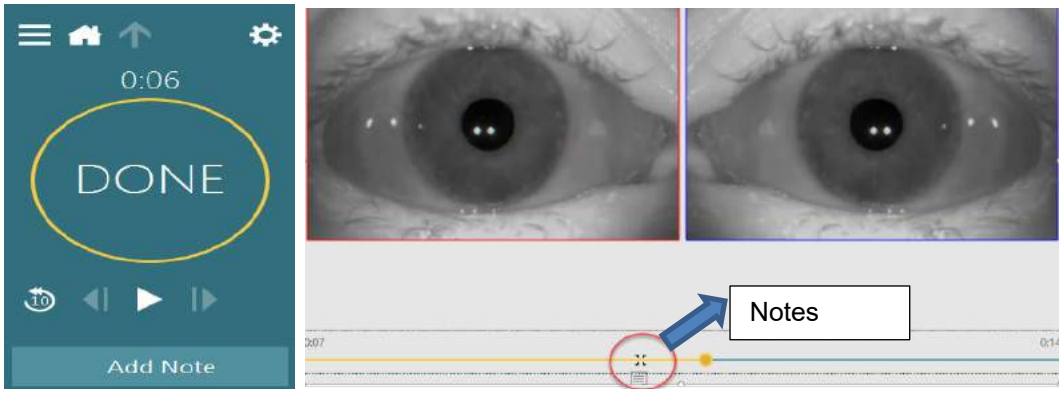


Figure 1. 11. 1 Add Note button and The location of note during the test.

1.12 Fixation suppression

There may be times in certain tests where a fixation light is presented to the patient to differentiate peripheral from central abnormalities.

The fixation light can be turned on manually (Figure 1. 12. 1) by the examiner by pressing the 'Fixation' button or by using the remote control.

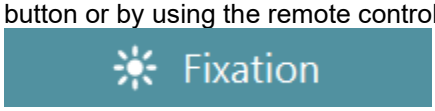


Figure 1. 12. 1 Fixation light button

The fixation light can also be set to be displayed in either left or right eye (default is left eye). This allows the examiner to select the better eye for fixation, particularly in those patients with visual impairments. This setting can be changed from the System Default Settings screen.

A yellow bar appears in the timeline when reviewing the test to mark the duration of the fixation light (Figure 1. 12. 2). The length of the bar determines the length of time the fixation light was active.

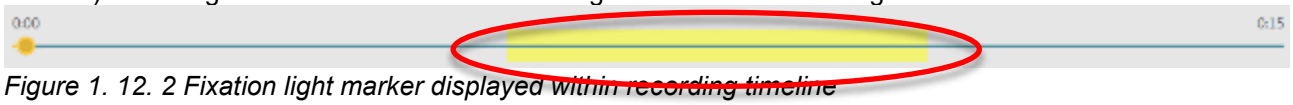


Figure 1. 12. 2 Fixation light marker displayed within recording timeline

1.13 Add Tests or Delete Tests

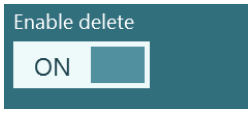
Each test has 'Test menu' in left up corner of test panel. If you click 'Test menu' the user can view the current test session with a test list.

To Add Tests

At the end of the test list, the user can find **Add Test** button and this allows a user to find the list of tests to make his choice. Once the test is selected, it is added to the bottom of the patient's test session.

Delete Tests

The user can also delete and/or replace any test (with or without data) the session to make new customized test list. To delete any test, the user should activate the '**Enable delete'** option which is at the end of the test list.



 symbol appears besides each test in the test lists. This allows the user to delete any test of his/her choice. Clicking or touching this symbol will remove the test from the session. The current test cannot be deleted (Figure 1. 13. 1).

NOTICE: Current test will be highlighted with yellow color and cannot be deleted. Once deleted, the test data cannot be recovered.

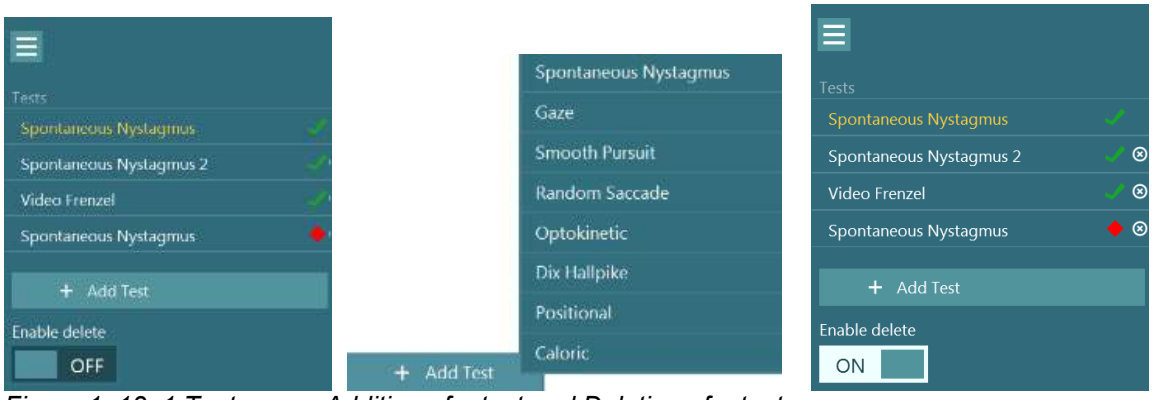


Figure 1. 13. 1 Test menu, Addition of a test and Deletion of a test

1.14 Repeating tests

A test can be repeated or replaced. After the test is completed, the user can click on the Repeat Test button (Figure 1. 14. 1). The software will ask if the test should be overwritten or a new test instance should be created to repeat the test. If the test is overwritten, the name will remain the same. If the test is repeated, then the name will have a number at the end of the test signifying the repeated status (Figure 1. 14. 2, e. g. Dix-Hallpike Advanced).

Figure 1. 14. 1 Repeat Test button

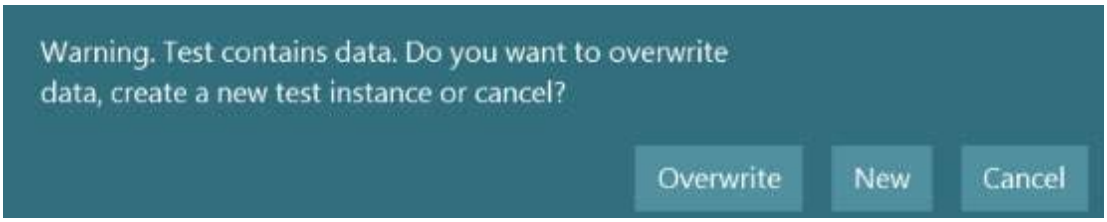


Figure 1. 14. 2 Overwrite or Repeat Confirmation Prompt.

1.15 Test review

Once the operator has ended the test, the software will allow the operator to review the patient's response during the test. The test review screen contains the playback menu, timeline, eye and room video recordings. The eye videos and room camera video are played synchronously from the Test Review screen. The playback will begin by clicking on the play button in the playback menu. As the test plays back, a yellow circle will show the current position of the video on both the timeline and the playback timer. This circle can be grabbed or dragged with the mouse to jump to a new location in the video playback. The size slider is available during the test review, allowing the user to make the eyes or the room camera video larger dynamically to focus on the selected video during playback (Figure 1. 15. 1).

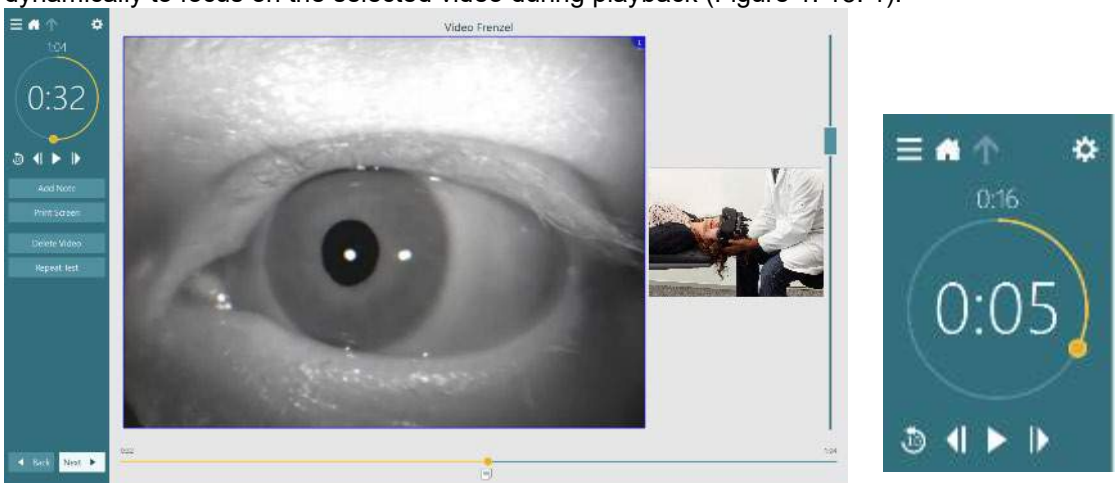


Figure 1. 15. 1 Test Review screen

Go to previous frame (hold to play backwards in slow motion).

Play/pause.

Go to next frame (hold to play forwards in slow motion).

Go back 10 secs in video playback.

1.16 Switching eye recorded in monocular systems

VisualEyes™ 505 system can be configured as a monocular system using one camera with the side-mount camera goggles or using the front-mount camera goggles. While the VisualEyes™ 505 system will show the single camera as the left eye, either eye can be recorded.

Front-mount camera goggles require removing the USB cable from the cable clip on top of the goggles, then move the camera to the portal for the eye to record. Press the camera into the portal with the UP label shown on the top of the camera (Figure 1. 16. 1).

Figure 1. 16. 1 Front mount camera goggles with camera in right eye portal

Side-mount camera goggles require removing a hex screw using the included hex tool from the bottom of the camera housing. Remove both the camera module and the empty module, then switch the modules and reattach (Figure 1. 16. 2).

Figure 1. 16. 2 Side-mount camera goggles hex screw for attaching camera module

1.17 General test display

VisualEyes™ 505 system offers an easy way to visualize video eye and room recordings during testing and review. The general display shows the eye images in the top portion of the screen and directly below it the room recording (Figure 1. 17. 1). The eye images are presented in real time with room recording. The right eye can be viewed in the red box and the left eye can be viewed in the blue box. The room recording is displayed in the box below the eye cameras.

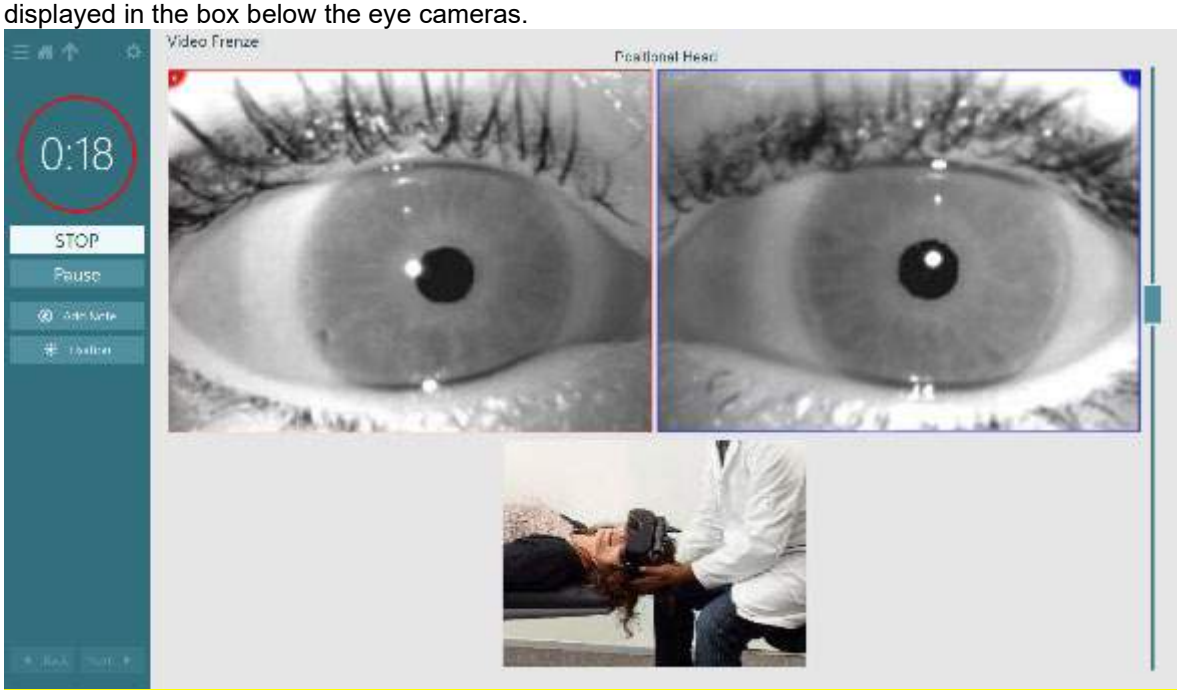


Figure 1. 17. 1 Example of general video Frenzel display

The test can be renamed if desired, such as for tests added directly to the session tree, by clicking or touching the test name at the top of the screen and entering a new name with the keyboard (Figure 1. 17. 2). When finished, press the Enter key on the keyboard or click outside of the text to complete the change.

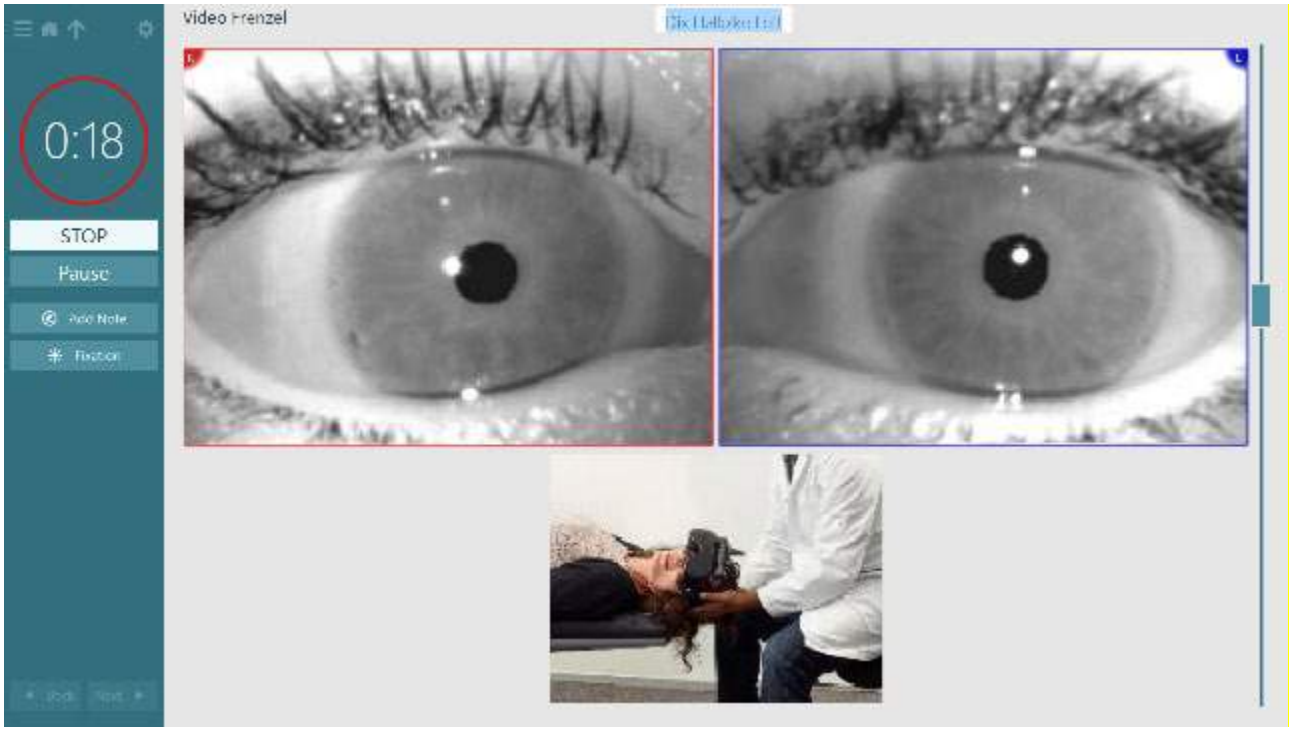


Figure 1. 17. 2 Changing test name dynamically

Adjustments can be made to the display proportions between eyes and room recording by moving the slider on the vertical scroll bar (Figure 1. 17. 3).

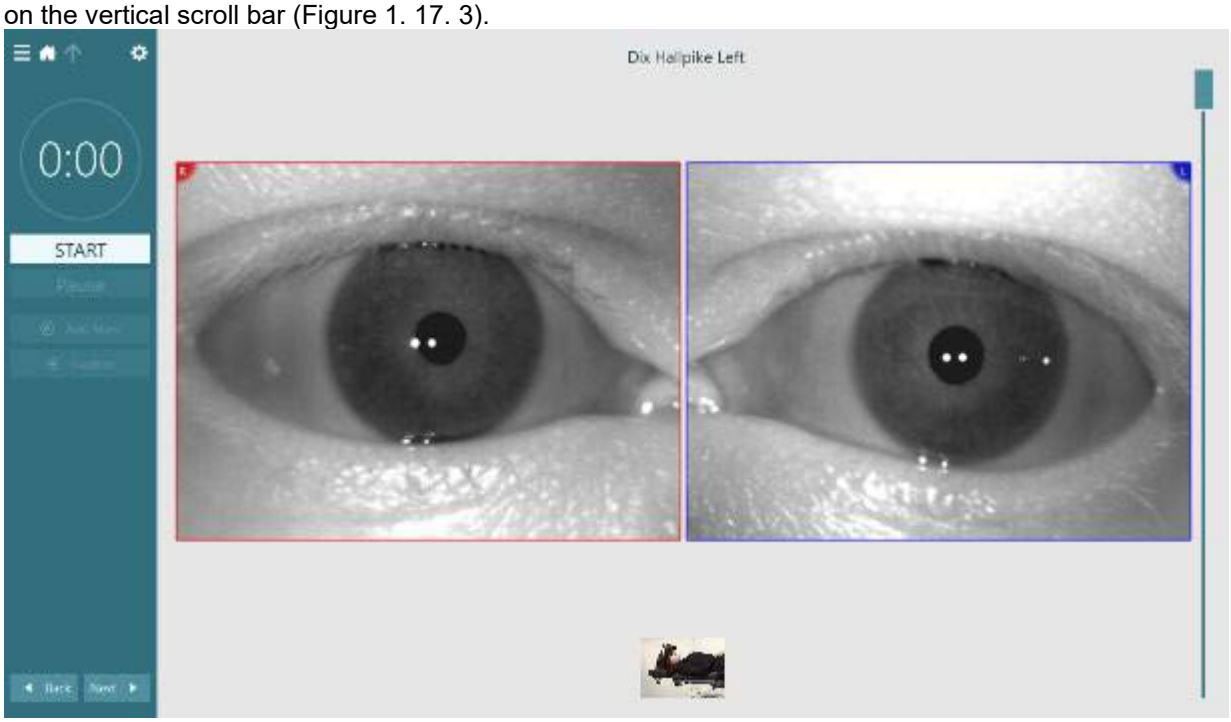


Figure 1. 17. 3 Eyes enlarged and room display reduced

Move slider upwards to shrink the room recording window and enlarge the eye display (Figure 1. 9. 3).

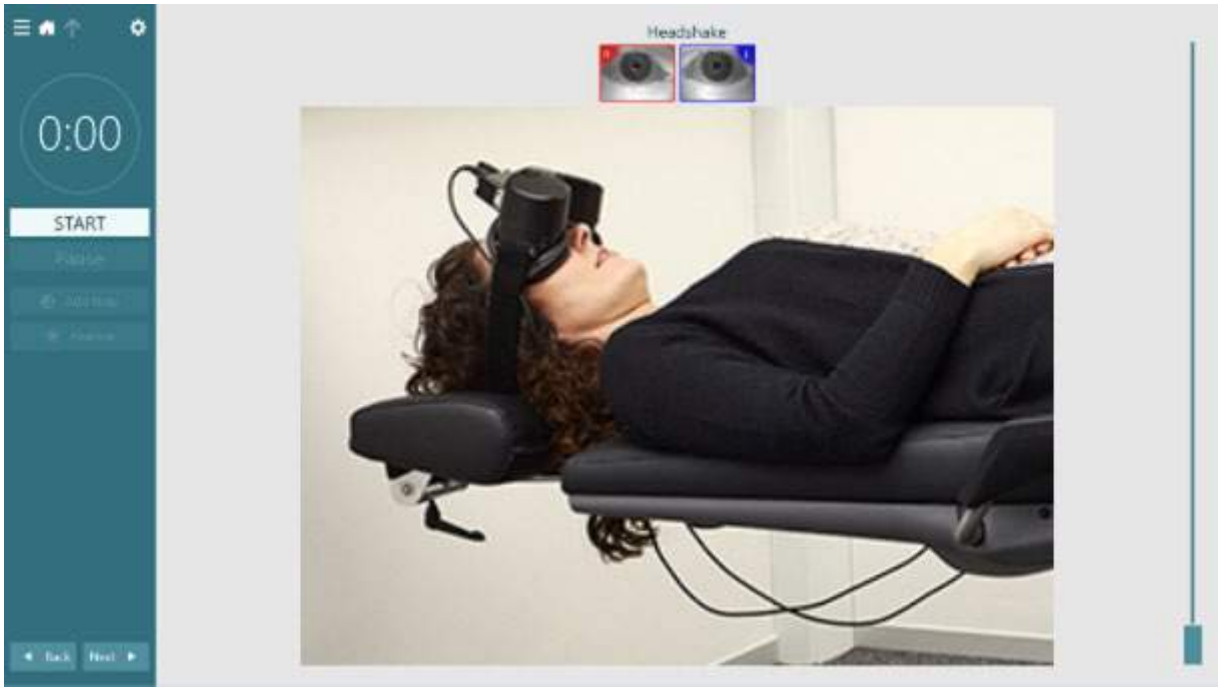


Figure 1. 17. 4 Eyes reduced and room display enlarged

Move slider downwards to enlarge room recording display and shrink the eye display (Figure 1. 9. 4).

2 Calibration

Note: The calibration is not required to be done for Video Frenzel test. If the user has secordary screen option s(e. g. TV, DLB and etc. ,), they can still perform the calibration for Spontaneous nystagmus test. Also if user has any add on modules for VisualEyes™ 505 system, they can perform the appropriate calibration procedure according to their licence and available test options.

Calibrations are particularly important in tests where eye movements are compared with a given stimulus of a known position and/or velocity. Calibration can be performed on both eyes (binocular) or individually (monocular) by turning off the non-essential eye or using a monocular goggle. Calibration is strongly recommended for all tests to accurately measure the velocity of the nystagmus.

2.1 Source selection

Before selecting 'calibration option', user has to select the hardware source (Top mounted goggles / Side mounted goggles / Front mounted goggles / ESC / Pediatric observation camera / Datalink) using 'select source' option (Figure 2. 1. 1). The options are based on their user license.

After selecting the data source, select the stimuli (TV / DLB / Laser and drum).

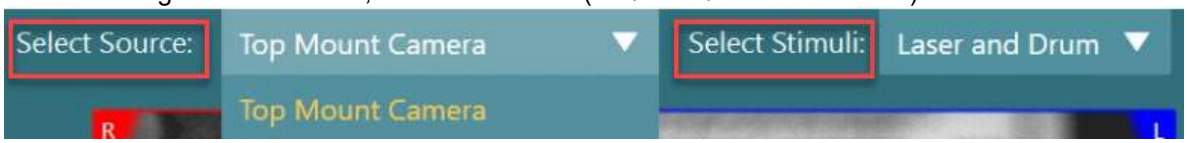


Figure 2. 1. 1 Hardware source selection

2.2 Performing calibration

In the test screen side panel, click the **Calibration** button (Figure 2. 2. 1)

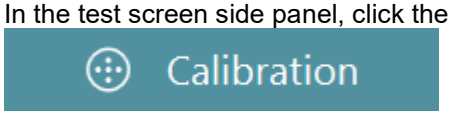


Figure 2. 2. 1 Calibration button

The Calibration dialog box will open (Figure 2. 2. 2)

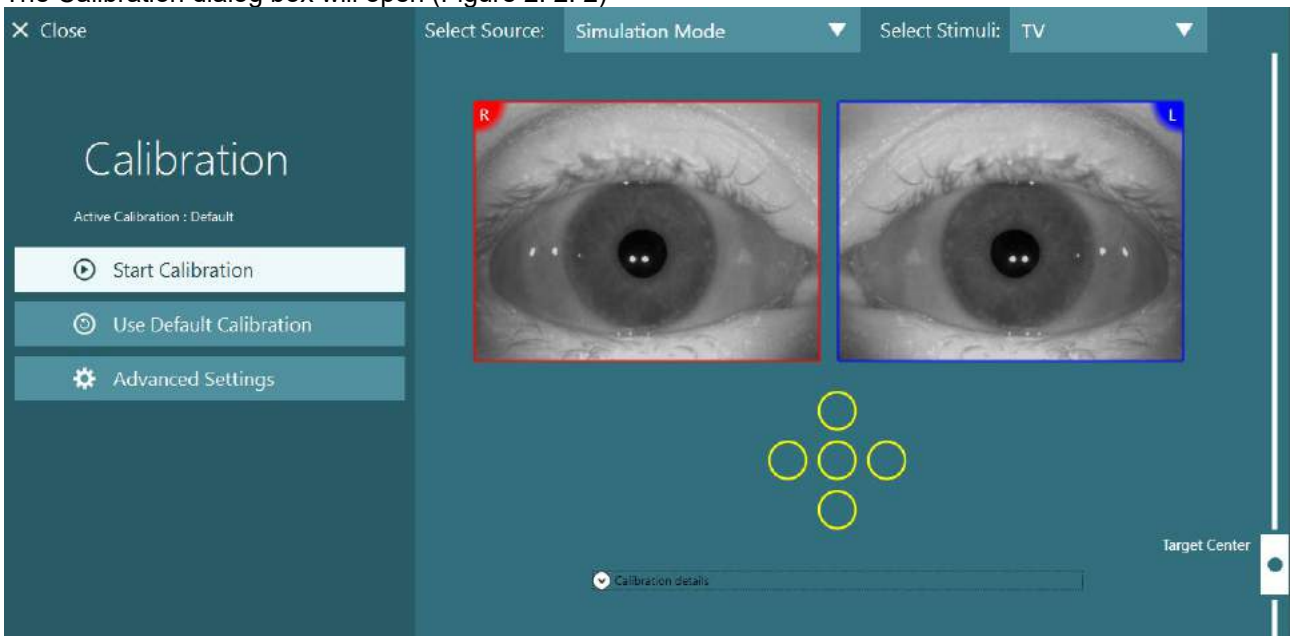


Figure 2. 2. 2 Calibration screen with Cameras

Before beginning calibration, ensure that the correct hardware source will be used for calibration and subsequent testing. Then center the calibration stimulus for the patient using the target center slider. Vertical tests will still display the target from the center of the screen, but horizontal tests will display the target centered at the target center position specified by the target center slider. (Figure 2. 2. 3)

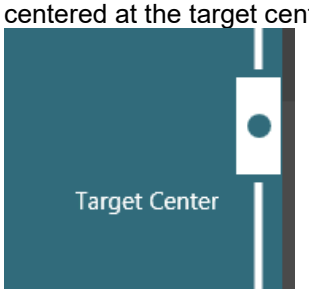


Figure 2. 2. 3 Target Center slider

When testing with a VNG source, the upper area of the dialog shows the video images of the eyes that are being calibrated. If necessary, adjust the pupil threshold to achieve optimal eye detection.

Click the **Start Calibration** button to begin the calibration routine. (Figure 2. 2. 4)

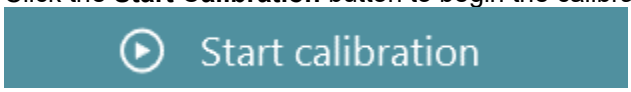


Figure 2. 2. 4 Start calibration button

Ask the patient to look at the first calibration point. After a few seconds of fixation a target confirmed mark (Figure 2. 2. 5) will appear to confirm calibration of the center point. If the patient fails to fixate on the center point, the software will present a warning message. (Figure 2. 2. 6)

Figure 2. 2. 5 Target confirmed mark

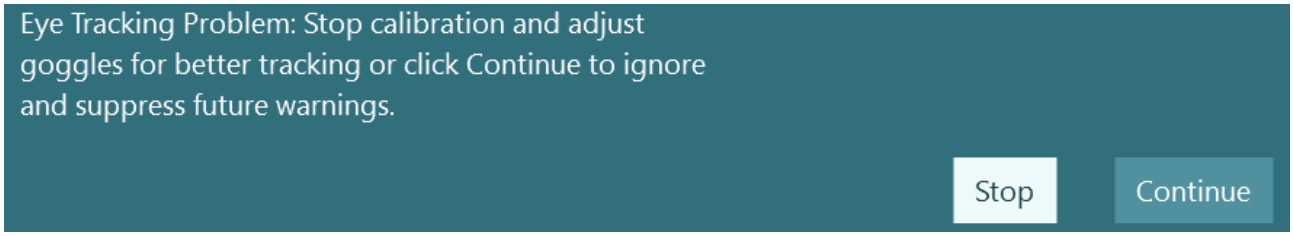


Figure 2. 2. 6 Eye tracking problem warning

Automatic fixation detection may not be achieved successfully in some patients. In such cases, by observing the video image of the calibrated eye on the screen, if the calibration point has been fixated upon, clicking the **Accept point** button will manually accept the value and move to the next target position. (Figure 2. 2. 7).

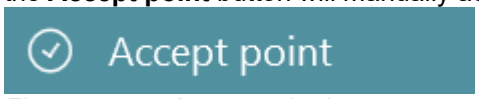


Figure 2. 2. 7 Accept point button

Ask the patient to fixate on the target to the left without moving his / her head. After a few seconds of fixation, a yellow target confirmed mark will appear to confirm calibration. The target will then move to the right, center, up, and then down. Below the checkmarks the patient's eye positions will be displayed graphically (Figure 2. 2. 8).

Figure 2. 2. 8 Calibration completed with all positions accepted

Once calibration is complete, the yellow tick marks will change to green, indicating the patient has achieved appropriate calibration that is within tolerance at each of the calibration points. (Figure 2. 2. 8). The user can choose either graphical or / tabular explanation for the calibration (Figure 2. 2. 9).

Figure 2. 2. 9 Calibration failure with values and failure reason

If the patient could not fixate on one or target positions, a red cross mark (Figure 2. 2. 10) shall appear to indicate failure. The software will provide a **Redo Horizontal**, **Redo Vertical**, or **Redo All** button to clear the failure points and allow the calibration of the direction(s) again.

Figure 2. 2. 10 Unsuccessful target mark

If the calibration is completed successfully, the **Accept and Close** action becomes available (Figure 2. 2. 11). Selecting this action will use the patient derived calibration values and close the calibration screen.

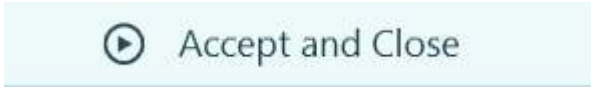


Figure 2. 2. 11 Accept calibration and close calibration screen button

Figure 2. 2. 12 Target Size option

Target Size: This option adjusts size of target in degree increments. Note if the target size is increased, the maximum angle will decrease (Figure 2. 2. 12).

2.3 Torsion calibration

Tests that use the torsion tracker will need to be calibrated before use, Click on the “Torsion” button in the side panel to start the calibration process (Figure 2. 3. 1).

Figure 2. 3. 1 Torsion Calibration button

Have the patient look straight ahead, then click on the Auto Detect button. The software will select an iral segment with good contrast to track rotation. The tracking area can be adjusted using the sliders below the eyes.

If the torsion tracker is to be utilized in the dark with dilated pupils, it is very important to perform the torsion calibration in the dark with dilated pupils. If possible, ask the patient to look slightly up – this will make the iris more visible.

The white circle indicating the tracking area must never be filled out by the pupil, this will lead to unstable torsion tracking (Figure 2. 3. 2).

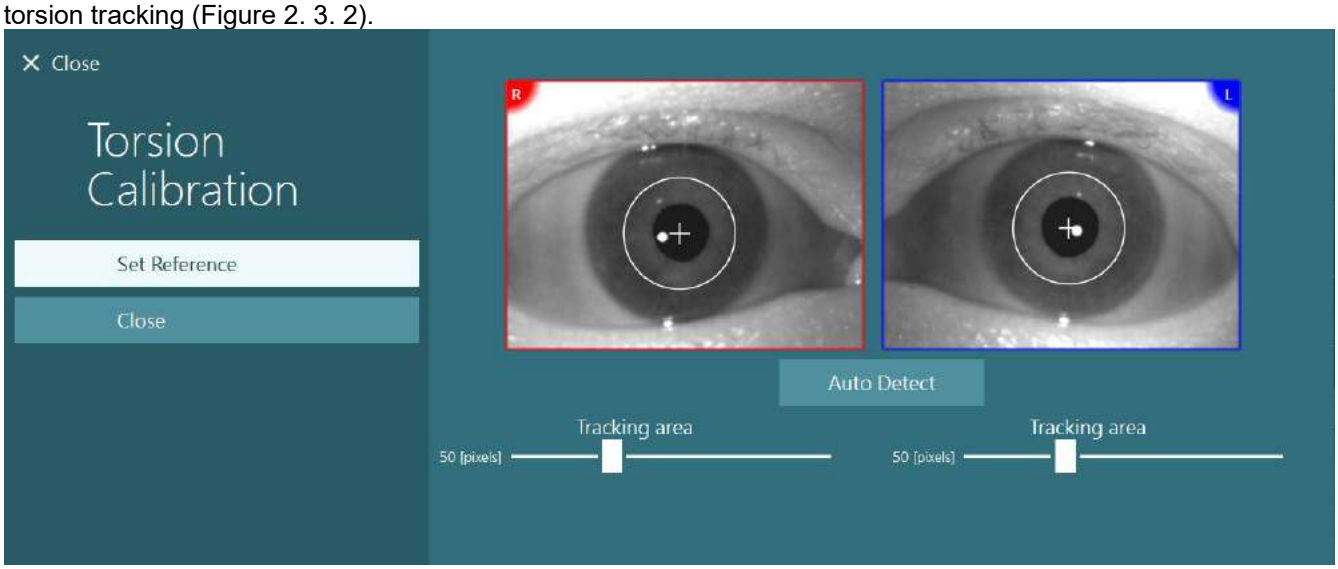


Figure 2. 3. 2 Adjusting the Tracking area

Once the adjustments have been made, click on the Set Reference button. The crosshair will now show a circle with crosshair. Confirm that the torsion angle is responding with the patient’s eye movements, otherwise adjust the tracking area and click on Set Reference to update. To return to the calibration settings, click on the Close button (Figure 2. 3. 3).

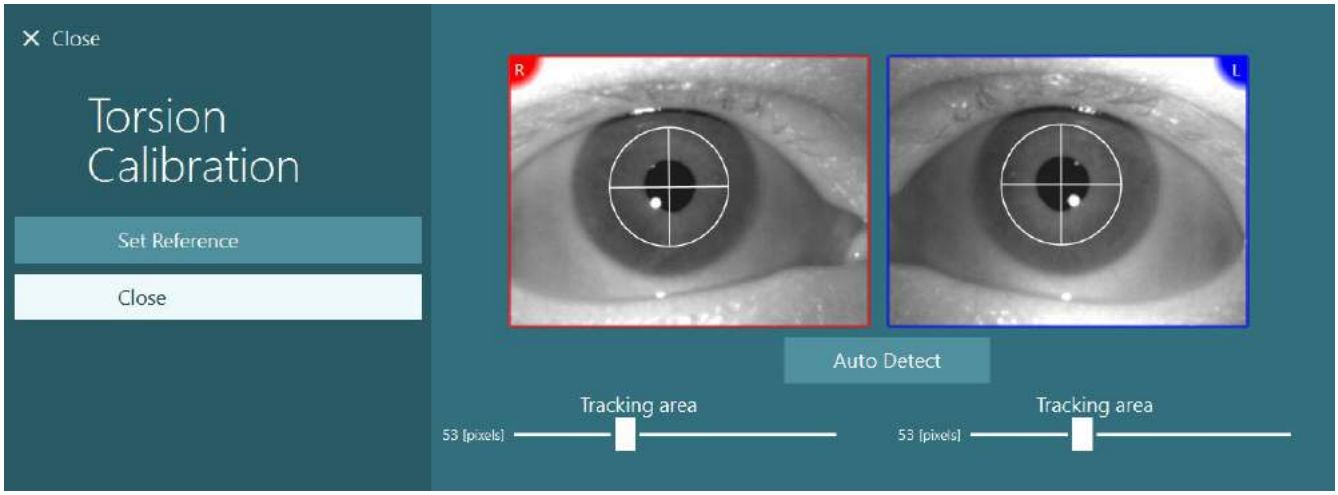


Figure 2. 3. 3 Torsion Crosshairs with reference area selected

2.4 Default calibration

If a calibration is unable to be completed, use the default calibration option (Figure 2. 4. 1). This sets the VisualEyes™ 505 system to use software default calibration settings which provide only an approximate calibration value.

Figure 2. 4. 1 Use default calibration button

2.5 Review calibrations

The patient's calibration traces (Figure 2. 5. 1) and videos are saved for later review. These results can be used to determine if the patient's eyes were properly calibrated before the VNG test was performed. During review it can be determined which subtests are related to which calibrations, if calibration was performed more than once. The traces and videos can be accessed from the **Session Review** screen and **Patient Sessions** screen.

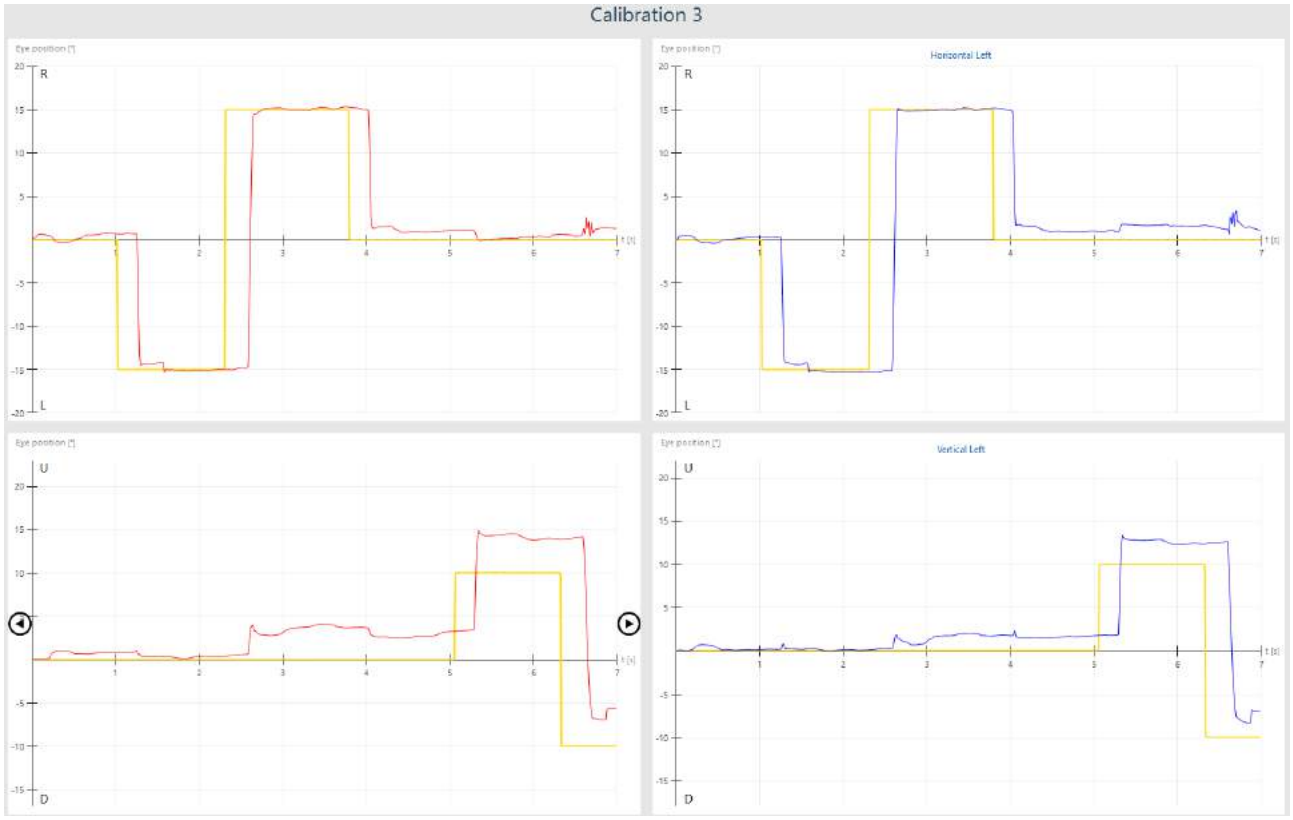


Figure 2. 5. 1 Calibration traces

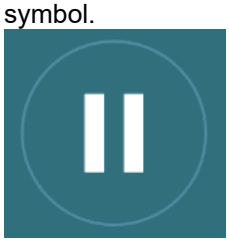
3 Testing

3.1 VisualEyes 505 Standards Tests

3.1.1 Video Frenzel Test

There are a number of functions commonly used in Video Frenzel testing:

Pause – Suspends the testing procedure. Timer displays a pause symbol.



Resume - Allows the user to resume the testing procedure and continue form the place the clinician left off.

NOTICE

The duration between pausing and resuming the test is not factored into the time value. The timer resumes where it left off at the pause.

3.1.2 Spontaneous nystagmus test

The spontaneous nystagmus test is used to record non-evoked eye movements. This test is conducted with the vision denied cover attached to the front of the mask. This allows for recordings with the eyes open in complete darkness thus eliminating any possibility of fixation. If nystagmus is detected, the Add Time button can be used to extend the testing time. The fixation light will come on automatically at 15 seconds and last for 10 seconds. This can be changed in the test settings to come on manually if desired.

The average slow phase velocity (a. SPV) graph to the right side of the data graph shows the a. SPV for horizontal and vertical channels. The result value is displayed as a bar with the white portion representing values within test thresholds and grey portions exceeding the test threshold (refer Figure 3. 1. 1).

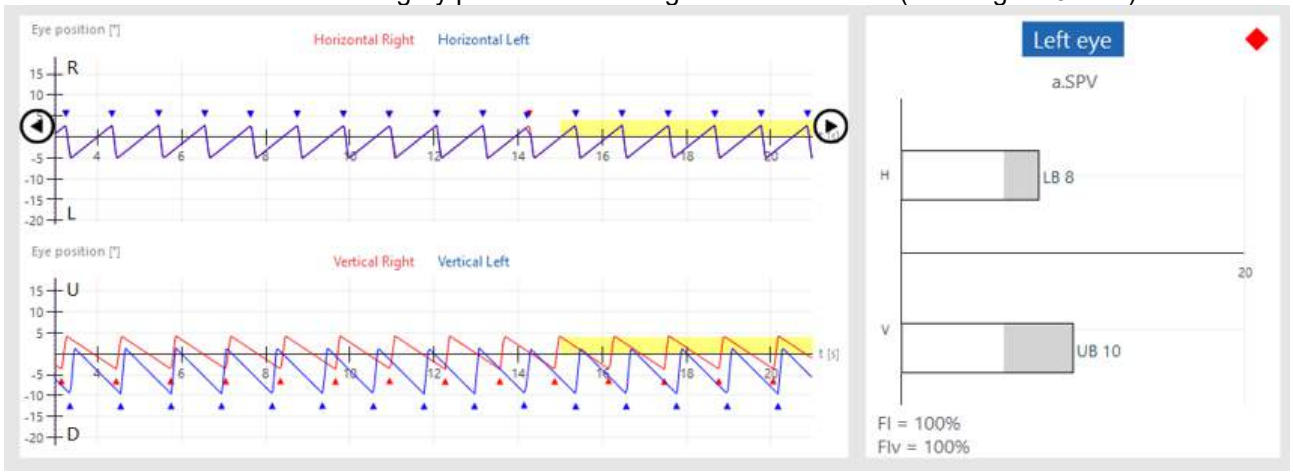


Figure 3. 1. 1 Spontaneous Nystagmus Waveform and a. SPV graph

3.2 VisualEyes 505 Tests available only with Addon Modules

3.2.1 Dix-Hallpike Advanced test

The Dix-Hallpike Advanced test is a specific test to diagnose BPPV (benign paroxysmal positional vertigo) with using the VORTEQ IMU to aid the examiner in placing the patient in the correct positions.

The Dix-Hallpike test is contraindicated in patients who exhibit the following: current or past injuries of the neck or spine, brainstem malformations, such as Arnold-Chiari, pre-existing neurological symptoms including but not to limited to: blurred vision, numbness, weakness of the arms or legs and confusion.

Before starting the test, verify the VORTEQ IMU sensor is connected to the computer (either by Bluetooth wireless or by a micro-USB cable). Switch on the VORTEQ IMU and verify the VORTEQ IMU is connected. Have the patient wear the goggles with the VORTEQ IMU and have the patient face forward while sitting upright. When the test begins, the software will center the VORTEQ IMU in preparation for the test (Figure 3. 2. 1).

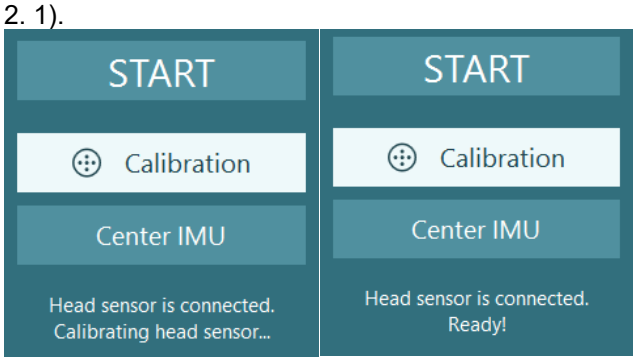


Figure 3. 2. 1 Head Sensor Connected, Calibrating, and Ready statuses

Once the subtest is started, recline the patient into the supine position with the head turned to the direction tested. The VORTEQ IMU spatial location will be shown with a black bar on the position sliders. As the head is moved into position, the position marker will be updated on the slider with the head representation. When the head is pointing at the desired angle, the spatial target location will be shown green instead of orange (Figure 3. 2. 2). Note that, the user can also start collecting data, even if he/she couldn't reach a head position that turns the bar green. Once the test is started, after 60 seconds, the software will provide an audible "ding" sound and mark the waveform to indicate the time to bring the patient to a sitting position (Figure 3. 2. 2). The test will then continue for another 60 seconds. Each portion of the test may be shortened by pressing the foot pedal, RF Remote's Enter button, side switch on the top mount goggles, or Enter key on the keyboard.

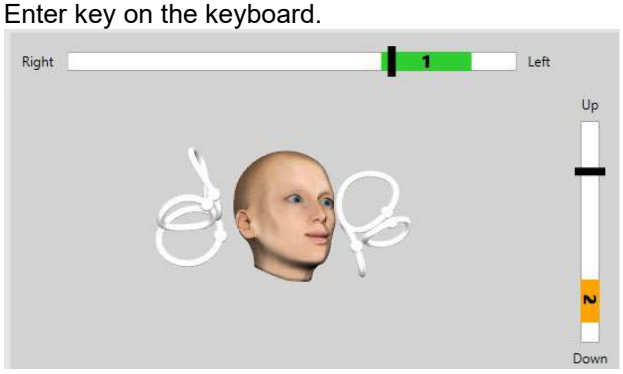


Figure 3. 2. 2 Head Orientation

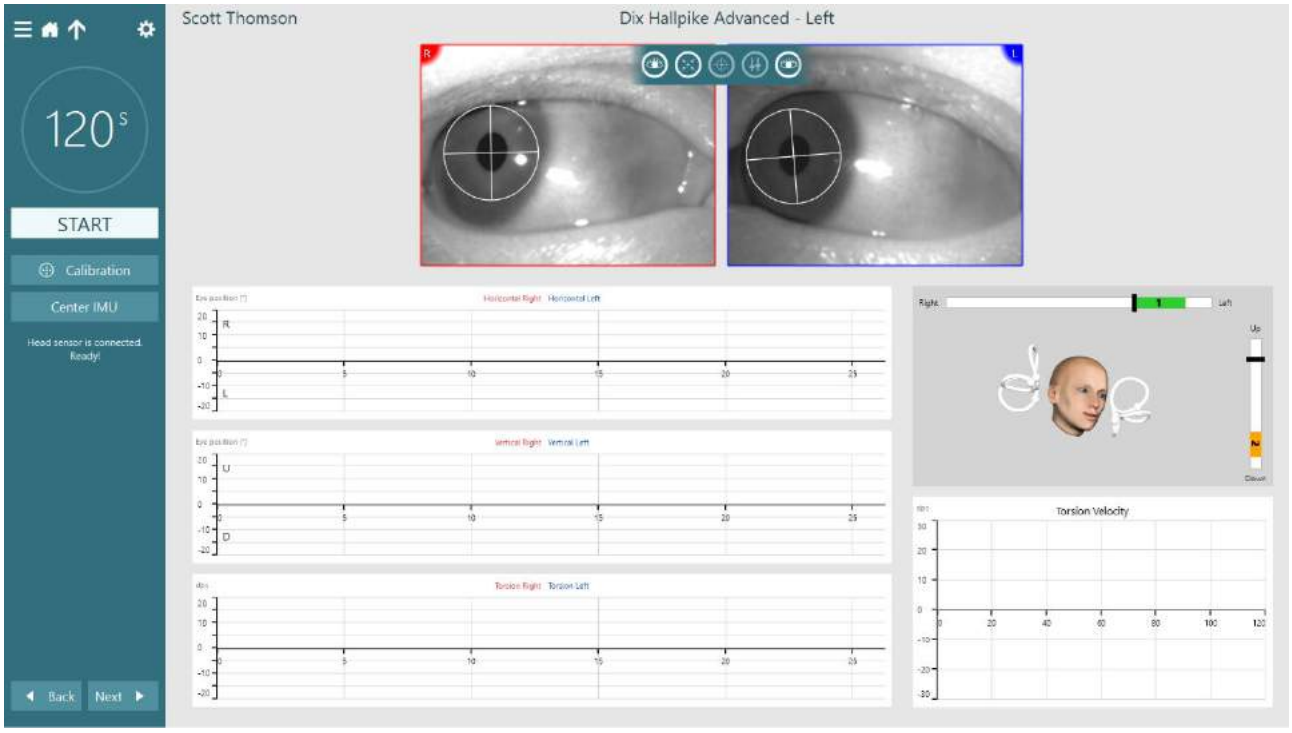


Figure 3. 2. 3 Dix-Hallpike Advanced subtest

The Dix Hallpike Advanced test has two subtests, Left (Figure 3. 2. 3) and Right. In the Dix Hallpike Advanced summary, the left test will be displayed on the first page and the right test will be displayed on the second page. Additional pages are created for subtests that are repeated. The graphs will club the eyes together and separate the horizontal, vertical, and torsion traces. The eye selected can be switched for each test by clicking or touching on the eye title of the a. SPV bar graph. (Figure 3. 2. 4). The Torsion Velocity graph will display both left and right eye's torsional velocity values.

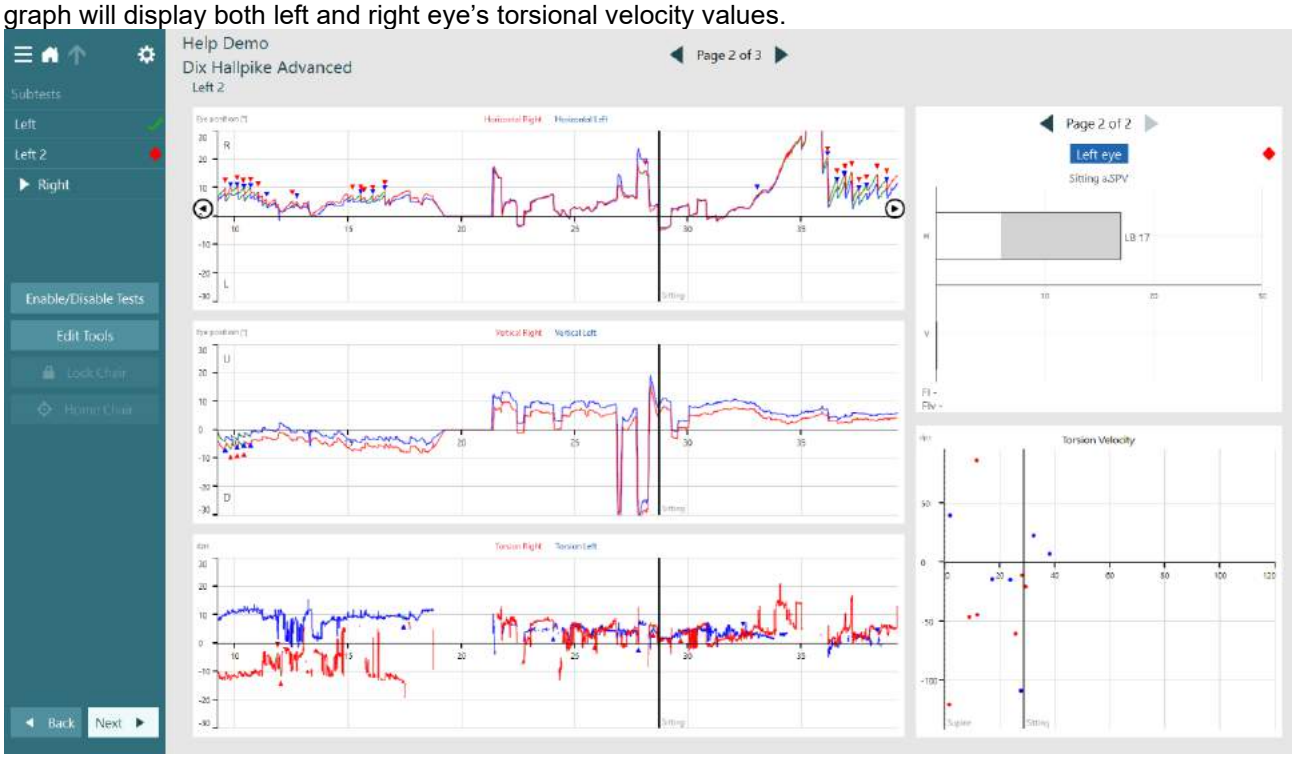


Figure 3. 2. 4 Horizontal, vertical, and torsional eye movements in the Dix Hallpike Advanced summary

3.2.2 Dynamic Visual Acuity test

Dynamic Visual Acuity (DVA) testing has the patient distinguish the orientation of the optotype character as the patient moves his / her head at a specified velocity and direction. The DVA test is performed with the patient wearing the DVA headband instead of the binocular goggles. If the patient normally wears eyeglasses or contact lenses these should also be used during the DVA test, and the DVA headband will allow this.

The default patient distance to the stimulus is eight feet (2. 4 meters) in a standard laptop setup. This distance and stimulus size can be configured from Configuration > System Default Settings > DVA Stimulus. The DVA stimulus can be displayed on the TV or on the primary computer screen if the office dimensions do not allow for the required patient distance. If the stimulus is set to the TV, the computer screen will show a large optotype for the operator instead of the required size for the DVA logMAR assessment.

Static Acuity

The first subtest of the DVA test is the static acuity assessment. Once the test begins (either by the operator or the patient) the optotype will appear in a random orientation. After setting the patient's static acuity the software will display the static acuity in the DVA results graph as a solid black circle (Figure 3. 2. 5).

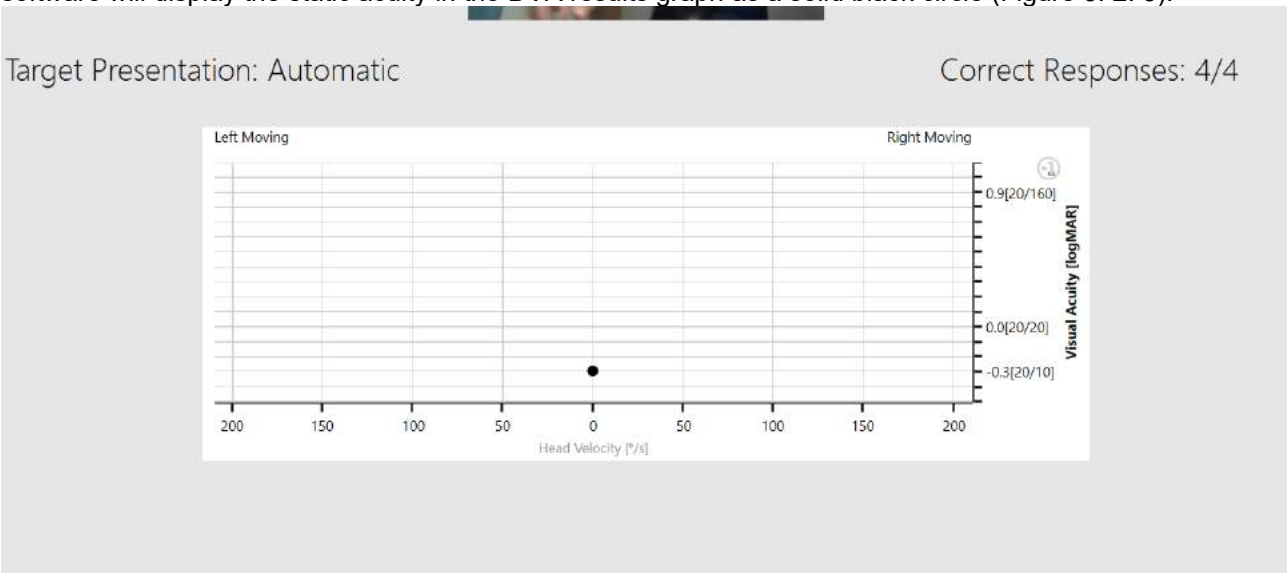


Figure 3. 2. 5 Static Acuity

Automatic Presentation

In the automatic presentation style, the patient can confirm the orientation of the optotype using the matching direction button on the RF Remote control. Alternatively the patient can say the orientation out loud and the operator can then use the keyboard arrow keys or the direction buttons in the side panel to enter the patient's response. When the patient correctly distinguishes the optotype, the size will decrease. Conversely if the patient incorrectly distinguishes the optotype, the size will increase. The static acuity is defined when the patient can distinguish the optotype orientation three times at a particular LogMAR level.

Manual Presentation

In the manual presentation style, the operator sets the initial optotype size to LogMAR 0, then uses the Increase Size and Decrease Size buttons to adjust the optotype size to the size where the patient can clearly identify the orientation. The operator will then use the Rotate Optotype button to randomly change the orientation of the optotype. If the patient can correctly distinguish the optotype orientation at a specific LogMAR level three times, then the operator will use the Set Acuity button to lock in the value of the patient's DVA static acuity (refer Figure 3. 2. 6).

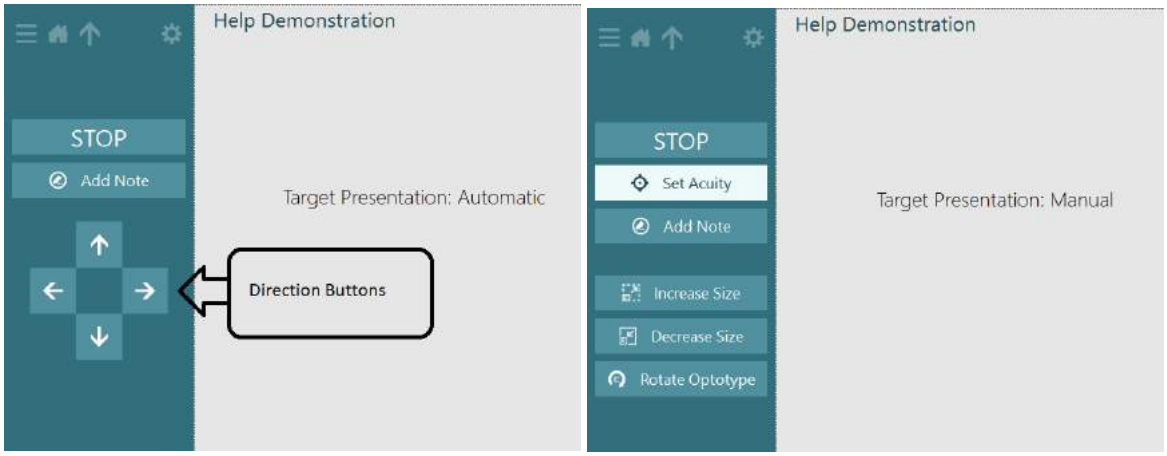


Figure 3. 2. 6 Dynamic Visual Acuity Direction Buttons (Automatic) vs. Size and Rotation Buttons (Manual)

Dynamic Acuity
The remaining subtests of the DVA test are dynamic acuity assessment in different directions. Once the subtest begins (either by the operator or the patient) the optotype will appear in a random orientation. The patient will move his / her head in tune with the metronome.

Automatic Presentation
In the automatic presentation style, the patient shakes his / her head and chooses the orientation of the optotype using the matching direction button on the RF Remote control. Alternatively the patient can say the orientation out loud and the operator can then use the keyboard arrow keys or the direction buttons in the side panel to enter the patient's response. When the patient correctly distinguishes the optotype, the size will decrease. If the patient incorrectly distinguishes the optotype, the size will increase. The dynamic acuity is defined when the patient can distinguish the optotype orientation three times at a particular LogMAR level. The optotype will only be displayed when the patient moves his / her head to the noted direction at the desired velocity. Horizontal subtests are set to 100 degrees per second, and vertical subtests are set to 75 degrees per second.

Manual Presentation
In the manual presentation style, the operator sets the initial optotype size to LogMAR 0, then uses the Increase Size and Decrease Size buttons to adjust the optotype size to the size where the patient can clearly identify the orientation (also activated by the up and down arrow keys respectively). The operator will then use the Rotate Optotype button to randomly change the orientation of the optotype (also activated by the left and right arrow keys). If the patient can correctly distinguish the optotype orientation at a specific LogMAR level three times, then the operator will use the Set Acuity button to lock in the value of the patient's DVA dynamic acuity.

The results will be displayed after each subtest is completed (refer Figure 3. 2. 7).

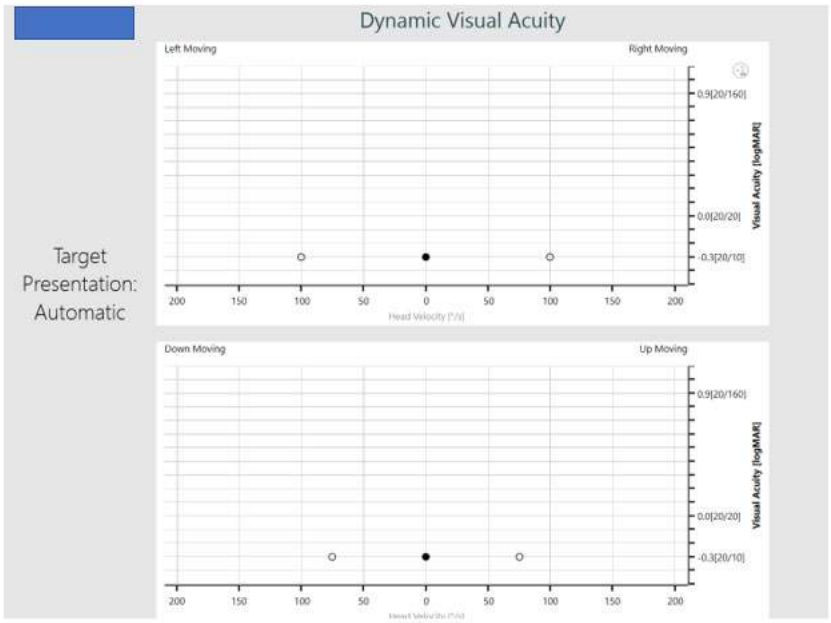


Figure 3. 2. 7 Dynamic Visual Acuity Results

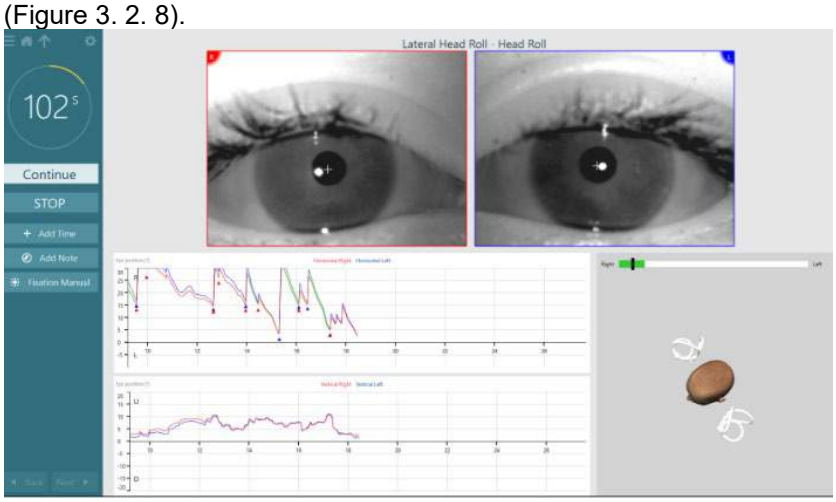
3.2.3 Lateral Head Roll Test

The Lateral Head Roll test is part of the VORTEQ Assessment bundle. The Lateral Head Roll test is performed to identify horizontal canal BPPV. The Lateral Head Roll test has 2 additional features that provide significant improvements over the standard positional tests 3D Head Model Guide and Guide to assist in proper head placement.

Select the Lateral Head Roll test from your test menu. Once the system is calibrated you are ready to begin testing. You will use the 3D Head Model to guide you through the appropriate head/body positions for the Lateral Head Roll test. Make sure the VORTEQ IMU is attached to the goggle and turned on. The test is performed with the patient Supine (laying down).

1. Step 1 is to turn the patient's head 45 degrees towards the Right.
2. Step 2 is to turn the patient's head 45 towards the Left.

The black bar represents the head movement and when the head is in the correct position the shaded area will turn green. Once you have reached the first position you can record for a minimum of 20 seconds, then press enter and proceed to the second step. Record another 20 seconds at minimum and then stop the test (Figure 3. 2. 8).



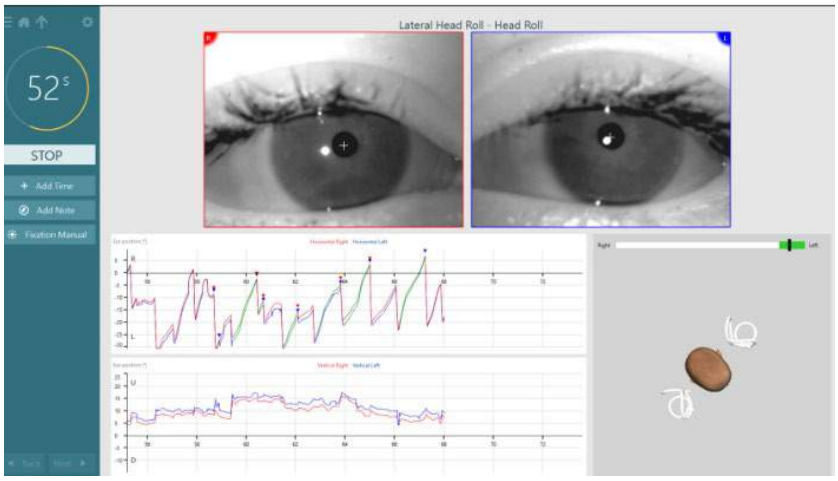


Figure 3. 2. 8 Performing Lateral Head Roll Test

When you have completed the test (Figure 3. 2. 9) you will see a summary screen with bar graphs representing any nystagmus that was generated during the maneuver. Any nystagmus greater than 6 deg/sec is shown highlighted in grey and represents an abnormal finding.

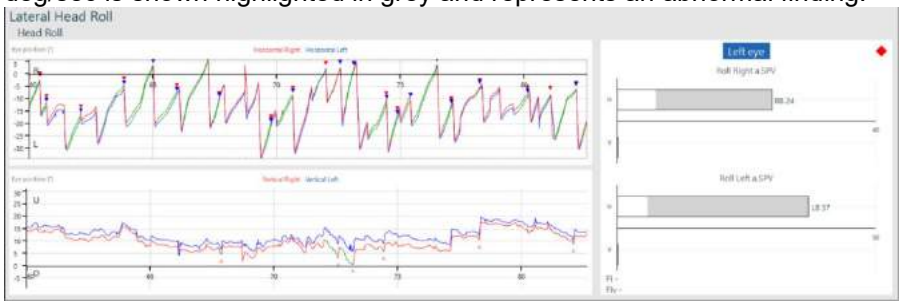


Figure 3. 2. 9 Lateral Head Roll result screen

3.2.4 vHIT EyeSeeCam

Using the EyeSeeCam camera goggle, the user can perform the head impulse test with one camera recording either eye with minimal goggle slippage. As the clinician performs small head thrusts on the patient's head, the waveform will show the head impulse in the waveform trace window and a close-up of that head impulse below. If the head impulse and eye movement are in opposite directions and the head impulse was performed so that the impulse fell within the swoosh profile, then the software will accept the head impulse and show a green checkmark in the upper right corner of the respective head impulse window. If the head impulse failed the criteria, a red '**X'** will be displayed in the upper right corner. Accepted head impulses will increment the appropriate head impulse count in the timer on the side panel. When the accepted head impulse count reaches the defined amount (default is 7 head impulses in each direction), the test will end automatically. The clinician can also end the test manually by clicking on the STOP button.

The operator can perform 4 different sub tests using VisualEyes™ system including Lateral vHIT, LARP vHIT, RALP vHIT and SHIMP test. These tests are explained below in detail. Before starting any vHIT test using the EyeSeeCam goggle, the user has to ensure that standard calibration and head calibration is done with EyeSeeCam goggle. If the camera position is adjusted during testing the head calibration must be repeated.

Standard calibration for ESC vHIT
When the user enters the test the calibration options ‘Start Calibration’ and ‘Head Calibration’ will appear. The user can also choose ‘Use Default Calibration’.

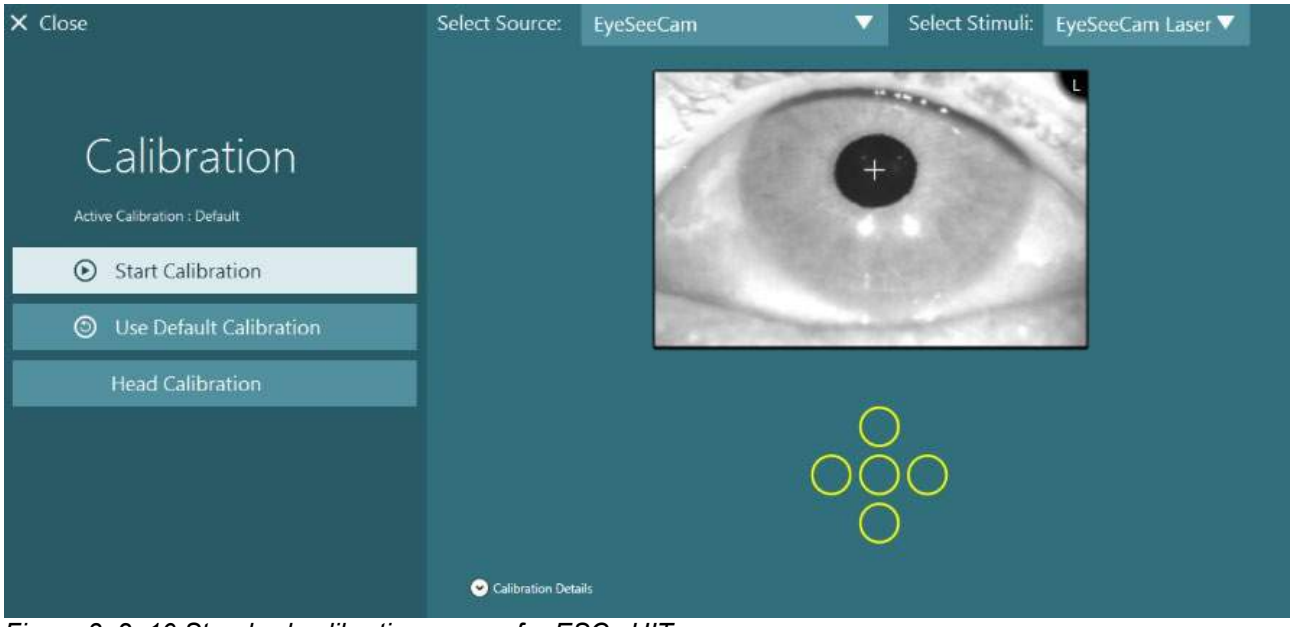


Figure 3. 2. 10 Standard calibration screen for ESC vHIT

By clicking ‘Start Calibration’, the standard 5 point calibration can be done. Refer to section 2 for detailed method to do the standard calibration (Figure 3. 2. 10).

Once the standard calibration is done, the user can proceed to ‘Head Calibration’. Ask the patient to fixate at a point as a first step, click ‘Head Calibation’ and ‘Start’ to start head calibration. Ask the patient to shake the head slowly in a horizontal direction. When the system can track the head movement horizontally you get a green bar in the screen. After a few seconds, the system moves to vertical calibration, and you must ask the patient to move his/her head slowly in a vertical direction. When the system can track the head movement vertically you get a green bar in the screen. Once the calibration is done, the user can get a report of head calibration. The user can now proceed with subtest of their choice (Figure 3. 2. 11).

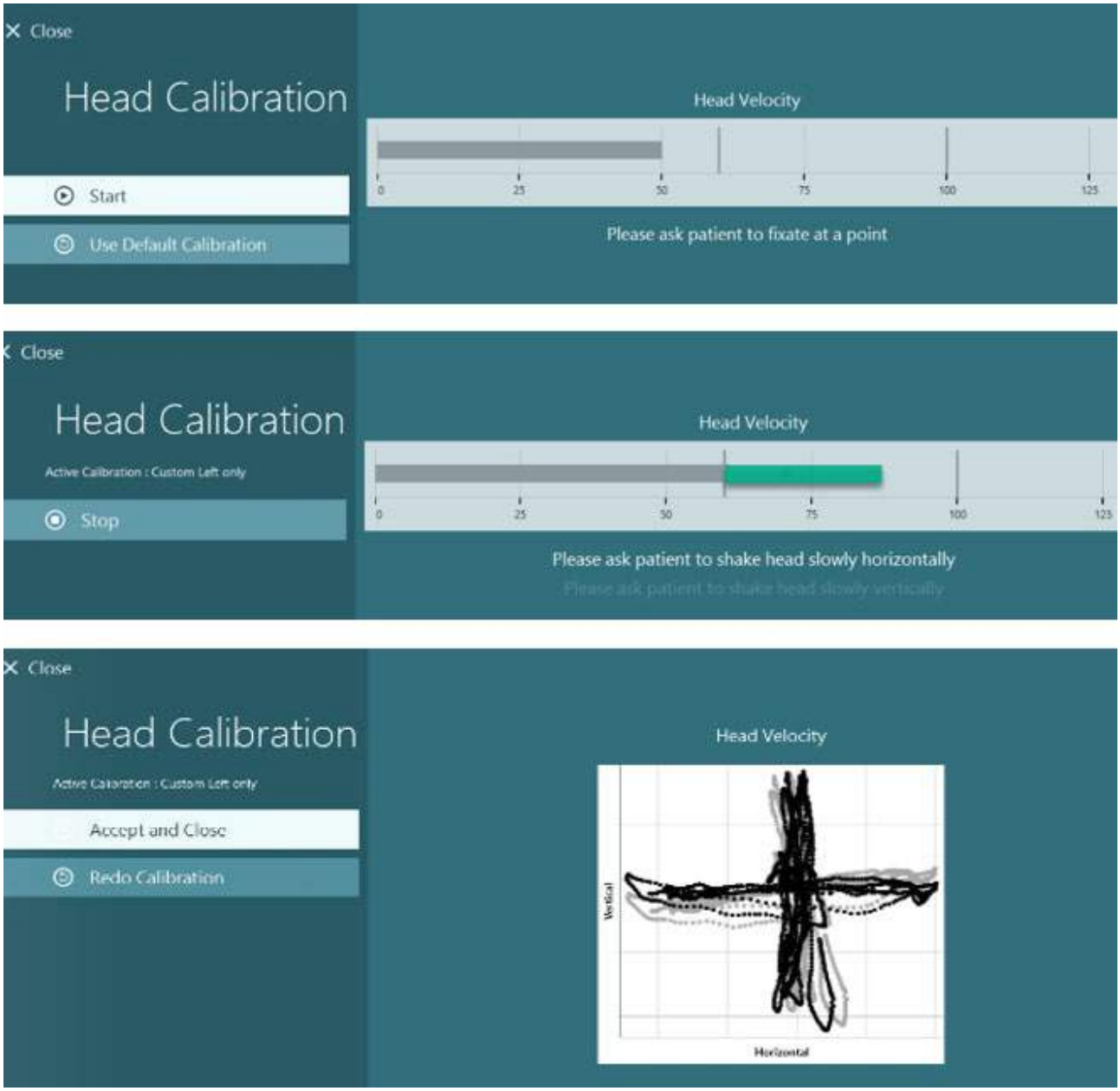


Figure 3. 2. 11 Head calibration procedure and result screen for ESC vHIT

Lateral VHIT

The Lateral vHIT test assesses the function of the lateral semicircular canals. For this test, hold the patient's jaw while standing behind the patient (Figure 3. 2. 12). During the test, the patient's teeth should be clenched so the hand thrust will be transferred to the patient's head. Practice a few impulses before beginning the recording. This will also familiarize the patient with the stimulus. Do **not** allow the hands to touch or move the goggles during head impulses as that movement will affect the gain measurement.

Figure 3. 2. 12 Lateral vHIT hand placement

Left Anterior Right Posterior (LARP) / Right Anterior Left Posterior (RALP) VHIT
The LARP and RALP tests assess the function of the vertical semicircular canals. For assessing the function of the vertical semicircular canals, the head is rotated right-downward to left-upward in the plane of the right anterior and left posterior canals (RALP) or left-downward to right-upward in the plane of the left anterior and right posterior canals (LARP). Alternatively, the head can be rotated 45 degrees to the right for LARP testing and 45 degrees (Figure 3. 2. 13) to the left for RALP testing. Regardless of setup the patient must always gaze straight ahead.

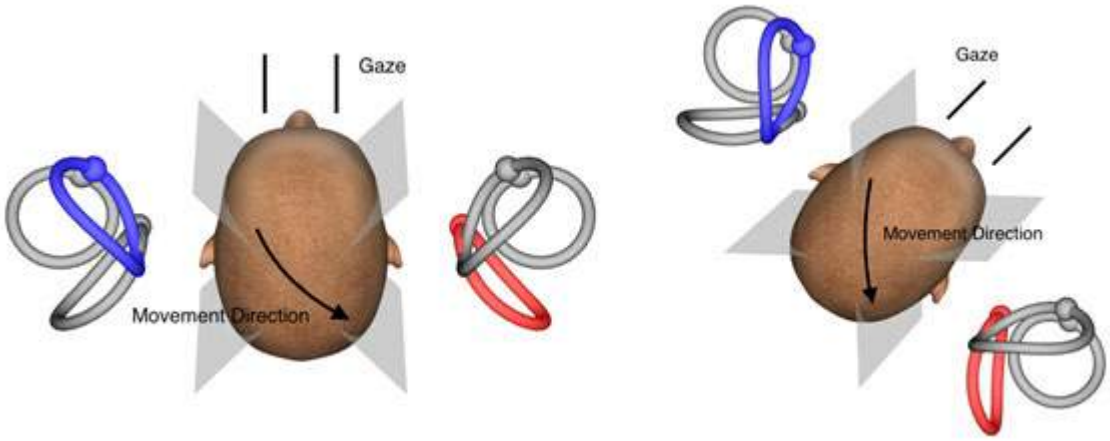


Figure 3. 2. 13 vHIT testing with head-on gaze and corrected straight gaze in LARP testing

Performing the Test
A three-dimensional head model with the semicircular canals (Figure 3. 2. 14) is displayed in the upper right corner of the screen. The EyeSeeCam head sensor will automatically tare (i. e. reset) if the sensor is left still. At the start of the test, have the patient look straight ahead and keep the head still. The EyeSeeCam head sensor will then tare and the head model should appear looking forward. As the head impulses are performed, the activated semicircular canal pair are highlighted in blue and red depending on the direction of the impulse.

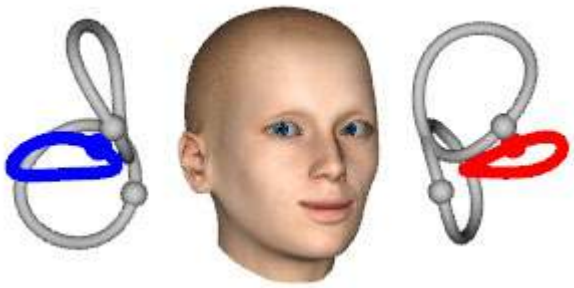


Figure 3. 2. 14 Head model with highlighted semicircular canals

When the operator performs the head impulse, the software will display the head movement and eye movement in the appropriate impulse graph depending on the impulse direction. If the head movement fits the swoosh velocity profile, the head impulse will be accepted and show a green check mark in the upper right corner of the impulse graph (Figure 3. 2. 15). Rejected head impulses will display a red x in the upper right corner.

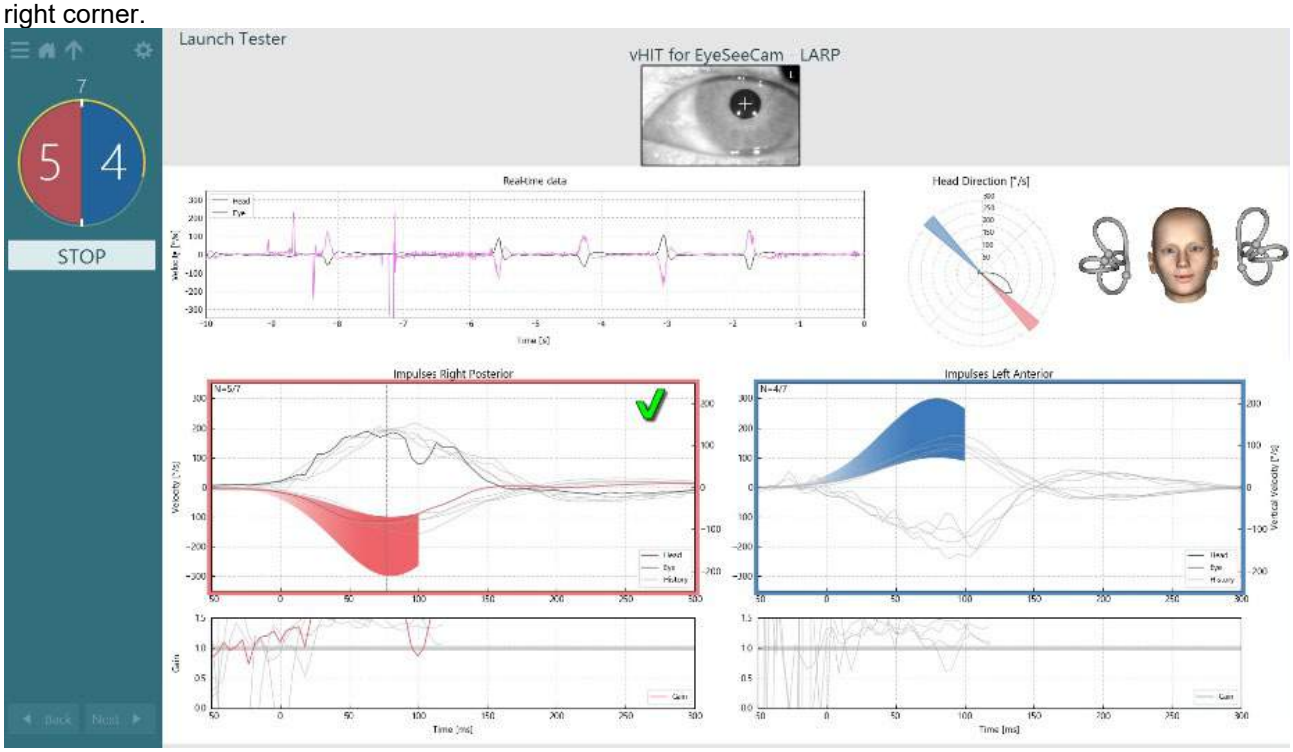


Figure 3. 2. 15 Example of EyeSeeCam test showing a green checkmark (LARP)

The test will end automatically once the required number of successful head impulses are performed in both directions. The timer is replaced with the head impulse counter with the head impulses separated and the required number of successful head impulses at the top. The clinician can stop the test at any time using either the Enter key on the RF Remote, the STOP button on the screen, or using the foot pedal.

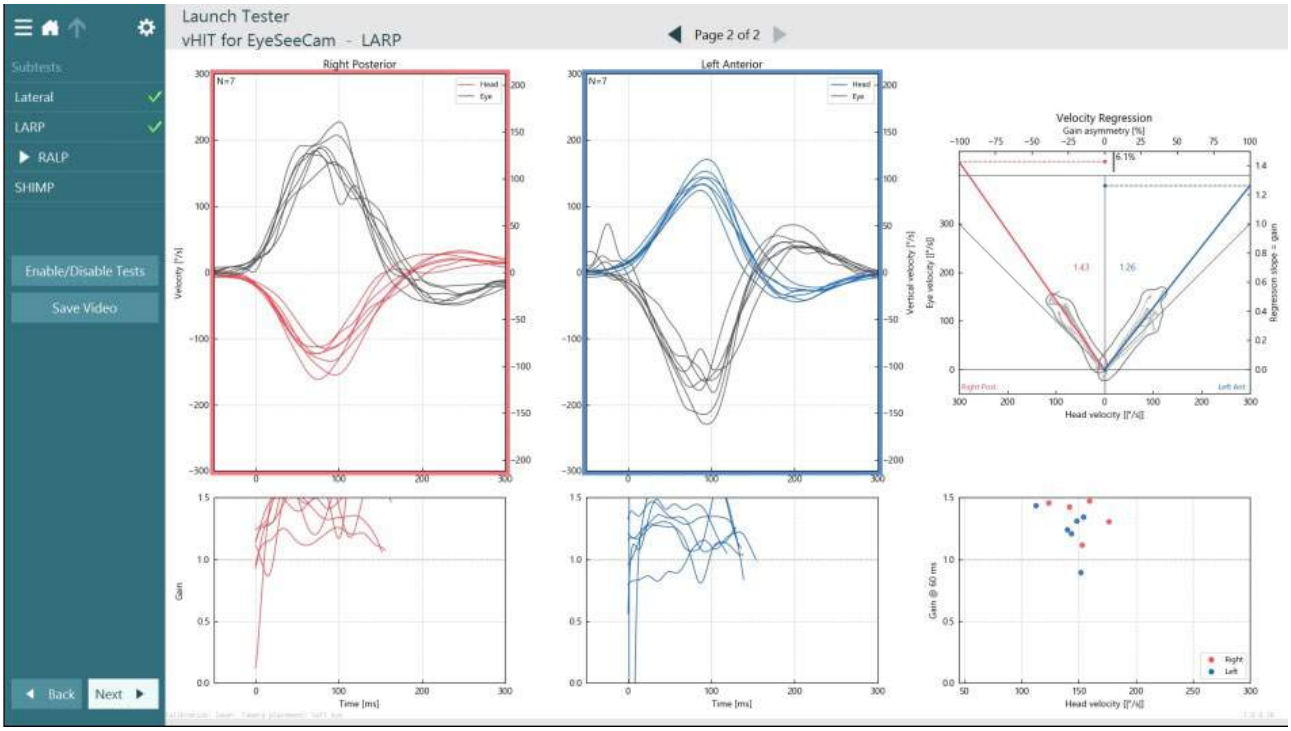


Figure 3. 2. 16 VHIT EyeSeeCam analysis

As each subtest is performed, the software displays each subtest's analysis on a page (Figure 3. 2. 16). The analysis displayed is defined by the page navigation at the top of the screen. Once the Lateral, LARP, and RALP tests have been performed, the EyeSeeSix report can be created from the VHIT for EyeSeeCam summary's side panel. If a subtest is repeated, the desired subtest can be selected from the combo boxes at the top of the EyeSeeSix report (Figure 3. 2. 17).

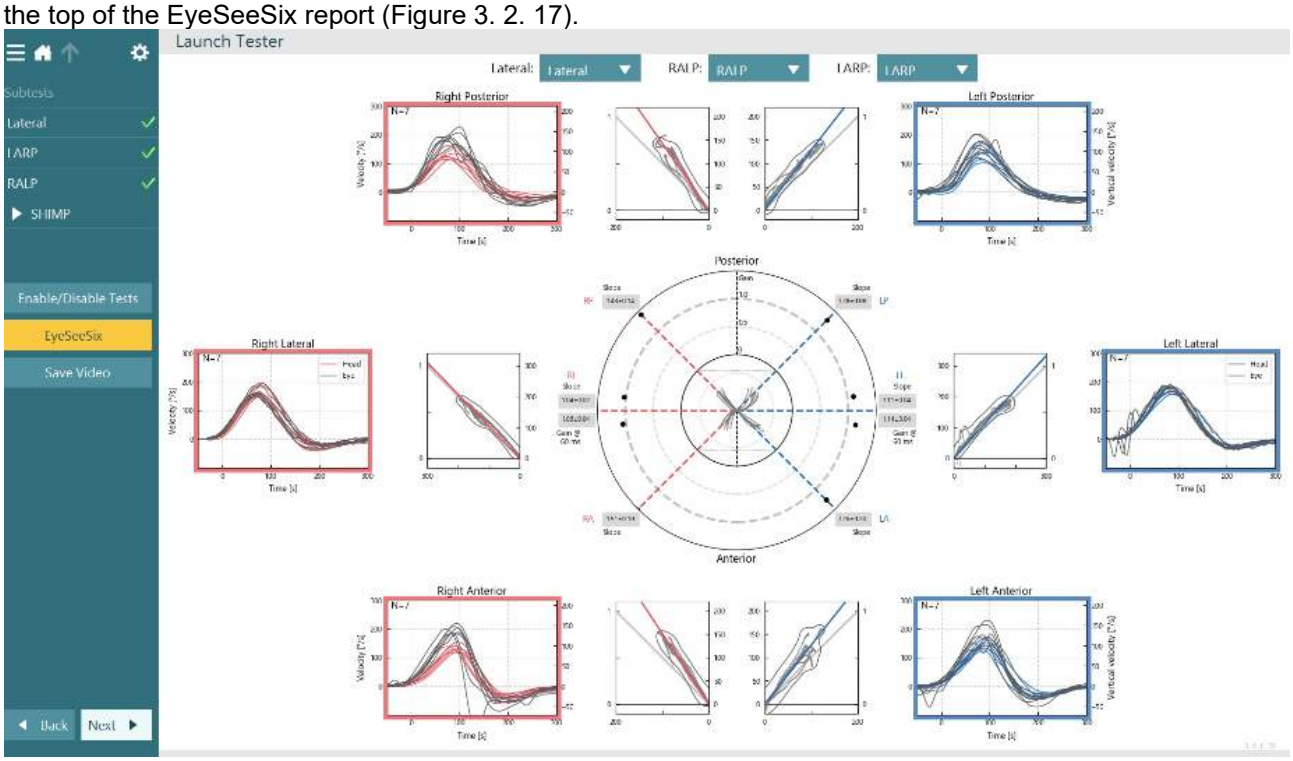


Figure 3. 2. 17 VHIT EyeSeeSix report

To view the information in a tabular form, click on the Numerical Results button (Figure 3. 2. 18). The text can be copied (click and drag or by using Ctrl + A on the keyboard) and pasted into Excel or other spreadsheet software.

Summary

Velocity Gain

	Right				Left			
	mean	std	median	iqr	mean	std	median	iqr
Gain @ 40 ms	0.75	0.05	0.75	0.06	0.96	0.08	0.96	0.12
Gain @ 60 ms	0.83	0.04	0.83	0.06	1.01	0.05	1.01	0.07
Gain @ 80 ms	0.90	0.05	0.90	0.07	1.02	0.02	1.02	0.02
Median 0-100 ms	0.80	0.05	0.80	0.07	1.02	0.07	1.02	0.10
Regression	0.86	0.03	0.86	0.05	1.03	0.04	1.03	0.06

Saccades

	Right			Left		
	1st Saccade	2nd Saccade	3rd Saccade	1st Saccade	2nd Saccade	3rd Saccade
Amplitude [°]	14.99 ± 000.92	-	-	13.58 ± 000.52	7.24 ± 002.52	-
Peak Velocity [°/s]	142.23 ± 004.12	-	-	136.61 ± 016.03	243.53 ± 050.31	-
Duration [ms]	185.50 ± 010.50	-	-	168.00 ± 011.00	83.00 ± 008.00	-
Latency [ms]	8.50 ± 010.50	-	-	22.00 ± 003.00	579.00 ± 024.00	-
Total	2	0	0	2	2	0

Data

Saccade Parameters

	Head Impulse			1st Saccade				2nd Saccade				3rd Saccade			
	Direction	Peak Time [ms]	Peak Velocity [°/s]	Amplitude [°]	Peak Velocity [°/s]	Duration [ms]	Latency [ms]	Amplitude [°]	Peak Velocity [°/s]	Duration [ms]	Latency [ms]	Amplitude [°]	Peak Velocity [°/s]	Duration [ms]	Latency [ms]
1	right	74.00	189.40	14.07	146.35	175.00	-2.00	-	-	-	-	-	-	-	-
2	left	95.00	190.06	14.10	152.64	157.00	25.00	9.76	293.84	91.00	603.00	-	-	-	-
3	right	92.00	197.11	15.90	138.10	196.00	19.00	-	-	-	-	-	-	-	-
4	left	79.00	160.99	13.07	120.58	179.00	19.00	4.72	193.23	75.00	555.00	-	-	-	-

Figure 3. 2. 18 Numerical Results

Clicking on the 3D Waves button will toggle the display of the waveforms in 3D space (Figure 3. 2. 19).

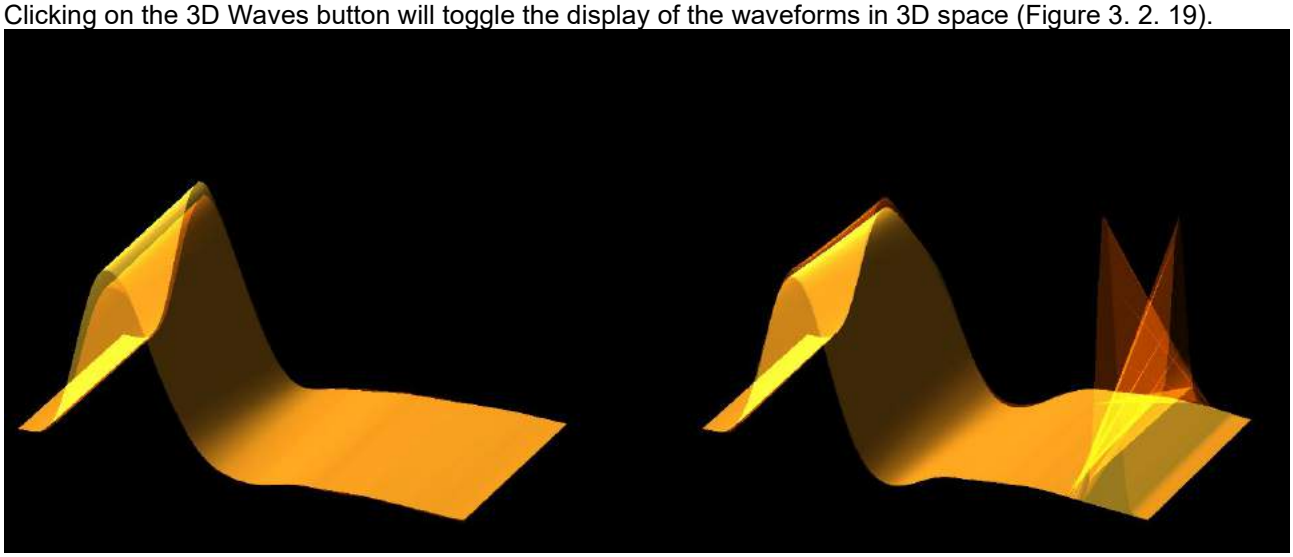


Figure 3. 2. 19 Eye Movements rendered in 3D space

Suppression Head IMpulse Paradigm (SHIMP) test

Along with the video Head Impulse Test or Head Impulse Test, the SHIMP test helps the operator to determine the residual vestibular function. This test resembles the lateral vHIT test and assesses the lateral semicircular canals. In addition to that a laser target is used as suppression medium for the SHIMP test.

The vHIT goggle is placed on the patient head as in other vHIT tests. The eye is centered in the viewing area taking care that the reflections are beneath the pupil. After adjusting the patient, calibrating and centering the laser fixed dots on the wall, you are ready to begin the SHIMP test.

Test preparation:

The head fixed laser projects a 5 dot pattern on the wall as used for calibration. The patient is instructed to focus on the center dot for fixation and align the center dot of laser to the wall fixed dot (for traditional vHIT testing). SHIMPs are performed on the lateral canal by turning the head 7 – 25 (depends on preset numbers) times at high velocities to the left and right side.

Performing test:

1. The first step is to have the patient relax his neck, open his eyes wide and fixate on the center dot in the 5 dot pattern.
2. The second step is to turn the patient's head either to the right or the left. The 5 dot laser pattern will move with the head so they are now located in a new position.
3. The patient is instructed to keep his eye on the center dot, so when the head moves the eyes should be focused on the newly positioned center laser dot.

The VOR gains should be similar in vHIT and SHIMP tests. However, the pattern of saccades generated is different. vHIT rarely generates compensatory saccades in normal patients, while in SHIMP testing, healthy subjects will make a large anti-compensatory saccade at the end of the head turn (Figure). This is referred to as a "SHIMP saccade". This pattern of result is exactly opposite for impaired patients. An impaired VOR system will lead to a catch-up saccade on the vHIT but no (or very few) compensatory SHIMP saccades. Sample test and result screens are provided below (Figure 3. 2. 20 and Figure 3. 2. 21).

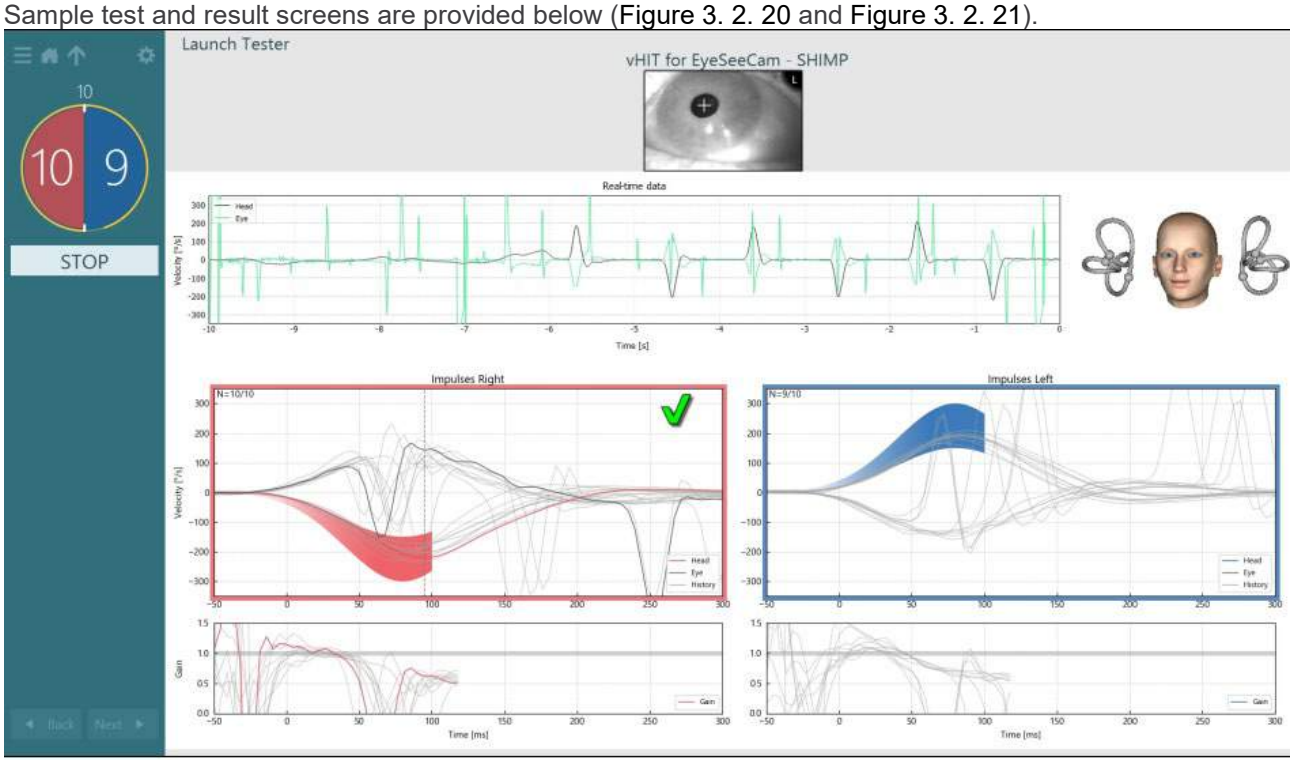


Figure 3. 2. 20 Test screen for SHIMP test

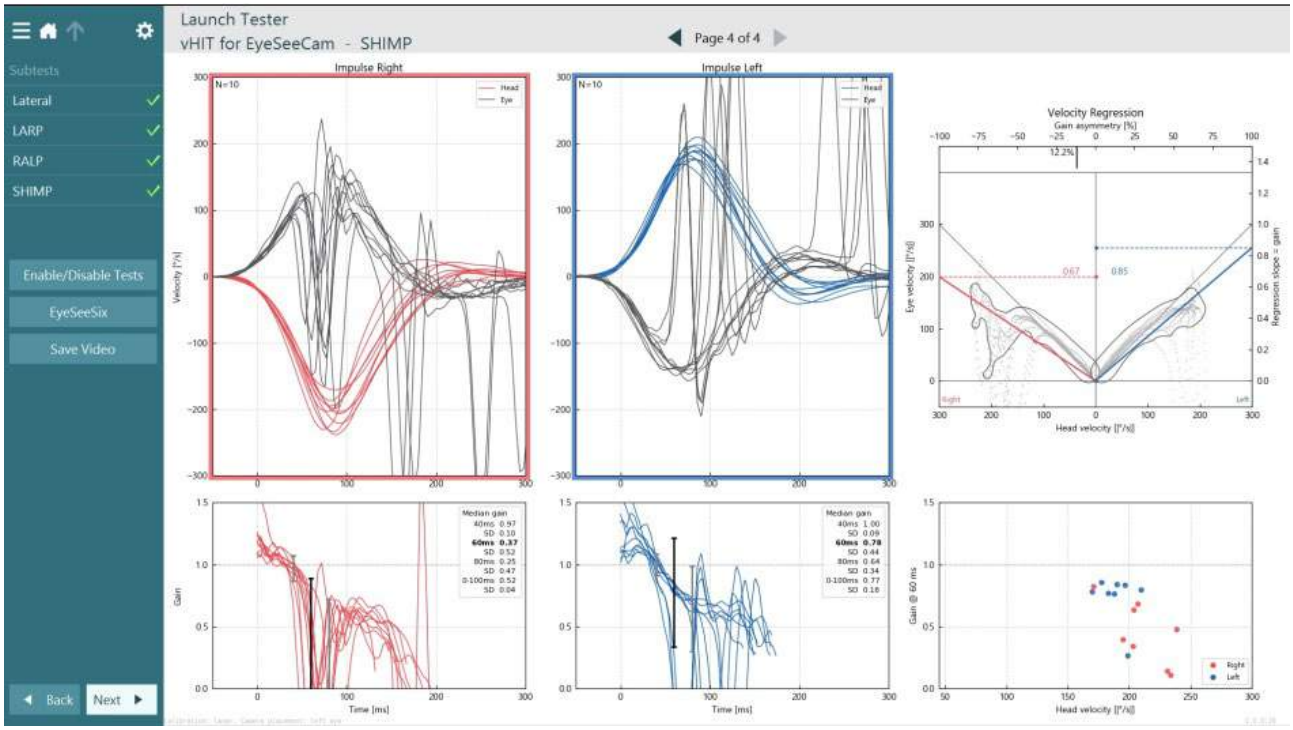


Figure 3. 2. 21 Result screen for SHIMP test

4 Patient sessions

4.1 Selecting a session

VisualEyes™ system easily allows review of current and or previous sessions for the selected patient. After selecting the desired patient profile, the operator can select the **Patient Sessions** button from the VisualEyes main screen. This helps to review a previous test sessions of the selected patient (Figure 4. 1. 1).

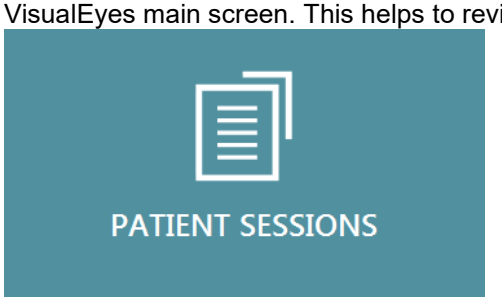


Figure 4. 1. 1 Patient Sessions button

The Patient Sessions screen lists all of the previous test sessions created in VisualEyes™ 505. Each visit is listed by the date and time when the session was created. Selecting this option will allow review and print of previous individual tests based on test type and date the test was completed. Session dates are displayed in the side menu (Figure 4. 1. 2). Selection of a specific session date will display the tests performed on that day. Clicking on the test title will load the test review screen for that test.

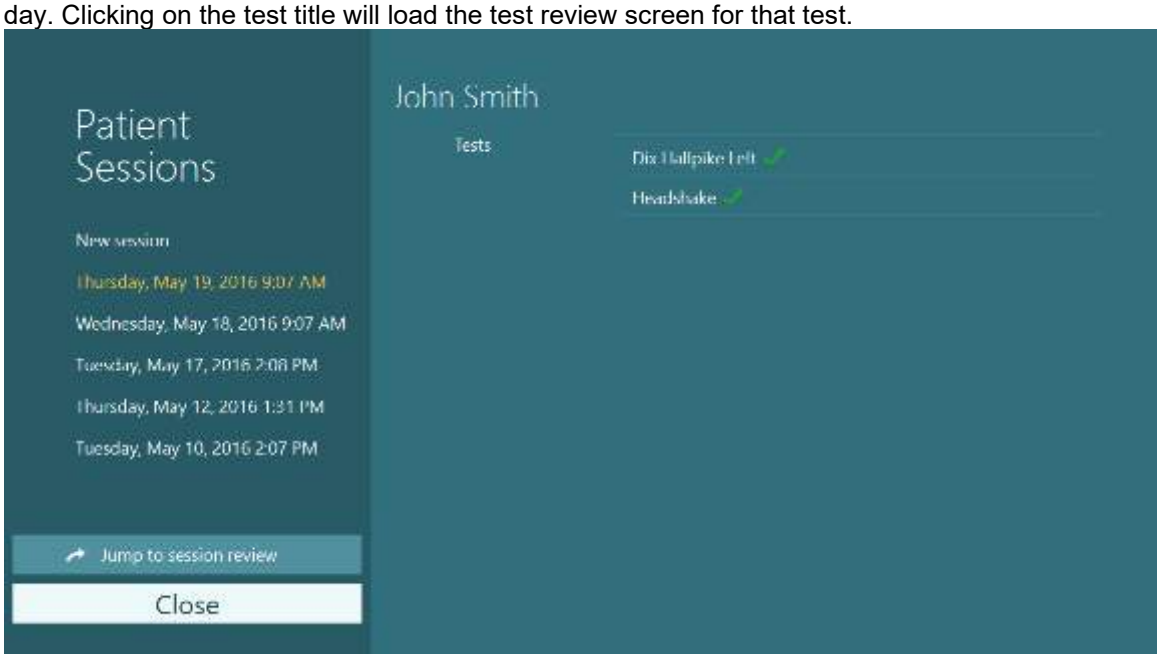


Figure 4. 1. 2 Patient Sessions Screen

4.2 Reviewing the session

After selecting the patient session from the listing, click on the Jump to session review button to go to the Session Review screen (Figure 4. 2. 1.

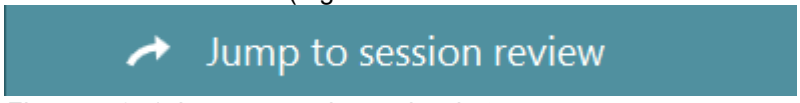


Figure 4. 2. 1 Jump to session review button

In the current patient's session, the Session Review can be accessed from the Review Session button (Figure 4. 2. 2).

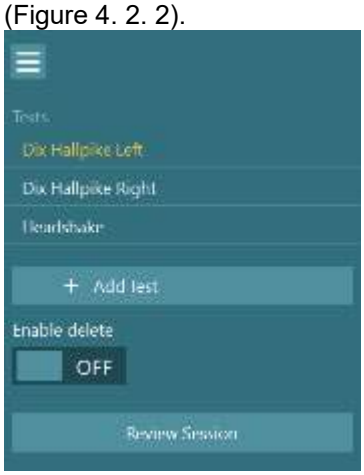


Figure 4. 2. 2 Session Tree Review menu with Review Session button

Review Session will list the tests within the protocol that have been or are yet to be completed (Figure 4. 2. 3). A green checkmark will be present next to completed test names.

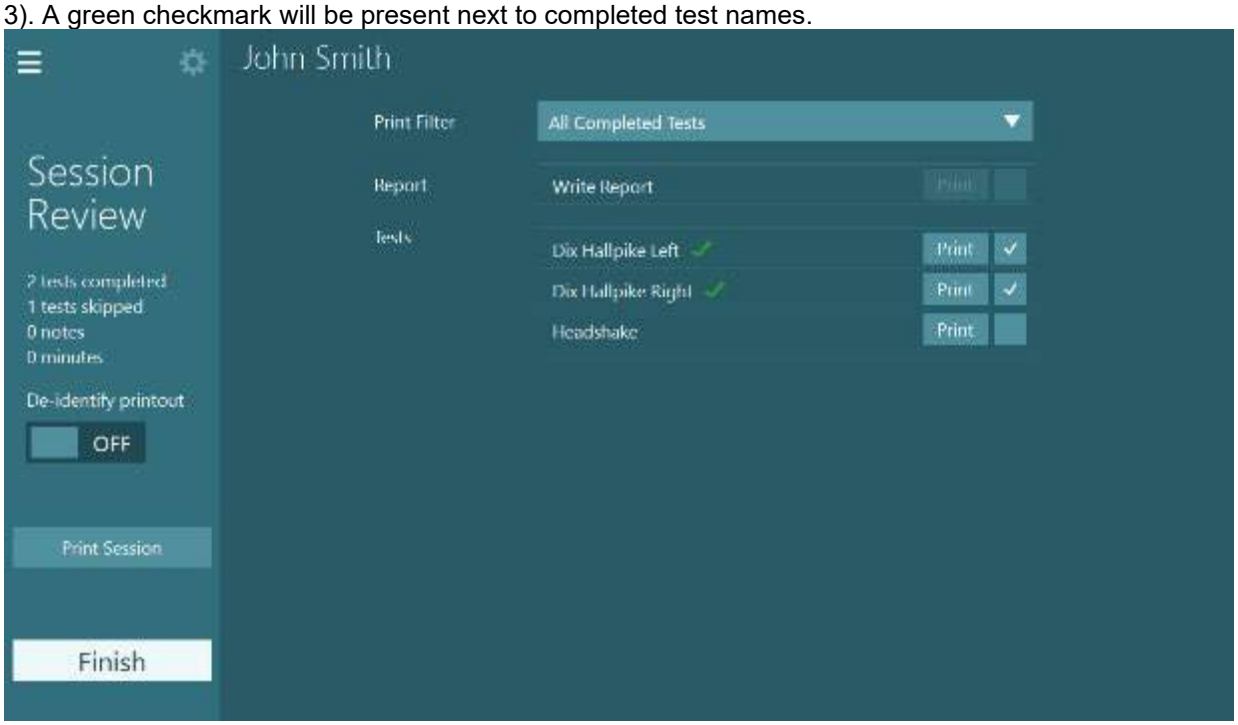


Figure 4. 2. 3 Session Review screen shows complete and incomplete tests

Selecting a specific test will display the results for further analysis.

It is also in the **Session Review** area that the session and or individual tests can be printed (for more information see Chapter 8 Printing).

5 Patient videos

5.1 Recording patient videos

Video recording is set to record some tests in the protocol by default. Which tests to record the video is set in the individual test settings in Protocol Management.

- Select **Configuration**
- Select **Protocol Management**
- Highlight the protocol from the list for editing
- Select a test from the protocol
- Select **Edit Test** the gear icon next to the subtest
- Select **Test Parameters** option

- A Video Auto- Save Settings dialogue box will appear (Figure 5. 1. 1)

Figure 5. 1. 1 Activate/ Deactivate Eye/s and or Room Recordings

VisualEyes™ 505 system provides a manual video save option for those times where one may encounter interesting results in a test without video auto-save settings. Following the completed test, a **Save Video** button will appear in the left side panel. By pressing this button, video recordings of the eyes will be automatically saved to the patient session for current or later review.

5.2 Video playback

The videos recorded during the patient session may be reviewed during and/or after testing.
If the operator is within a current test session and has not yet completed the entire protocol, it is possible to view the videos after each subtest.

This can be done by clicking on the play button within the review screen (Figure 5. 2. 1). A number above the timer will specify how much recording time in seconds is available for review. The video playback will play full recording from beginning to end.

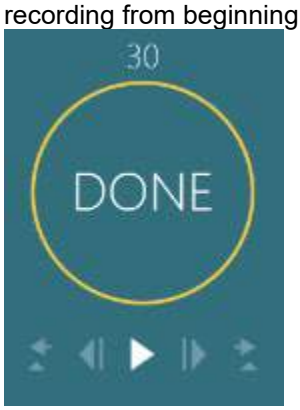


Figure 5. 2. 1 Video playback display

The video playback can be controlled by buttons (Figure 5. 2. 2) displayed in a playback menu bar underneath the timer:

Figure 5. 2. 2 Playback menu

Go to previous frame (hold to play backwards in slow motion).

Play/pause.

Go to next frame (hold to play forwards in slow motion).

Go to previous visible nystagmus point.

Go to next visible nystagmus point.

The video playback presents both eyes and raw trace data in parallel.
The eye movements can be reviewed on both primary and secondary screens. The eye recordings will show the crosshair for easier identification of abnormal eye movements.
A moving dashed line (Figure 5. 2. 3) within the raw trace indicates the current point of video playback.

Figure 5. 2. 3 Dashed line indicating point of video playback

Following a completed session, the recorded videos are archived in the Patient Videos menu.
The video for each individual test can be reviewed by selecting the **Patient Videos** menu from the main screen (Figure 5. 2. 4).

Figure 5. 2. 4 Patient Videos button

The tests are categorized by date and test type (Figure 5. 2. 5).

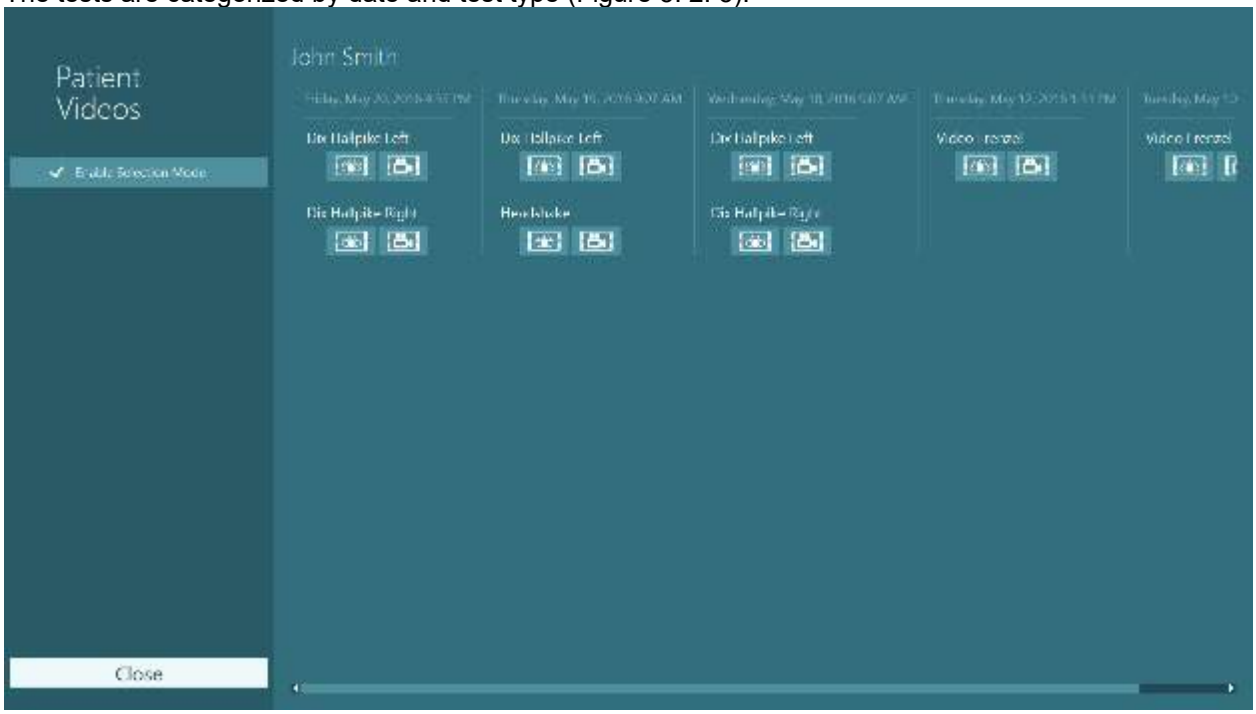


Figure 5. 2. 5 Patient videos display categorized by date and type of test

To playback the video click on the video file of interest. It will be launched in a compatible video player (Figure 5. 2. 6).

Video of eye recordings (no raw data).

Videos of room recording

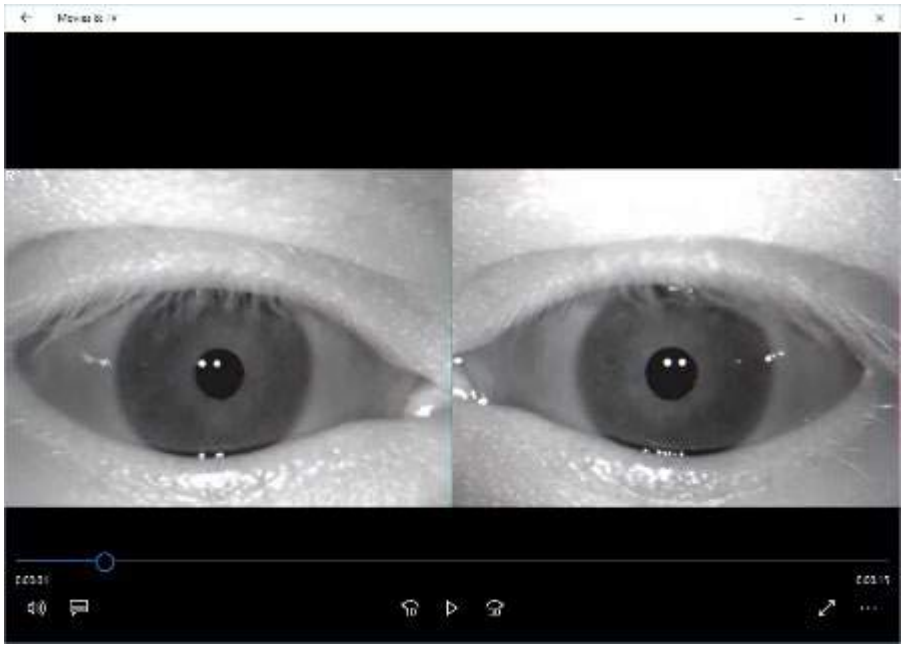


Figure 5. 2. 6 Video playback within a compatible video player

5.3 Exporting patient videos

VisualEyes™ can export videos to another directory or onto an external device. This option is useful should the clinician like to use the recorded video material for teaching purposes or for confirmation of results.

Touch or click on the Enable Selection Mode button (Figure 5. 3. 1) to activate video selection mode. When the video selection mode is active, multiple videos can be selected. When the selection mode is inactive, clicking or touching the video will play the video.

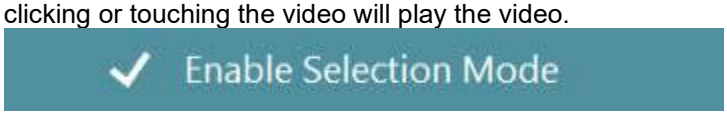


Figure 5. 3. 1 Enable Selection Mode button

Touch or click the videos of interest for Export. The files will highlight yellow (Figure 5. 3. 2) to indicate that these are the chosen files for export.

Figure 5. 3. 2 Highlighted selected videos

Select the **Export Selected Videos** (Figure 5. 3. 3) button.

Figure 5. 3. 3 Export Selected Videos button

The Export Video Files dialog will be displayed. Select the destination directory for exporting the files of interest (Figure 5. 3. 4). By default the eye and room recordings will be merged together (if both the eye and room recordings are selected) to make it easier to use in presentations. Uncheck the option Combine eye and room videos to export the videos without merging.

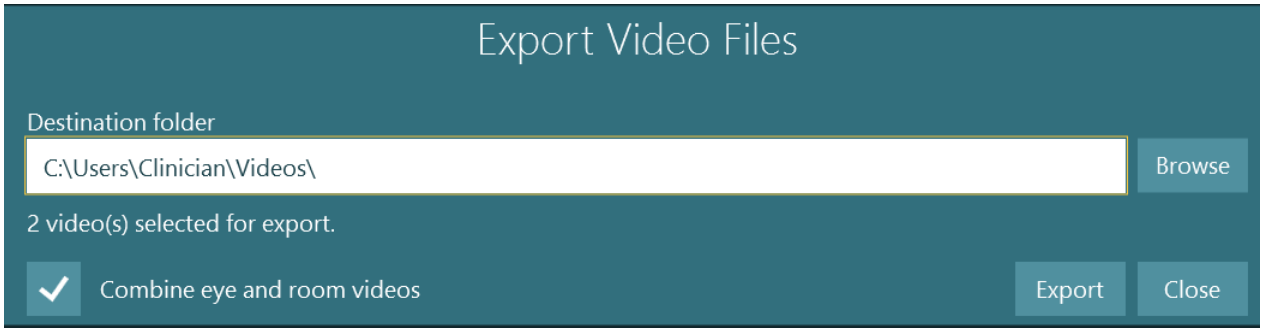


Figure 5. 3. 4 Export Video Files dialog

The export results are shown below the destination folder box (Figure 5. 3. 5). If there are any errors, they will be displayed here as well.

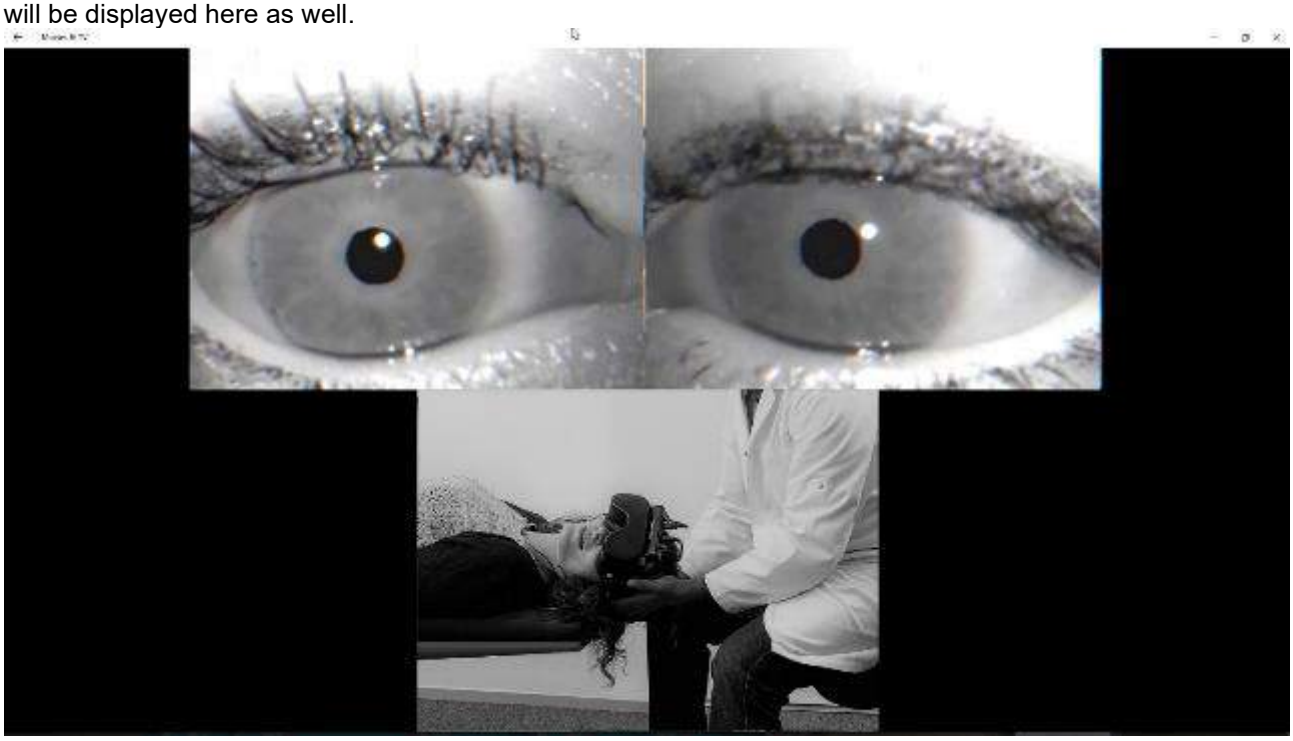


Figure 5. 3. 5 Exported eye and room recording as a merged video

5.4 Delete selected patient videos

Touch or click on the Enable Selection Mode button (Figure 5. 4. 1) to activate video selection mode. When the video selection mode is active, multiple videos can be selected. When the selection mode is inactive, clicking or touching the video will play the video.

Figure 5. 4. 1 Enable Selection Mode button

Touch or click the videos of interest for removal. You can delete both room and eye recordings.
The files will highlight yellow (Figure 5. 4. 2) to indicate that these are the chosen files for removal.

Figure 5. 4. 2 Highlighted selected videos

Select the **Delete Selected Videos** (Figure 5. 4. 3) button.

Figure 5. 4. 3 Delete Selected Videos button

VisualEyes™ 505 system will ask to confirm the deletion (Figure 5. 4. 4).

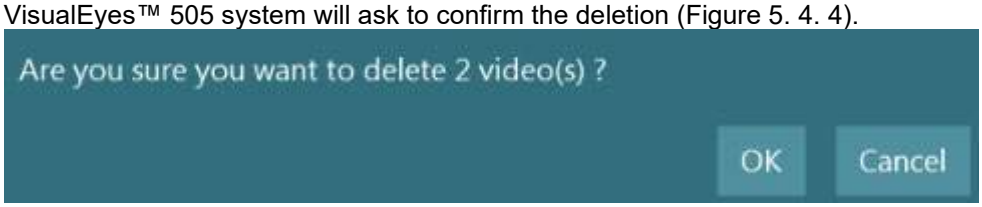


Figure 5. 4. 4 Delete videos confirmation message

NOTICE

The action to delete the videos cannot be undone. Use this feature with care.

6 General editing tools

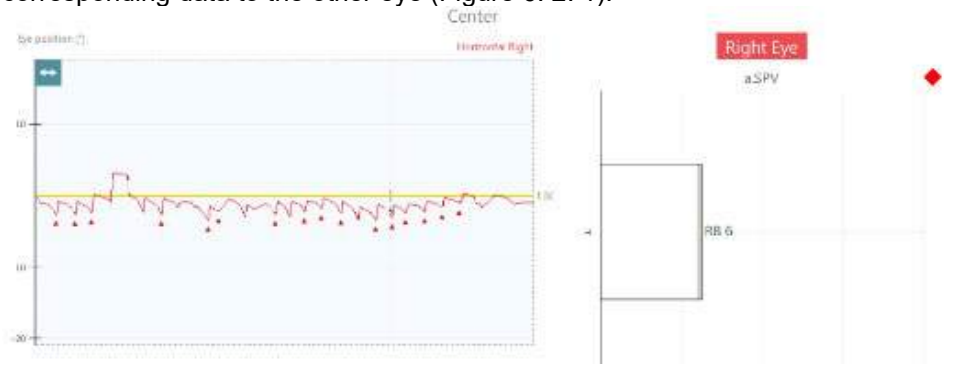
6.1 Quick access test properties

There may be times where it is necessary to make a quick change to a specific test in the protocol. VisualEyes™ 505 software suite provides a way to quickly access test properties that allow temporary changes to be made to a test. This can be accessed by selecting the configuration icon in the side panel.

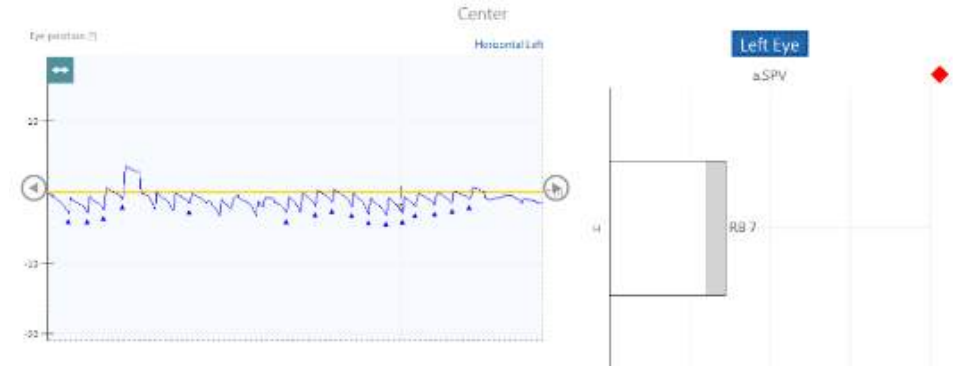
The temporary settings that can be changed will depend on the type of test (spontaneous nystagmus, etc.). Any changes made will be to the patient's current session and will not be saved in the selected protocol.

6.2 Selecting eyes

The VisualEyes™ system is set by default to show results for the best eye recording in the case of nystagmus tests. However, there may be times where the best eye varies from one subtest to another. In such cases the VisualEyes™ system allows the user to change the eye being displayed by simply clicking or touching the Eye display title (i. e. left/right eye). This will change the Eye display title and all the corresponding data to the other eye (Figure 6. 2. 1).



(a) Display for right eye



(b) Display for left eye

Figure 6. 2. 1 Results display for right (a) and left (b) eyes

VisualEyes™ 505 suite provides the option of displaying individual eye traces (i. e. right or left only) for all nystagmus tests. The default SPV indicator (a. SPV bar graph) is set to display the eye with the larger response.

6.3 Pupil diameters

This graph shows how the pupil diameter changes over time. It is used for pupillometry assessment. The value is given in pixels and refers to the pupil size shown on the camera. Only relative size is indicated, and it is not possible to indicate the absolute size (e. g. millimeter).

To activate this trace, select ‘pupil diameter’ (Figure 6. 3. 1) in the test settings (Go to Temporary settings/Computer Screen to see this option):

Figure 6. 3. 1 Pupil Diameter option

6.4 General editing tools

There is an **Edit Tools** item (Figure 6. 4. 1) for editing the nystagmus in the recordings. The options may slightly vary according to the selected tests.

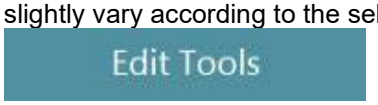


Figure 6. 4. 1 Edit Tools button

The editing options in this menu include (Figure 6. 4. 2):

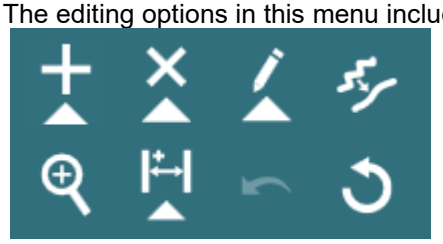


Figure 6. 4. 2 Edit Tools menu for nystagmus configuration

6.4.1 Add Beats

	Selecting this function allows insertion of nystagmus beats that were not originally detected by the nystagmus algorithm (Figure 6. 4. 3).

- Use the selection box to define the start and end points of a nystagmus beat’s slow phase velocity to add to the analysis
- The software will measure the slope identified in the tracing and place a SPV marker in this position or highlight the slope green depending on the system setting

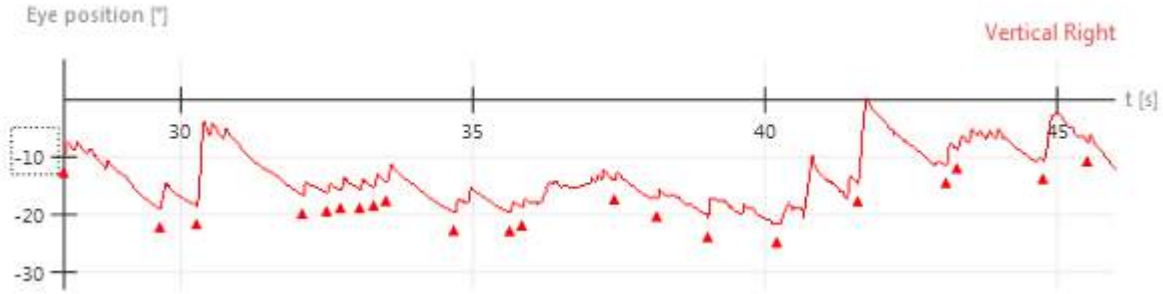


Figure 6. 4. 3 Added beats to nystagmus trace

6.4.2 Remove Beats

	This function will remove multiple nystagmus beats at the operator’s discretion (Figure 6. 4. 4)

- Use the selection box to define the start and end points of the time to remove all nystagmus beats in the selected time frame
- Once removed, the beats become translucent and are removed from the analysis

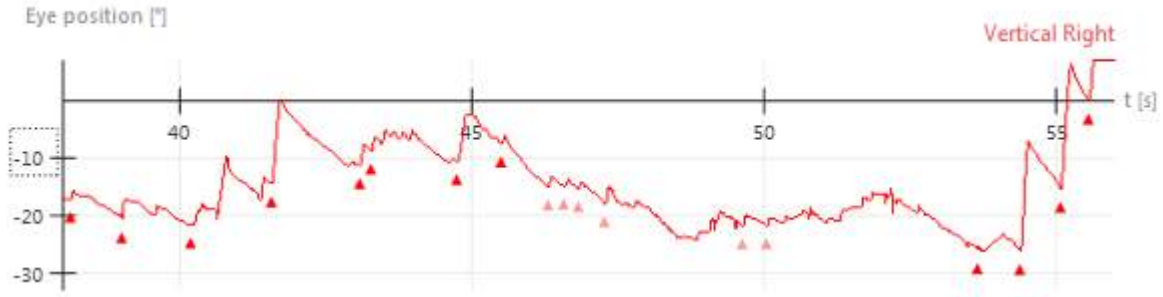


Figure 6. 4. 4 Removed beats with translucent triangles

6.4.3 Edit Slopes

	This function enables overriding the current slope measurement and toggle inclusion of the nystagmus beat in analysis.

- Selecting the tool, the slope of the nystagmus beat will be highlighted in bright green (Figure 6. 4. 5)

Figure 6. 4. 5 Selected nystagmus slope

- The operator can tab through individual beats using the left and right arrow keys on the keyboard or by using touch screen
- For each beat the current SPV value will be displayed on the graph
- Use the up and down arrow or buttons in the tool bar to increase or decrease the slope respectively, 1 degree at a time
- During slope editing *(Figure 6. 4. 6*), the slope line color changes from green to red. Accepting the new value will change the slope line color to green

Figure 6. 4. 6 Editing selected nystagmus slope

- One cannot reverse the phase of the slope, i. e. change a right beating slope into a left beating slope
- The slope value cannot be zero, instead reject the slope from the analysis using the exclude button

- The toolbar displays the current beat's slow phase velocity in the center of the toolbar. To examine the slope values for each nystagmus beat, use the right and left arrow keys to move through the nystagmus beats and note the slow phase velocity value for each beat

Alternative display for viewing nystagmus

- VisualEyes can either display triangles to show the location and direction of nystagmus beats or highlight the nystagmus slow phase in green. In addition to a system wide setting in System Default Settings (see Section 13. 5 General), the current test settings *(Figure 6. 4. 7*) can be changed if desired
- Access the test settings from the gear button on the side panel. Select Nystagmus Parameters
- **Display nystagmus markers** will control whether the nystagmus triangle markers are displayed
- **Highlight nystagmus slow phase** will control whether the nystagmus slow phase is drawn in green color. This setting is applied after the test collection is complete

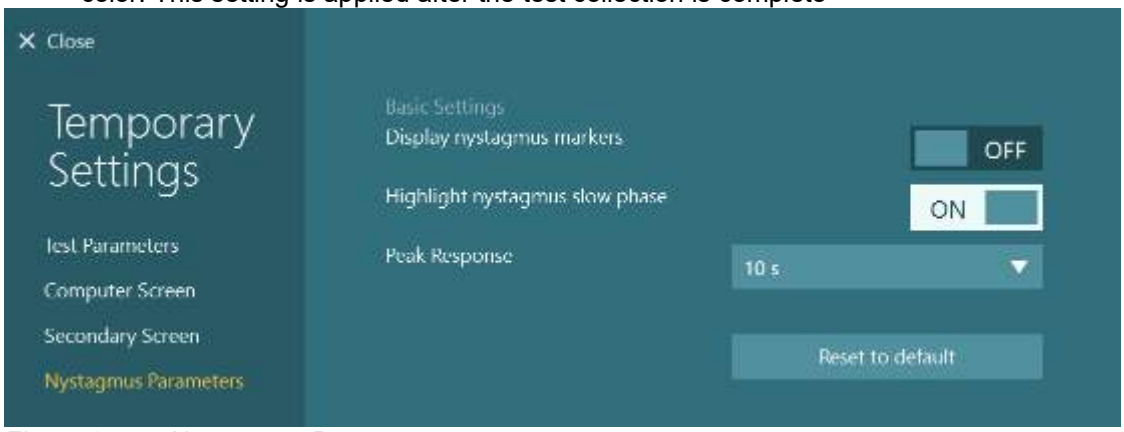


Figure 6. 4. 7 Nystagmus Parameters

- This will give a quick view of the actual slow phase velocity of the nystagmus *(Figure 6. 4. 8*)

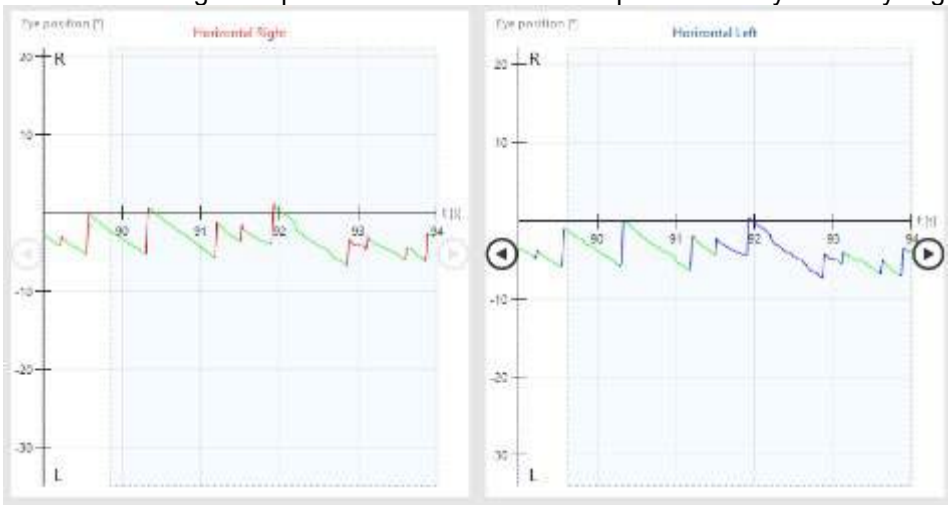


Figure 6. 4. 8 Slow phase velocities highlighted and eyes split into separate graphs

6.4.4 Smooth data

	Data smoothing uses an algorithm to remove noise from a dataset, allowing important patterns to standout

6.4.5 Zoom Trace

	Zoom Trace function provides the ability to zoom in and enlarge segments of the completed test graph for a closer look of the raw data (Figure 6. 4. 9 and Figure 6. 4. 10). The magnification allows the operator to look at the fine details of the waveform to help determine if a beat is actually noise or a real response.

- elect the tool and click on the area of interest
- The area selected will be magnified 2X
- To exit magnification, click anywhere on the graph and it shall return to original view

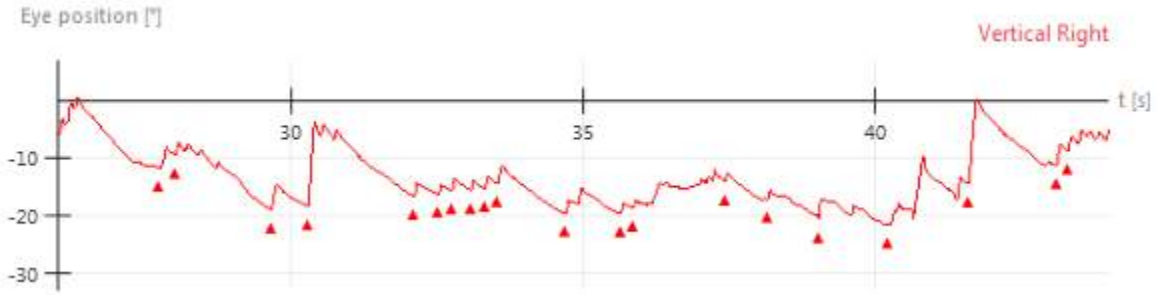


Figure 6. 4. 9 Gaze test Right 30 degrees raw results (no zoom)

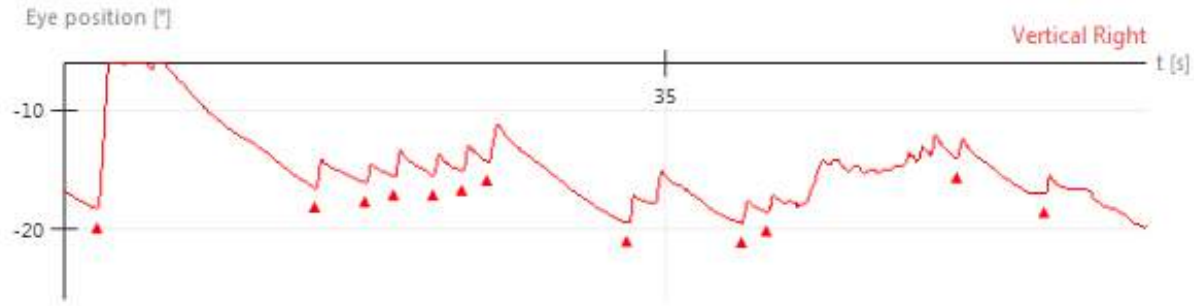


Figure 6. 4. 10 Gaze test Right 30 degrees 2X magnification (time and amplitude)

6.4.6 Enable beats

	This option provides an ability to enable the previously deleted beats in the selected trace area.

6.4.7 Undo last Action

	This option allows user to go one step back in their action.

6.4.8 Reset Beats

	This feature resets the waveform back to the original software analysis. (Figure 6. 4. 11 and Figure 6. 4. 12).

- By selecting this tool all data altered will return to its original software analysis

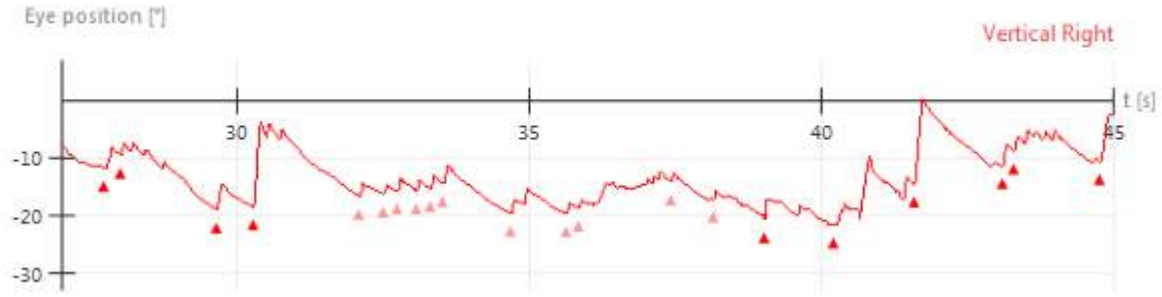


Figure 6. 4. 11 Nystagmus waveform with removed beats

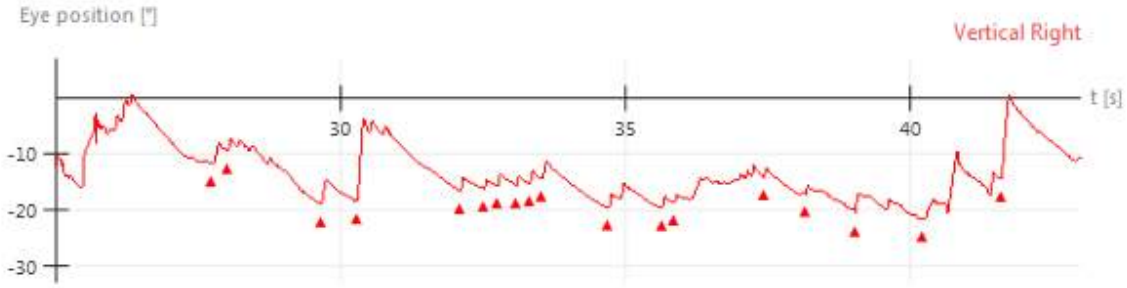


Figure 6. 4. 12 Nystagmus reset to original software analysis

6.4.9 Done Editing

Figure 6. 4. 13 Done Editing button

This function saves the edits made to the data and hides the editing tools (Figure 6. 4. 13).

6.5 Other functions available inside menu

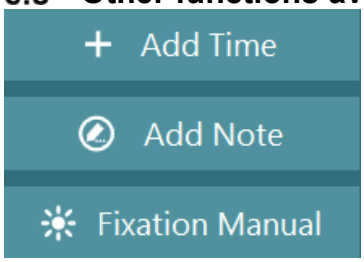


Figure 6. 5. 1 Additional functions available during testing

Add Time: Adds 30 seconds to the test recording (Figure 6. 5. 1).
Add Note: Insert a note at the current time during recording.
Fixation Manual: Turns on the selected fixation light defined in the System Default Settings (see Chapter 13. 2 Input) (controlled by user, not automatic). Also activated using the RF Remote.

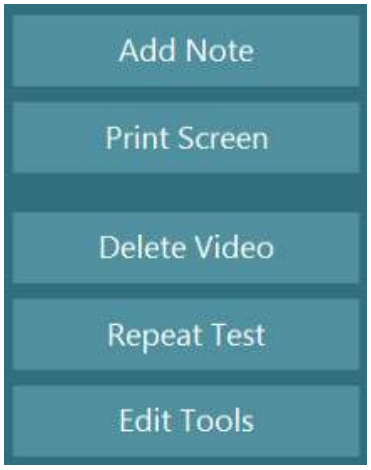


Figure 6. 5. 2 Additional functions available after testing is complete

After the test has finished the following options will be available (Figure 6. 5. 2).
Add Note: Adds a note to the end of the test.
Print Screen: Will print whatever is present on screen at the current time.
Delete Video: Deletes the video of the eye recording and room camera (if recorded) from the computer for this test.
Edit Tools: Provides access to tools used to override the analysis results.
Repeat Test: Repeat / replace the current test. A dialog box will be presented asking if the user would like to overwrite the current test (replace) or create a new instance (repeat) (Figure 6. 5. 3).

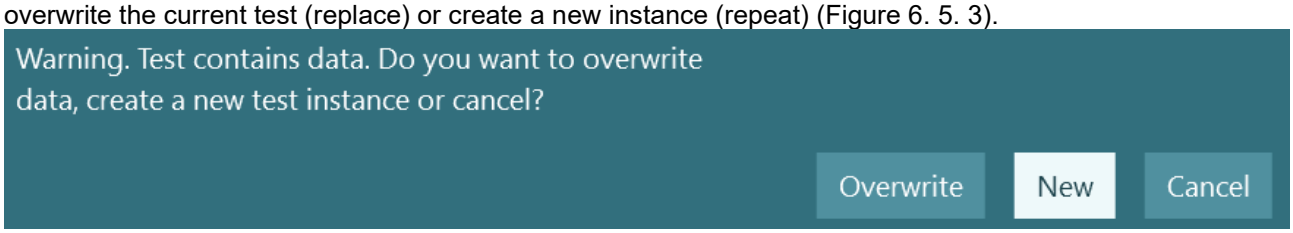


Figure 6. 5. 3 Repeat Test dialog

6.6 Override test results

Results will automatically be classified whether inside or outside threshold levels based on the criteria set in the suggested threshold tables in the system settings. The red diamond will indicate results outside of threshold and the green tick will indicate results within threshold. Should the user decide to overrule an outside of threshold test result, clicking on the red diamond (next to title of test/ sub test) will convert it to a green checkmark and pencil symbol, indicating the user changed the results to within threshold levels.

Symbol	Explanation
	Within Suggested Thresholds
	Altered Result
	Outside of Suggested Thresholds

Should any subtests outside the threshold ranges be altered, the overall test will convert to a within threshold result.

7 Patient report

7.1 Report editor

A report can be created in the report editor within the VisualEyes™ 505 software. This is a word processor that saves the created document in the patient review sessions for later viewing. The report editor can be accessed from the session review screen by selecting ‘Write report’ listing (Figure 7. 1. 1).

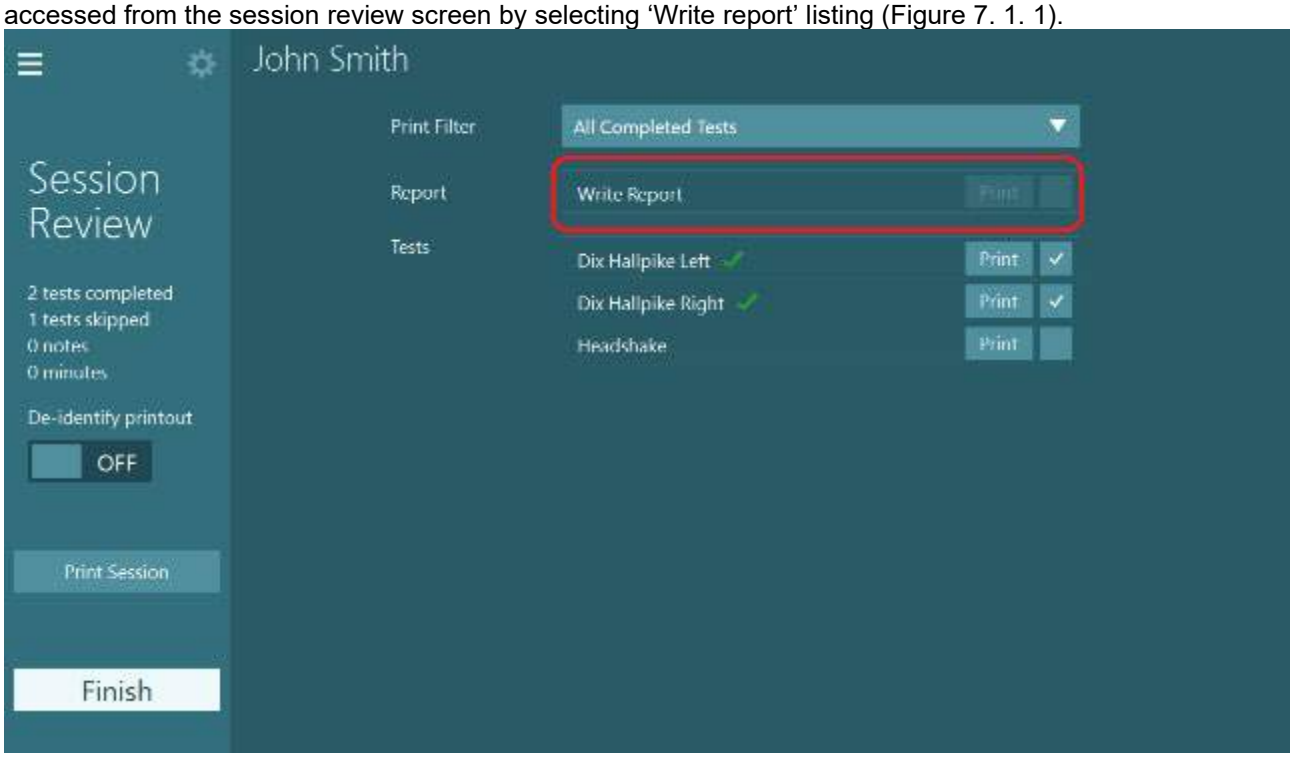


Figure 7. 1. 1 Session Review screen with Write Report circled

Figure 7. 1. 2 Report Editor

7.2 Text styles

The report can be written as per a normal word processor. There are options within the side menu in the report editor to change the font, size and alignment of the text as well as the font weight of bold, italics, and underline (Figure 7. 1. 2).

7.3 Templates

The templates section gives the operator an option to customize the patient report using patient information keywords and findings templates. From the Templates selection, choose the predefined template to use in the report. Using a predefined template will erase the currently written report and replace it with the template. Use the Manage Templates item from the Templates selection box on the Report Editor screen (Figure 7. 3. 1) to enter the Template Editor (Figure 7. 3. 2).

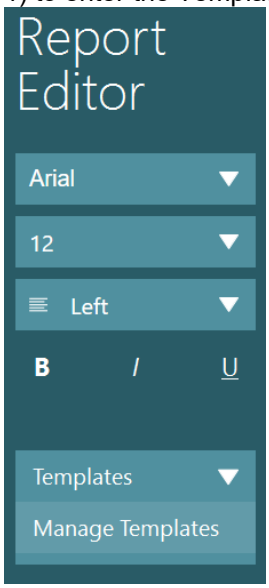


Figure 7. 3. 1 Manage Templates to access Template Editor

Figure 7. 3. 2 Template Editor

With a new installation of VisualEyes™ 505, there are no predefined templates included. Click on the New template button to create a report template (Figure 7. 3. 3 and Figure 7. 3. 4).

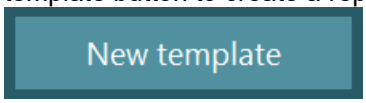


Figure 7. 3. 3 New template button

Figure 7. 3. 4 Template Editor with a new template

By default the name of the template will be New Template 1. This name can be changed at the top of the screen. The report template is then populated with text and can have both keywords and findings added to the template. Select the position in the template report to add the keyword, then select the keyword on the right side of the screen. Click on the add keyword button to add the keyword to the template text. The keyword will be shown with double arrows around the keyword text, e. g. <<Client_FirstName>>. To add a specific finding, click on the Show Findings option in the upper right, then select the appropriate finding from the list and add it with the add finding button.

Figure 7. 3. 5 Add Keyword or Finding button

Once the template text has been written, click or touch on the Save template button.

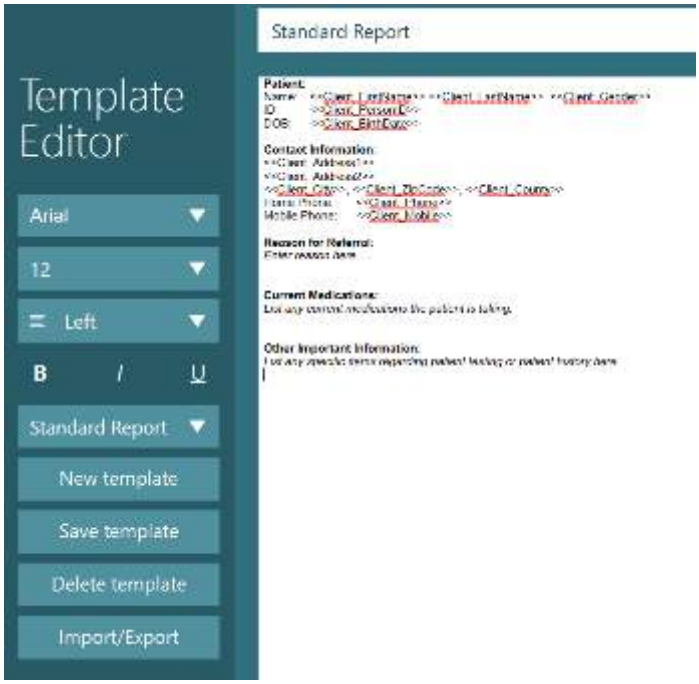


Figure 7. 3. 6 Template Editor with example template

Report templates can be imported or exported to template files using the Import/Export button. A dialog will be shown for selecting a report template to import or choose a location to export the current report template.

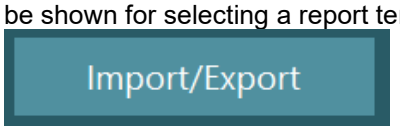


Figure 7. 3. 7 Import/Export button

Click or touch the Close editor button exit the Template Editor screen and return to the Report Editor screen.

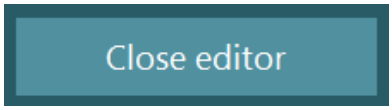


Figure 7. 3. 8 Close editor button

On the Report Editor screen, use the Templates selection box and select the template that was created. VisualEyes™ 505 will ask to replace the report with selected report template.

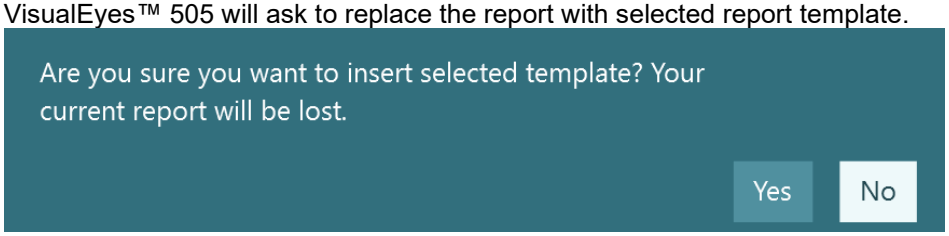


Figure 7. 3. 9 Confirm using selected template message

When the report template is applied, the keywords will be filled with the information from the patient demographics entered into OtoAccess®. Fields that are not filled will be blank in the report.

Figure 7. 3. 10 Report Editor with example patient using example template

7.4 Findings

Findings are predefined templates for patient testing results. They are used for quickly adding a comment of the patient's test result into the patient report. To use one of the findings in the report, move the cursor to the location in the report to insert the finding, then select the finding from the Findings selection menu.

To add a new finding to the list of findings, choose Manage Findings from the Findings menu. This will launch the Findings Editor screen (Figure 7. 4. 1).

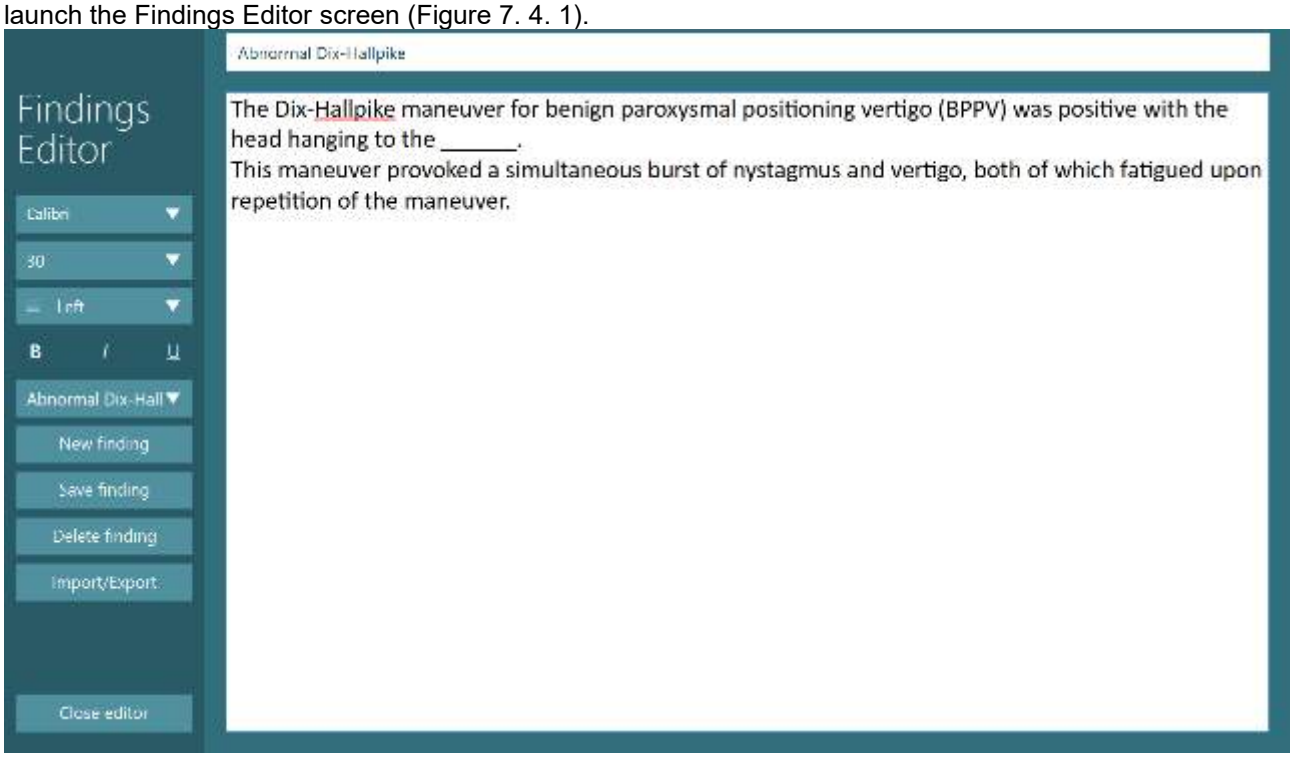


Figure 7. 4. 1 Findings Editor with Abnormal Dix-Hallpike listed

To create a new finding, click on New finding. A new finding called New Finding 1 will be displayed. Enter the text for the finding. The font name, size, and other style attributes will be kept with the text and will be displayed as such when added to the report. Click on the Save finding button when finished, then click on the Close editor button to return to the Report Editor screen.

7.5 Save report

Once a report is complete, select the Close editor button and this shall save the report with the patient's current session (Figure 7. 5. 1).

Figure 7. 5. 1 Session saved confirmation

8 Printing

8.1 Printing results

VisualEyes™ 505 gives the option to print a single test or a number of tests from a session.
A written report and individual tests can be printed out from the Session Review screen (Figure 8. 1. 1).

Figure 8. 1. 1 Session Review and printing options

The Print Filter will select the tests for printing in the report. The default setting is All Completed Tests, which will select all tests that have been performed with notes written to be printed in the report. Tests can be selected individually with the check boxes. Clicking the 'Print Session' button (Figure 8. 1. 2) will print the report with the selected tests and the clinical report (if selected).

Figure 8. 1. 2 Print button for the whole session

Once printing commences a status bar will appear to show the progress (Figure 8. 1. 3).

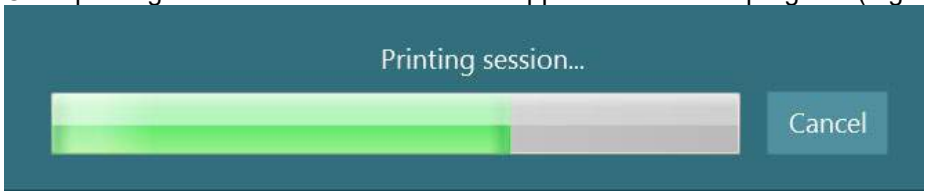


Figure 8. 1. 3 Print Status

8.2 Preview / Printing a session

Click on the Print Session to print the report directly to the selected printer. Click on the Preview button to review the report first. The report can be sent to the printer from the preview screen.

8.3 De-Identify patient name

When a report is printed the demographics of the patient entered into OtoAccess® database will automatically be displayed as identifiers on each page of the printout.

Enabling this feature (Figure 8. 3. 1) will create the results without displaying vital information about the patient in the page headers. This allows for using the patient data without disclosing any identifiers about the particular patient. This will not override the use of the keywords for the patient identifiers in the written report.

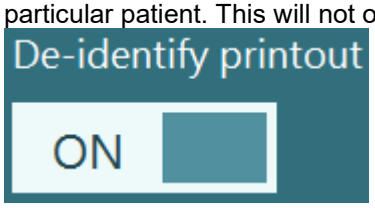


Figure 8. 3. 1 De-identify printout option

8.4 Printing a single test or clinical report

The clinical report can be printed individually using the Print button next to the Clinical Report.

A single test can be printed by clicking or touching the Print button beside the test name. The printed document will contain the notes for the test only.

Alternatively the test can be printed from the Test Review screen by clicking or touching the Print Screen (Figure 8. 4. 1) button.

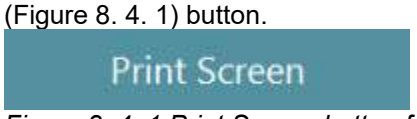


Figure 8. 4. 1 Print Screen button from Test Review screen

8.5 Create PDF

Figure 8. 5. 1 Create PDF button

Clicking or touching the Create PDF button will print the session with the selected tests and the clinical report (if selected) to a PDF file to a predefined data location. For further information refer to Chapter 10. 8 Print PDF.

8.6 Print to Database

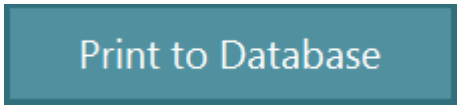


Figure 8. 6. 1 Print to Database button

Clicking or touching the Print to Database button will print the session with the selected tests and the clinical report (if selected) to an XPS file stored in the OtoAccess® 2 database. The report can be reviewed and printed from the OtoAccess® 2 database. If VisualEyes 505 is launched from OtoAccess® 1 software, this feature is not available.

9 Protocols and test settings

9.1 Protocols

Protocols are able to be customized to the desired settings of the end user. They may be composed from a list of tests and designated to be performed in a specific order at the preference of clinician or clinic. The default protocol is the list of tests that will be selected automatically when a new patient is tested in VisualEyes™ 505 and is designated with a star icon. On the main screen, the default protocol is automatically selected and is shown below the Begin Testing button.

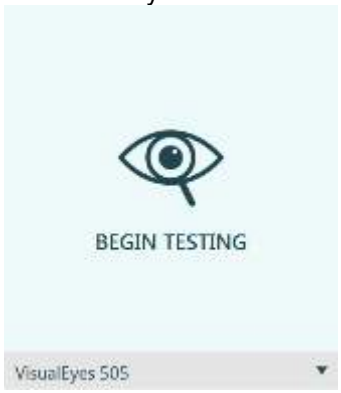


Figure 9. 1. 1 Begin Testing button with default protocol selected

By selecting the Configuration button and choosing Protocol Management, the user will be able to access the Protocol Management screen to modify the existing protocols or create new protocols.

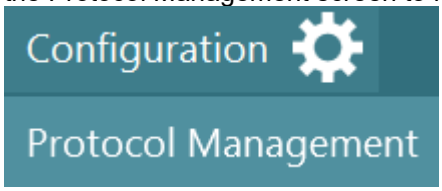


Figure 9. 1. 2 Protocol Management from Configuration menu

The Protocol Management screen will be shown listing the available protocols on the left and the tests in the currently selected protocol on the right.

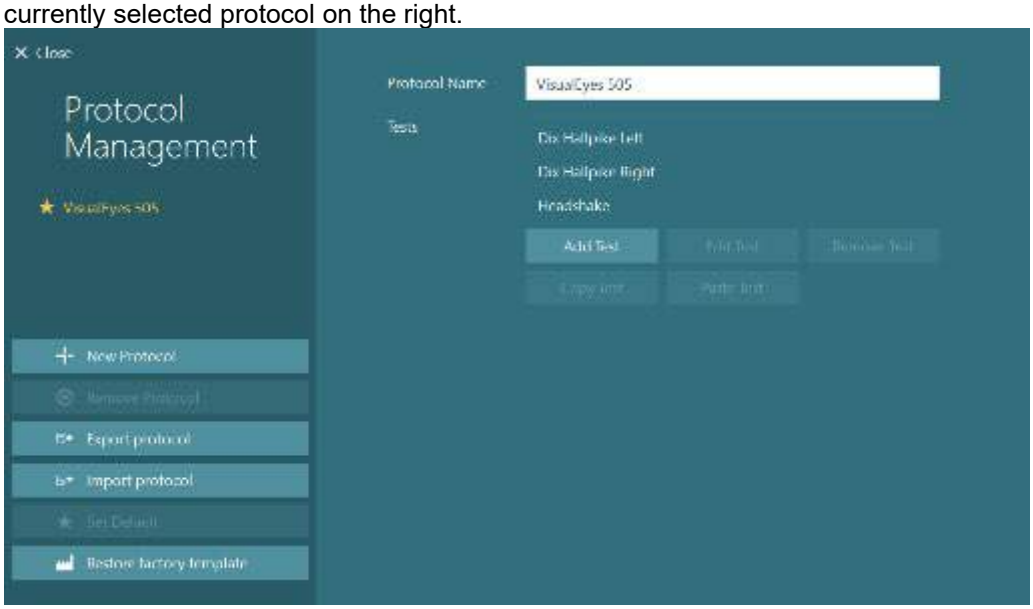


Figure 9. 1. 3 Protocol Management screen

9.2 Creating a new protocol

Clicking or touching the New Protocol button will create a new empty protocol (Figure 9. 2. 1).

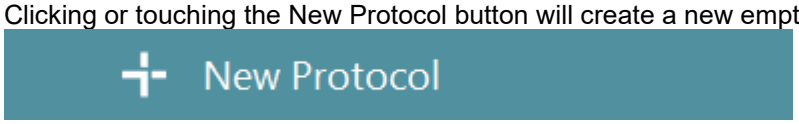


Figure 9. 2. 1 New Protocol button

The new protocol will be named New Protocol 1 which can be renamed (Figure 9. 2. 2).

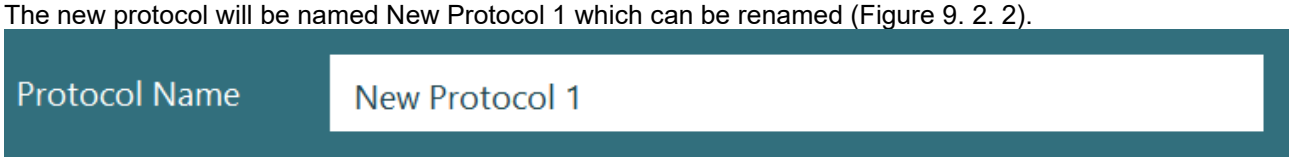


Figure 9. 2. 2 Protocol Name field with default New Protocol 1 name

Multiple protocols can be created and used to separate testing paradigms, user preferences, or hardware configurations (Figure 9. 2. 3).

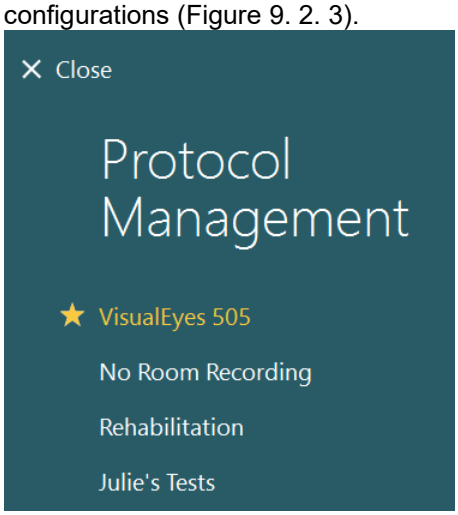


Figure 9. 2. 3 Protocol Listing

To add tests to the new protocol, click or touch the Add Test button (Figure 9. 2. 4) and select the Video Frenzel test from the popup list.

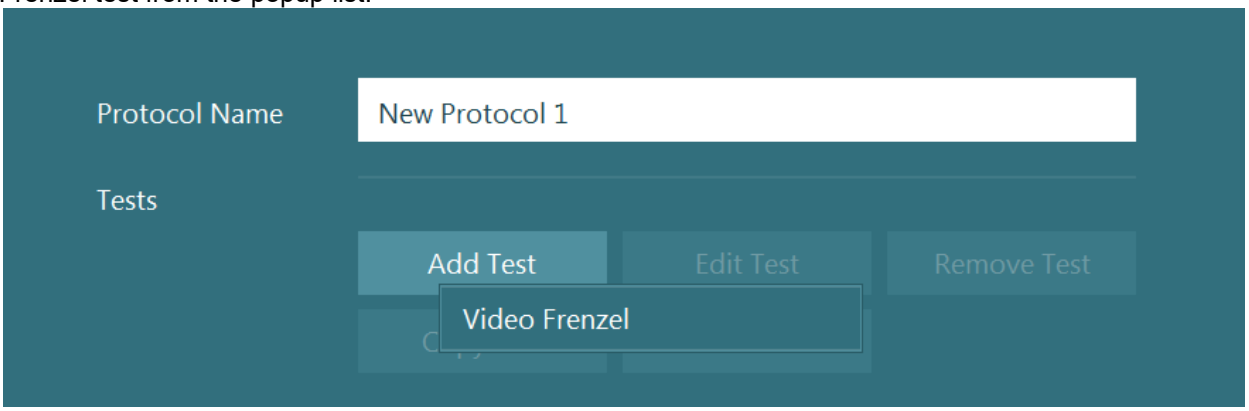


Figure 9. 2. 4 Add Test button

Additional tests can be created using the Add Test button or select a test, then click on the Copy Test button and Paste Test button to add it to the list. Tests can be renamed by clicking on Edit Test and changing the Test Name.

The tests within the protocol can be changed from their assigned position, by clicking the specific test with the mouse and dragging it up and down the list to the desired position.

9.3 Setting default protocol

The default protocol is the list of tests that will be selected automatically when a new patient is tested in VisualEyes™ 505 and is designated with a star icon. If multiple protocols are available, the first protocol is selected as the default protocol. If a different protocol should be set as the default protocol, select the appropriate protocol in the list, then click on the Set Default protocol button (Figure 9. 3. 1). A star shall appear next to the protocol name to symbolize the change (Figure 9. 3. 2).

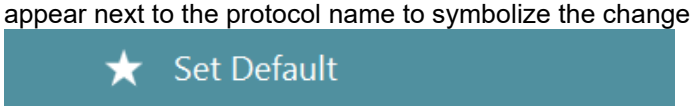


Figure 9. 3. 1 Set Default protocol button

Figure 9. 3. 2 Default Protocol changed

9.4 Remove protocol

Protocols can be removed from the Protocol Management if desired. Select the protocol and then click or touch the Remove Protocol button (Figure 9. 4. 1). VisualEyes™ 505 will require confirmation of the deletion.

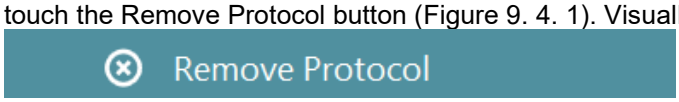


Figure 9. 4. 1 Remove Protocol button

When Protocol Management is closed, the software will ask to save the changes to the protocols. By choosing Save, all of the changes made to the protocols, including deleting protocols, will be made permanent (Figure 9. 4. 2). Choosing Don't Save will undo all changes, including protocol deletion, and revert the protocol settings back to the state before entering Protocol Management.

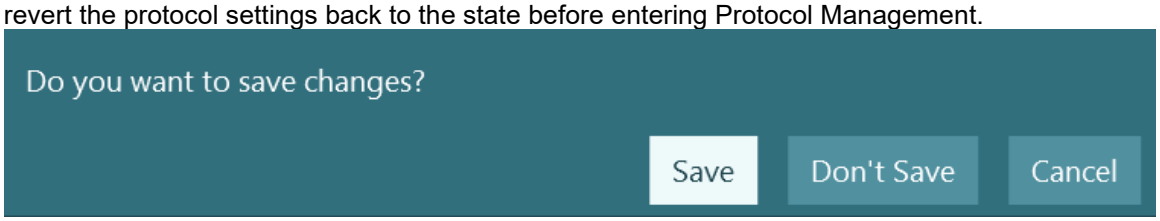


Figure 9. 4. 2 Save changes to protocols confirmation

9.5 Export and import protocol

VisualEyes™ 505 supports importing and exporting custom protocols of tests. After configuring the protocol as desired, select the protocol and then click or touch the Export protocol button (Figure 9. 5. 1). A dialog will be presented to select the destination folder for the exported protocol (Figure 9. 5. 2). Click on the Browse button to select a different folder. Click on the Export button to copy the protocol to the destination folder.

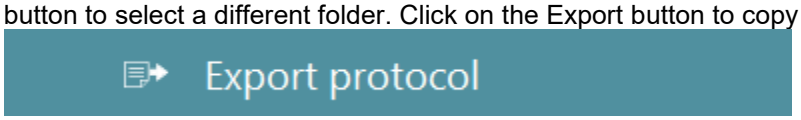


Figure 9. 5. 1 Export protocol button

Figure 9. 5. 2 Export protocol dialog

Clicking or touching the Import protocol button will present an Import protocol dialog. Click on the Browse button to locate the protocol file, then click or touch the Import button to add the protocol to the list of protocols. If the protocol already exists in the list, a copy of the protocol will be added. This can be used to copy a standard protocol for different users.

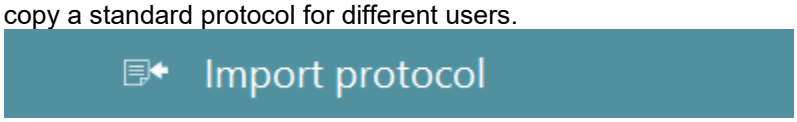


Figure 9. 5. 3 Import protocol button

Figure 9. 5. 4 Import protocol dialog

9.6 Restore factory protocol settings

The Set as default button available in the test settings screen allows the user to modify the default settings for creating new tests. In addition to using the Reset to default button to revert one page of settings back to factory defaults, the Restore factory template button will revert all settings back to the factory defaults. This will only affect new tests created; any existing tests in the protocols will not be affected.

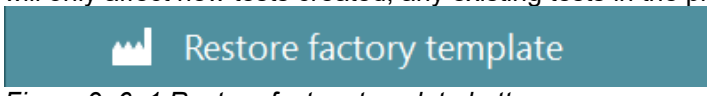


Figure 9. 6. 1 Restore factory template button

9.7 Configuring the tests

All tests within the VisualEyes™ 505 can be configured to the user' preference. The changes can be made from Protocol Management, where the changes will be available for new patients, or the changes can be made from the test's temporary settings, which will affect the current test if the test has not yet been performed.

By clicking on the Edit Test button or temporary settings button from the test screen, the properties for the current test are displayed.

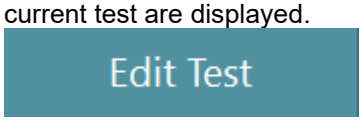


Figure 9. 7. 1 Edit Test button

Figure 9. 7. 2 Temporary Settings button (from testing screen)

The Test Parameters page will provide the following options:

- Test Name – name for the test
- Save Eye Recording – option to automatically save the eye recording during testing, default is on
- Save Room Recording – option to automatically save the room recording during testing, default is on

NOTICE

It is not recommended to turn off the Save Eye Recording or Save Room Recording in VisualEyes™ 505.

Figure 9. 7. 3 Settings screen showing Test Parameters

The Computer Screen and Secondary Screen pages will provide the following options:

- Display Eyes – shows the eyes on the screen, default is on
- Display Room Camera – shows the room camera recording on the screen, default is on
- Eye image size – sets the default size of the eye recordings, filling the remainder of the screen with the room camera recording, default is 61%

NOTICE

If the Display Eyes or Display Room Camera is turned off, the video will not be recorded for the eyes or room camera respectively. If the Display Eyes or Display Room Camera is turned on, verify the Save Eyes or Save Room Recording is turned on as well on the Test Parameters page.

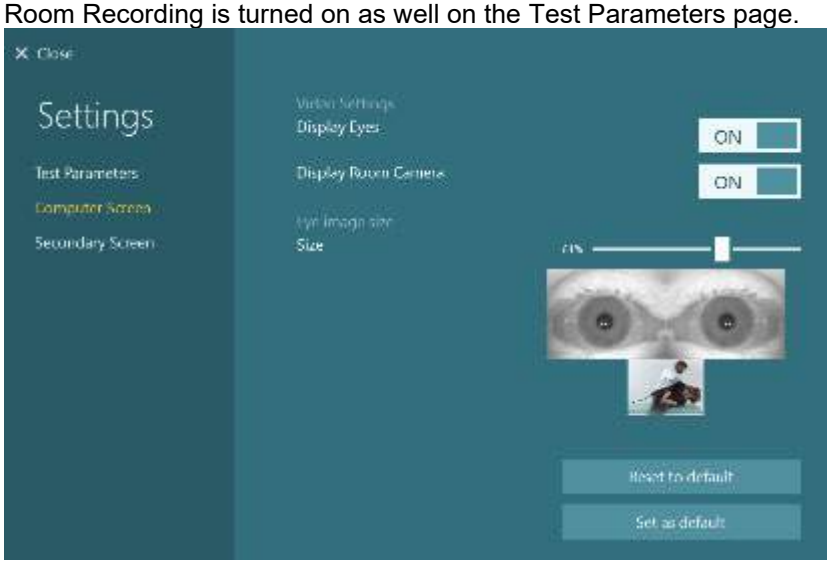


Figure 9. 7. 4 Computer and Secondary Screen settings

Changes made to the settings of the video Frenzel tests can be used in place of the default settings. For example the size value for the eye image size is set to 61% by default. If all tests should be set to have the eye image size the same width as the room camera recording (33% for binocular recording, 50% for monocular recording), then adjust the size slider and click on the Set as default button (Figure 6. 5. 5). The software will ask if these settings should apply to all new tests created. Click on Continue to make the settings default (Figure 9. 7. 6). In order to restore the default settings for the current settings page, click on the Reset to default button (Figure 9. 7. 7).

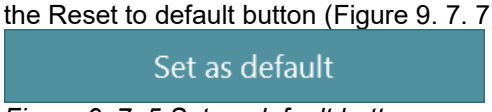


Figure 9. 7. 5 Set as default button

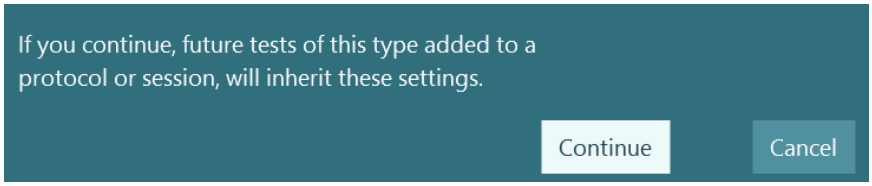


Figure 9. 7. 6 Confirmation message to save settings as defaults

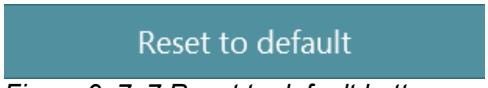


Figure 9. 7. 7 Reset to default button

Note: The configuration options for standard tests are discussed here. The user can also utilize the available options according to their add on modules and tests.

9.7.1 Configuring the Video Frenzel test (standard test)

Configuration options through protocol management (Permanent settings) or Temporary Settings, Figure 9. 7. 8:

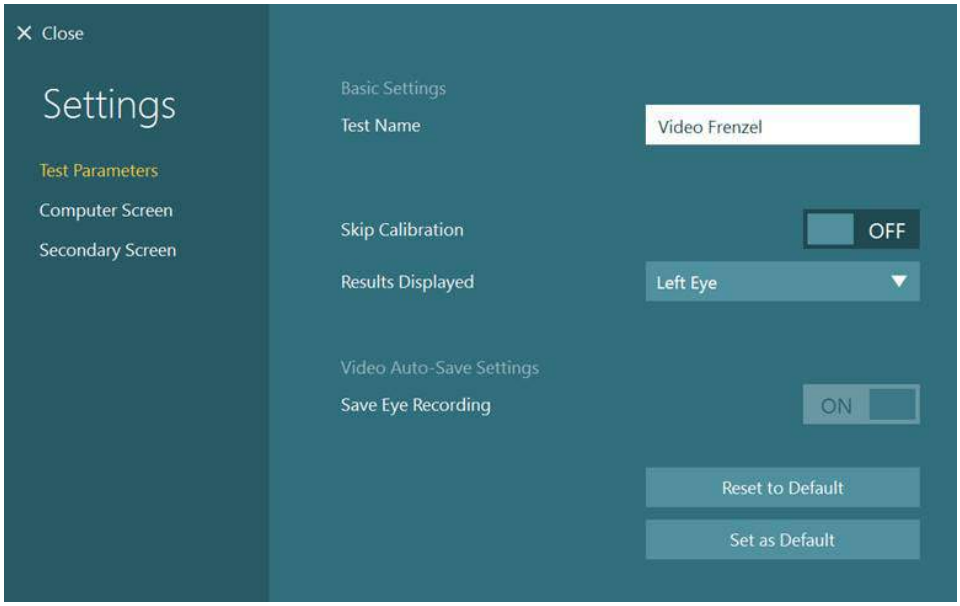


Figure 9. 7. 8 Video Frenzel test settings

Test Name: Name of test
Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).
Skip Calibration: The user can skip calibration to proceed with the test
Results Displayed: Selects which eye is shown by default. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.
Save Eye Recording: Choice to save eye video recordings.

9.7.2 Configuring the spontaneous nystagmus test (standard test)

Configuration options through protocol management (Permanent settings) or Temporary Settings (Figure 9. 7. 9):

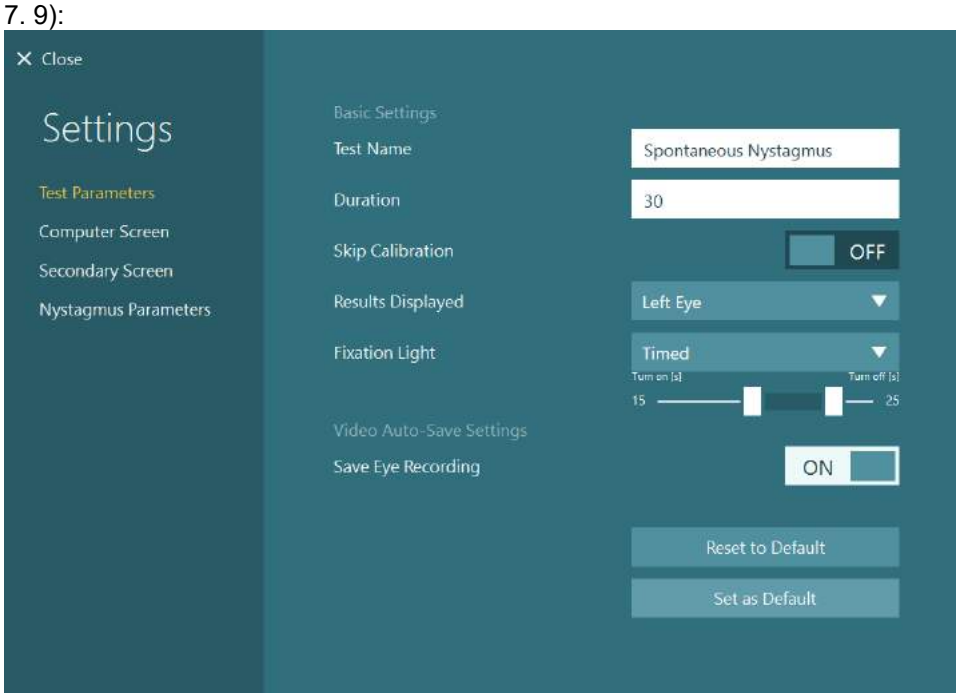


Figure 9. 7. 9 Spontaneous Nystagmus test settings

Test Name: Name of test
Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).
Skip Calibration: The user can skip calibration to proceed with the test
Results Displayed: Selects which eye is shown by default. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.
Fixation light: Determines when the fixation light in the goggles is displayed. Manual (default) will leave the operator to determine when the fixation light should be displayed. Timed will have the fixation light come on automatically at the designated time.
Save Eye Recording: Choice to save eye video recordings.

10 System default settings

10.1 System Default Settings

By selecting the Configuration button and choosing System Default Settings, the user will be able to access the various hardware and software settings.

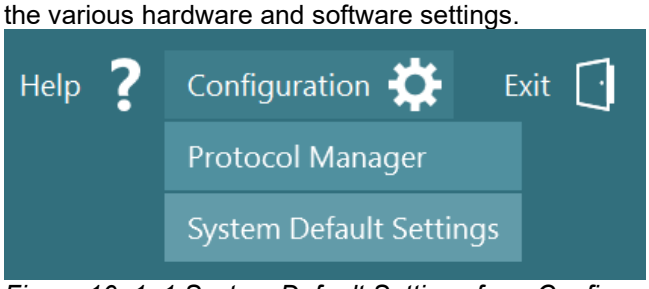


Figure 10. 1. 1 System Default Settings from Configuration menu

10.2 Input Settings

The Input settings screen provides access to the cameras and video settings.

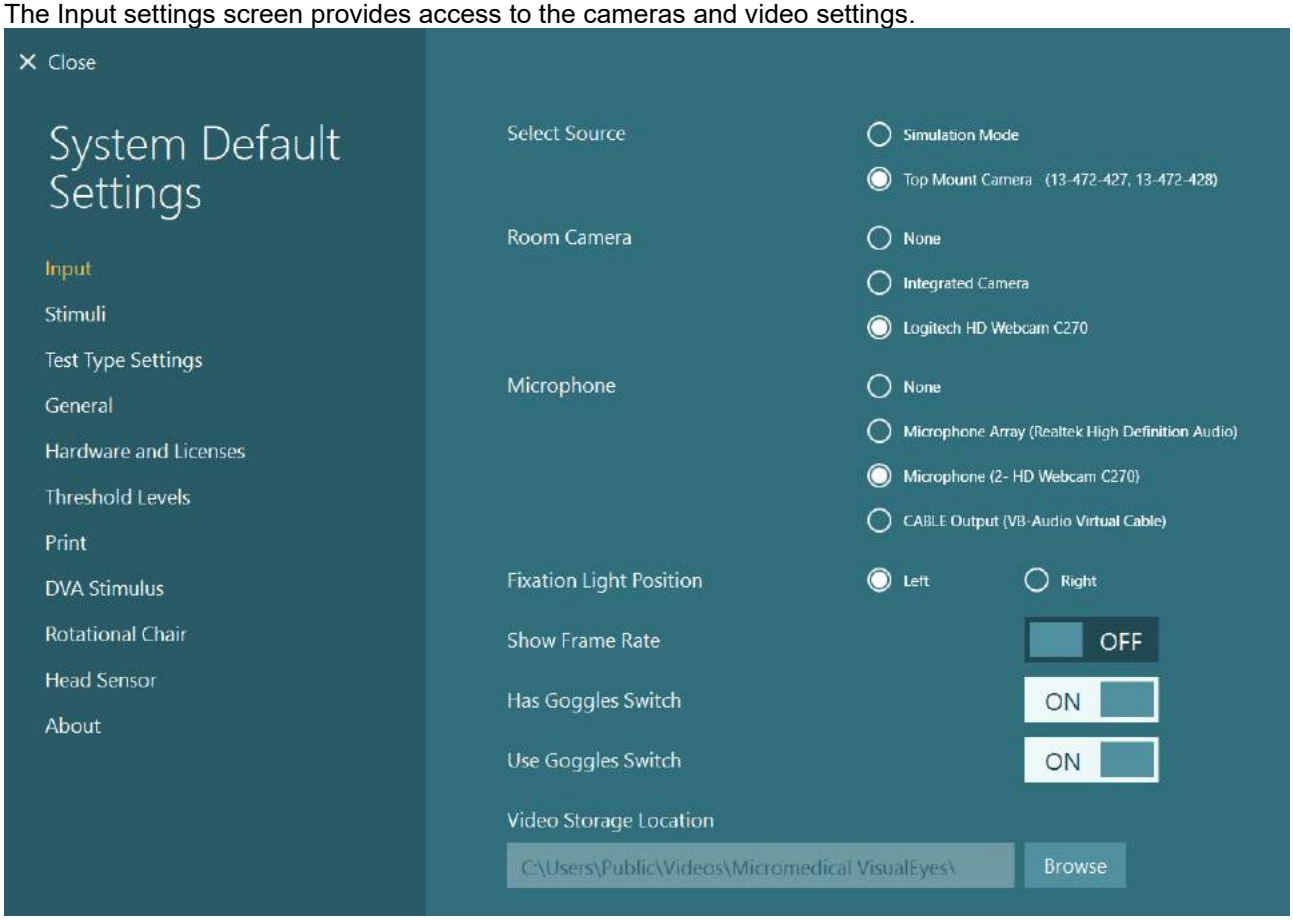


Figure 10. 2. 1 Hardware settings

The Select Source field determines which hardware is to be used for data acquisition. This would be limited to cameras for video frenzel systems, but would also contain other hardware in VNG systems.

- Simulated camera – demonstration option showing only an image of the eyes
- Top mount camera goggles (two cameras)
- Front mount camera goggles (single camera)
- Side mount camera goggles (single or two cameras)

The Room Camera selection will choose the camera for room recording. Choosing none will not initialize any room camera and will prevent the recording of the patient interview.

The Microphone selection will choose the audio recording source combined with the room recording and patient interview. If the Room Camera selection is set to none, the Microphone selection is not used.

The Fixation Light Position selects which fixation light to use in the top mount camera goggles and the side mount camera goggles. The front mount camera goggles will light the fixation light regardless of this setting.

The Show Frame Rate option displays the frame rate of the cameras as they are capturing video. This is a diagnostic tool used to check if the cameras are working correctly with the computer and normally is off.

The Has Goggles Switch option is available only with the top mount camera goggles and defines the goggles type as having the side switch. If the camera model does not have a side switch, this option should be turned off. The default setting is on.

The Use Goggles Switch option is a user preference option available only with the top mount camera goggles. If the camera model has a side switch, but the user does not wish to use the side switch and wants to disable the side switch completely, then this option should be turned off. The default setting is on.

The Video Storage Location sets the location where the videos are stored for the eye recording and the room recording. By default this is set to a Micromedical VisualEyes™ subfolder under the public videos folder. This can be changed to use a network location if desired.

10.3 Stimuli

The Stimuli settings are not used in the VisualEyes™ 505 system in general, as calibration is not required. However if a TV or second monitor is used in conjunction with the VisualEyes™ 505 system to showcase the eye recordings and room recording on a second screen, then the Stimulus Type must be set to TV, the Default Stimulus set ON, and the Secondary Monitor set ON. Set the correct display for the TV for the Select Monitor setting.

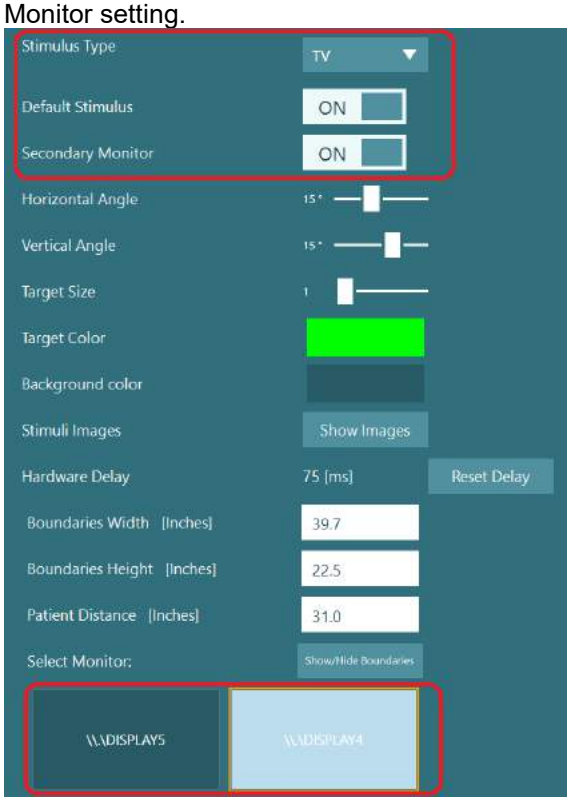


Figure 10. 3. 1 Stimulus settings

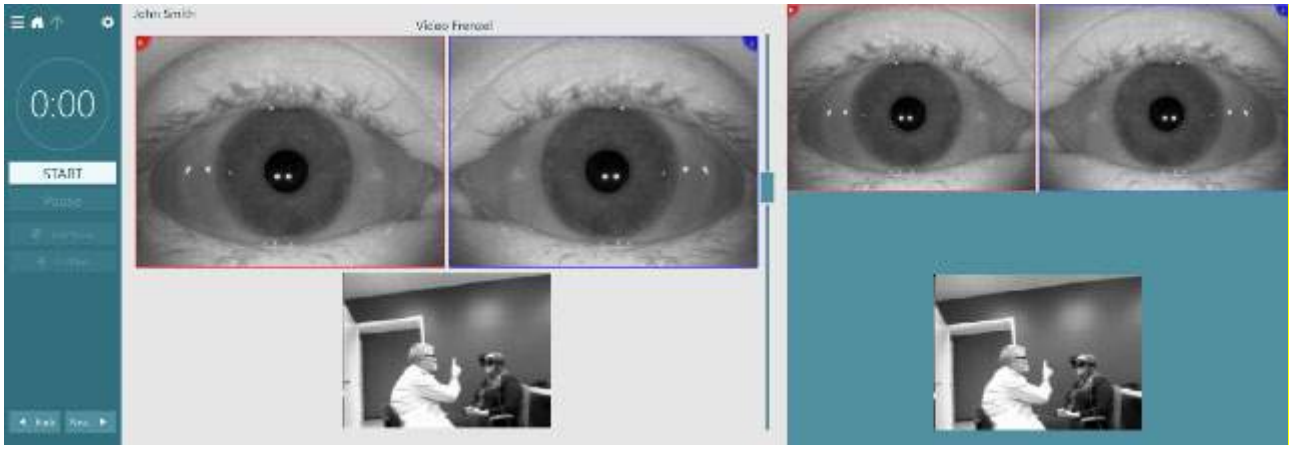


Figure 10. 3. 2 Test Screen with the second monitor enabled supporting different monitor resolutions

10.4 Test Type Settings

The Test Type Settings menu (Figure 10. 4. 1) presents options to customize the timer function.

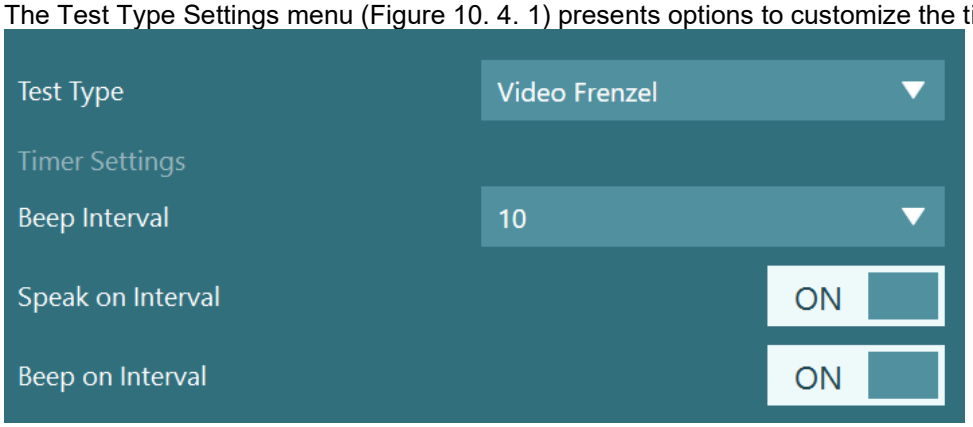


Figure 10. 4. 1 Timer settings

Beep Interval: Assigns the length of time between presentations of the beep and/or speaker. Selecting the numerical field will provide a drop down menu with interval options of 5, 10, 20 and 30 seconds.

Speak on Interval: Activating this feature will enable a vocal alert in English for each interval. The voice pronounces the time at the interval.

Beep on Interval: Activating this feature will enable a tonal alert to be presented at each specified interval.

Depends on the test selected, you can also view the following additional settings:

Shows Numeric Values on Graphs (e. g DVA test) : Activating this feature will enable the option to view the numerical values in the graphical display.

Count Style (e. g Dix Hallpike advanced Test): Choice to choose the ascending or descending order of counting style.

10.5 General

The General settings page contains additional program settings, though only the language and Hide Patient Identity apply to VF505 systems. Hide Patient Identity will hide the patient name and ID from the software screens and report. The report will print blank values in the header and the clinical report. The patient name and ID will still be available in the OtoAccess® software.

Language can also be selected within General Settings. Changing the program language will display the text in the selected language. The software will ask if the user wishes to change the names of the tests in all of the protocols to the new language in the newly selected language. The software supports Chinese, English, French, German, Greek, Italian, Japanese, Korean, Polish, Portuguese, Russian, Slovenian, Spanish, Turkish, and Danish. The software will have to be restarted when the program language is changed.

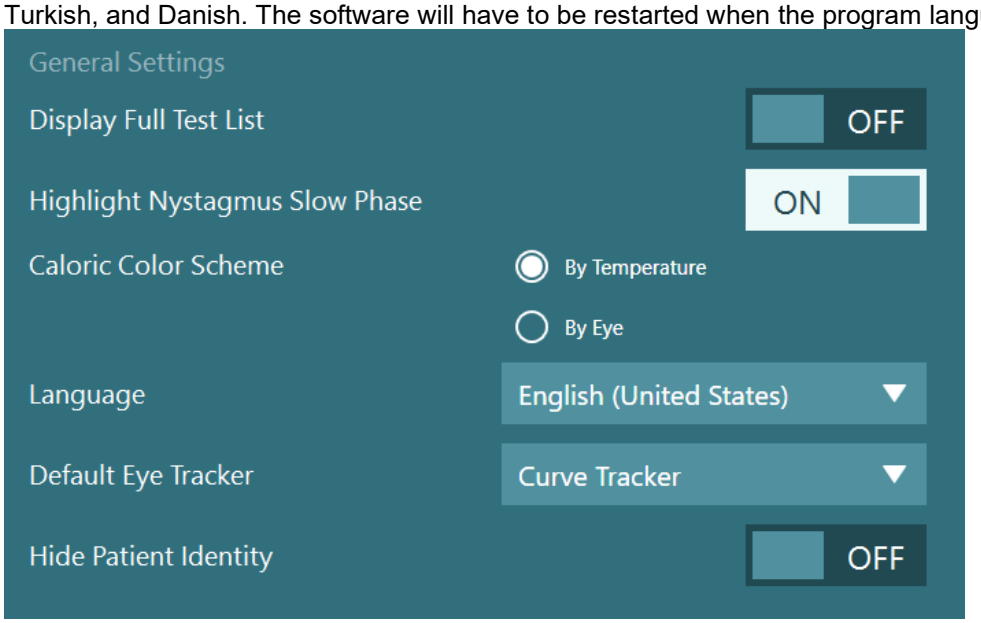


Figure 10. 5. 1 General settings

10.6 Hardware and Licenses

The Hardware and Licenses screen allows the user to enter the license keys for the cameras. Multiple licenses for the same camera set can be added for dealer demonstrations. The tests available for the selected license will be listed at the bottom of the screen.

If new hardware is to be licensed, connect the hardware to the computer, then return to the Home Screen. Click on Configuration > System Default Settings and select Hardware and Licenses. The software will show the hardware that is not registered. From the hardware selection menu, choose the type of hardware to register.

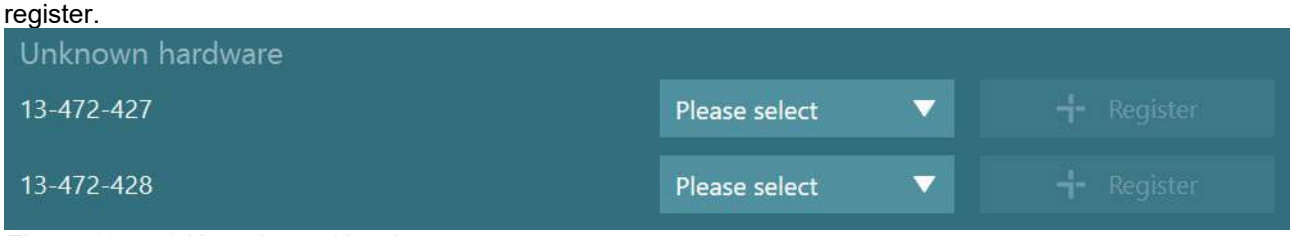


Figure 10. 6. 1 Unregistered hardware

If the camera type selected is a binocular camera, then select the paired serial number from the additional selection box. This will remove the second camera serial number from the list of unknown hardware.

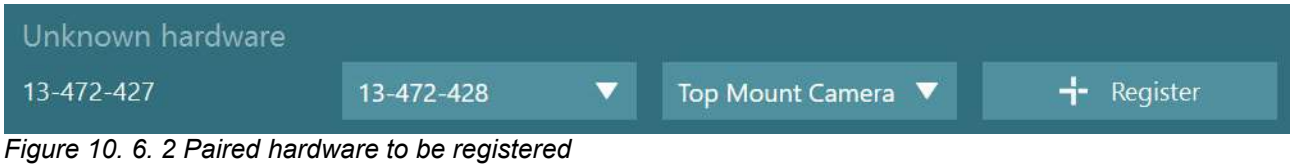


Figure 10. 6. 2 Paired hardware to be registered

Click on Register to add it to the registered hardware.

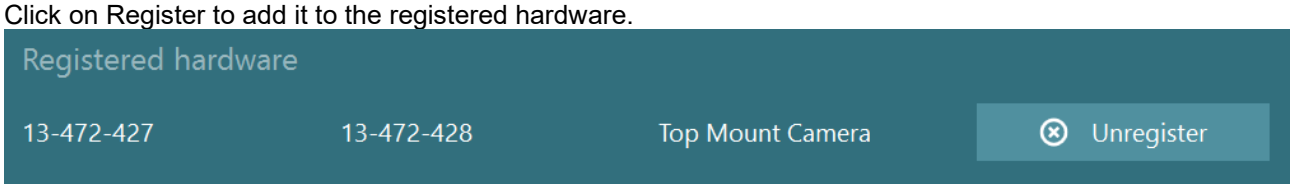


Figure 10. 6. 3 Cameras Registered

Once the hardware is registered, a license to use the hardware can be entered. Click on the Add new license button to enter the license code. If entering the license codes for a binocular camera set, when the license for one camera is entered, the software will show a green checkmark if the license code is valid for that camera serial number.

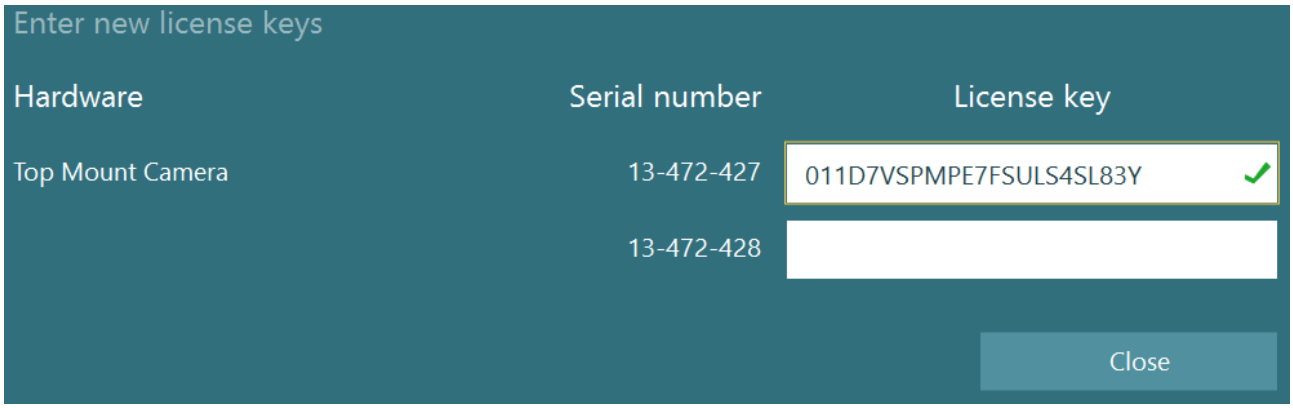


Figure 10. 6. 4 Entering license code for registered hardware

When the hardware license has been added, the new license will appear in the Registerd licenses section. The software will now use the registered license and change the input hardware to correspond with the license. For reference the hardware serial number and the license for the hardware serial number are displayed with the license type to help differentiate hardware or license types (for demonstration purposes).

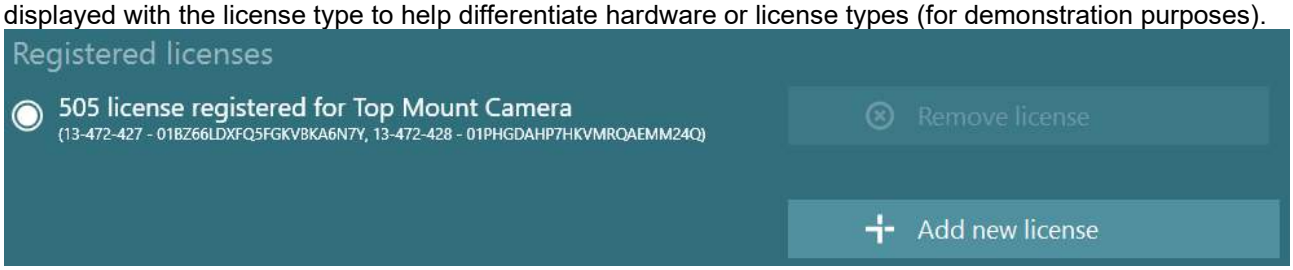


Figure 10. 6. 5 Registered licenses

NOTICE

When the hardware license is changed, protocols will hide any tests not available for testing with the currently selected license. These tests will be available again if the selected license supports the option.

10.7 Threshold levels

The Threshold Levels settings screen contains age-matched thresholds for various VNG tests. When the user has standard VisualEyes 505 system, threshold levels are applicable only for spontaneous nystagmus test. If user has add on modules, then the suggested threshold levels and relevant options can be utilized.

10.8 Print Settings

The Print settings screen provides access to automatic PDF document creation settings (Figure 10. 8. 1).

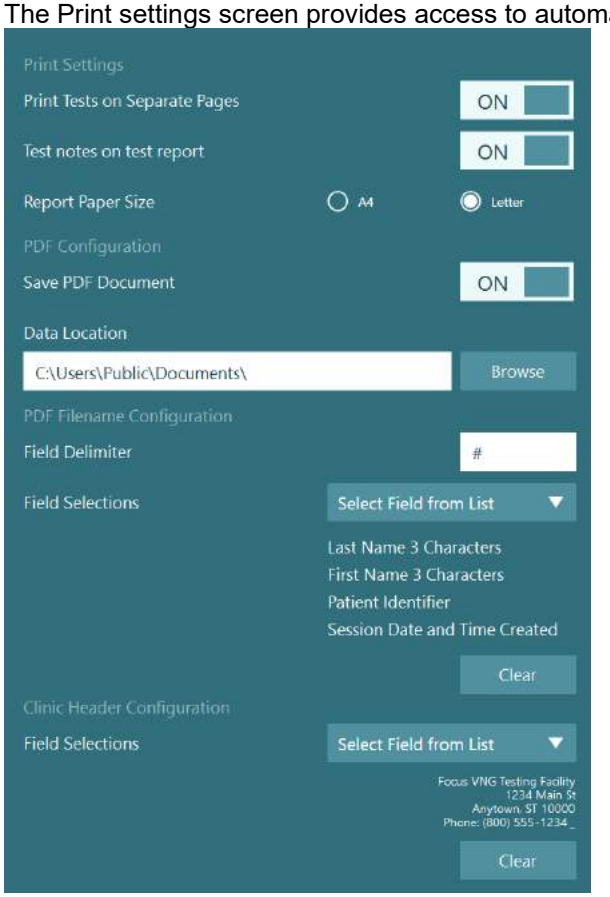


Figure 10. 8. 1 Print settings

Print Tests on Separate Pages: Selects whether page breaks should be added before each test is printed in the report. This option can be set off in VisualEyes™ 505 systems to reduce the extra space printed between tests, as only the notes are printed for video Frenzel tests.

Test notes on test report: This option will print the test notes in a second column on the test list. If this option is set off, then the test list will list the names of the tests in the center of the page.

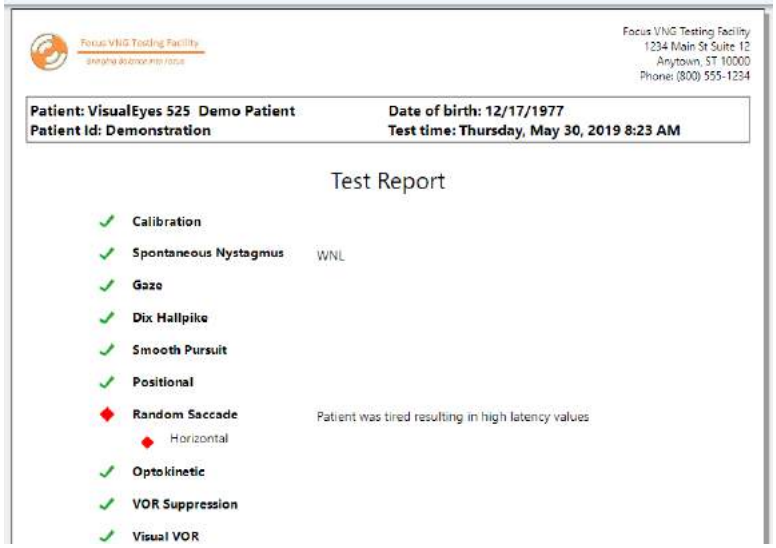


Figure 10. 8. 2 Test Report with Test Comments

Report Paper Size: Selects the paper format to print and or save the report to (choice of A4 or letter format)
Save PDF Document: If this option is selected, the Create PDF button is available from the Session Review screen to print the report to PDF to the specified location. For more information see Chapter 5. 4 Create PDF.
PDF Data Location: This is the folder where the PDF report is created. Use the Browse button to select the folder.
PDF Filename Configuration: These fields define the naming structure of the PDF report.

- Field Delimiter: Select a character to function as a field delimiter, typically a period, hashtag, or hyphen
- Field Selections: Select what is to be displayed on the report from following list:
    - First Name 3 Characters
    - Last Name 3 Characters
    - Module (Micromedical VisualEyes™)
    - Patient Identifier
    - Report Date and Time Created
    - Session Date and Time Created
    - Session Identifier

Clinic Header Configuration:
These fields define the naming structure of the clinic information printed in the top-right corner of each page of the report. If the VisualEyes™ 505 software is launched from OtoAccess® 2. 0 or later, the company logo set in OtoAccess® will be displayed in the top-left corner of each page. Otherwise a default clinic icon will be displayed in the top-left corner. To create the clinic header, use the Field Selections combination box to insert the components of the clinic address, using the Line Break option to insert a line break in the address and the comma option to separate Clinic City and Clinic State. If a field is inserted after another field, the program will insert a space automatically to separate the fields (e. g. Clinic State and Clinic Zip code). Use the Clear button to clear the current address and restart if needed.

10.9 About this software

The About screen lists the software version number and licenses used by the software.

11 Other functions

11.1 Help button

This manual is accessible by clicking or touching the Help button on the main screen or by pressing the F1 key within the software.

Figure 11. 1. 1 Help button

11.2 Exit button

Press the ‘Exit’ button from the main screen to leave the VisualEyes™ suite and return to OtoAccess®™.

Figure 11. 2. 1 Exit button