

Additional Information
Micromedical
VisualEyes™ 515
VisualEyes™ 525
by Interacoustics



Copyright © February 1, 2018 by Interacoustics. All rights reserved. Information in this document is subject to change without notice. Companies, names, and data used in example herein are fictitious unless otherwise noted. No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without express written permission of Interacoustics A/S, Micromedical Technologies or its licensees.

FireWire® is a registered trademark of Apple Inc., registered in the United States and other countries. Windows® is a registered trademark of the Microsoft Corporation, registered in the United States and other countries.

Table of Contents

1	TESTING BASICS.....	1
1.1	Default protocol	1
1.2	Moving through VisualEyes™	2
1.3	Eye image adjustment	3
1.4	Focus adjustment.....	6
1.5	Eye image contrast adjustment.....	6
1.6	Enlarging eye images	7
1.7	Monocular vs binocular eye recordings	8
1.8	Common test functions	8
1.9	Add Note	9
1.10	Add tests	9
1.11	Delete tests	10
2	CALIBRATION	12
2.1	Performing calibration	12
2.2	Default calibration	14
2.3	Review calibrations	15
3	TESTING	16
3.1	Overview	16
3.2	Nystagmus Marking and Peak Response.....	18
3.3	Nystagmus Testing	19
3.3.1	Spontaneous nystagmus test	19
3.3.2	Dix-Hallpike test.....	20
3.3.3	Positional test	21
3.4	Ocularmotor Testing	22
3.4.1	Gaze test	22
3.4.2	Smooth Pursuit test	22
3.4.3	Saccade test	24
3.4.4	Optokinetic test	25
3.5	Caloric testing	28
3.6	Rotational Chair Testing	34
3.6.1	Safety checks prior to beginning rotary chair tests.....	34
3.6.2	Sinusoidal harmonic acceleration (SHA) test	34
3.6.3	Step rotation test.....	41
3.6.4	VOR suppression test.....	49
3.6.5	Visual VOR test	53
4	PATIENT SESSION	57
4.1	Selecting a session	57
4.2	Session Review.....	58
5	VIDEO RECORDINGS	59
5.1	Recording patient videos	59
5.2	Video playback.....	59
5.3	Delete selected patient videos	62
5.4	Exporting patient videos.....	63
6	GENERAL AND EDITING TOOLS	65
6.1	Quick access test properties.....	65
6.2	Selecting eyes.....	65
6.3	Pupil diameters	66
6.4	Editing nystagmus.....	66
6.4.1	Add Beats	66
6.4.2	Remove Beats	67
6.4.3	Zoom Trace	67
6.4.4	Reset Beats	68

6.4.5	Edit Slopes.....	68
6.4.6	Done Editing	70
6.5	Editing saccade test results	70
6.6	Editing smooth pursuit test results	72
6.7	Editing rotary chair test results.....	73
6.7.1	Editing SHA Tests.....	73
6.7.2	Editing Step rotation tests.....	74
6.8	Other functions available in side menu	74
6.9	Fixation suppression	76
6.10	Override test results.....	77
7	PROTOCOL MANAGEMENT	78
7.1	Protocols	78
7.2	Creating a new protocol	79
7.3	Setting default protocol	79
7.4	Remove protocol	80
7.5	Exporting protocols	80
7.6	Importing protocols	80
7.7	Restore factory template	81
7.8	Selection of protocol	81
8	TEST PROPERTIES	82
8.1	Configuring the tests	82
8.2	Configuring oculomotor tests	83
8.2.1	Configuring the gaze test.....	83
8.2.2	Configuration of saccade Test.....	85
8.2.3	Configuration of smooth pursuit tests	87
8.2.4	Configuring the OPK tests	89
8.3	Configuring the nystagmus tests.....	91
8.3.1	Configuring the spontaneous nystagmus test	91
8.3.2	Configuring the Dix-Hallpike tests	92
8.3.3	Configuring the positional tests	93
8.3.4	Configuring the caloric test	94
8.4	Configuring rotary chair tests	97
8.4.1	Configuring sinusoidal harmonic acceleration test	97
8.4.2	Configuring step rotation test.....	100
8.4.3	Configuring VOR suppression test	103
8.4.4	Configuring visual VOR test	105
9	SUGGESTED THRESHOLD VALUES	108
9.1	Updating test thresholds	108
9.2	Nystagmus tests.....	109
9.3	Caloric tests	109
9.4	Optokinetic tests.....	110
9.5	Smooth pursuit tests	110
9.6	Saccade tests.....	110
9.7	Sinusoidal harmonic acceleration tests	111
9.8	Step rotation tests	112
9.9	VOR suppression tests	113
10	PATIENT REPORT	114
10.1	Write report editor	114
10.2	Text styles.....	114
10.3	Templates	115
10.4	Findings.....	117
10.5	Save report.....	118
11	PRINTING.....	119
11.1	Printing results	119
11.2	Printing patient demographics	119

11.3	De-identify printout	120
11.4	Printing calibration	120
11.5	Printing a single test or clinical report	120
11.6	Printing a session.....	120
11.7	Printing traces	120
11.8	Condensed printing	120
11.9	Create PDF	120
12	SYSTEM DEFAULT SETTINGS	121
12.1	System Default Settings.....	121
12.2	Hardware.....	121
12.3	Calibration	122
12.4	Timer settings.....	123
12.5	General	123
12.6	License	124
12.7	Threshold levels	125
12.8	Reclining chair.....	125
12.8.1	Selecting the reclining rotational chair	125
12.8.2	Maintenance routines with System 2000 Reclining and Orion Reclining chair	126
12.8.3	Rotational safety settings.....	129
12.9	Print PDF.....	130
12.10	About this software	130
13	OTHER FUNCTIONS	131
13.1	Help button.....	131
13.2	Exit button	131

1 Testing basics

1.1 Default protocol

To begin the testing process, from the main screen select **Begin Testing** (Figure 1.1.1).

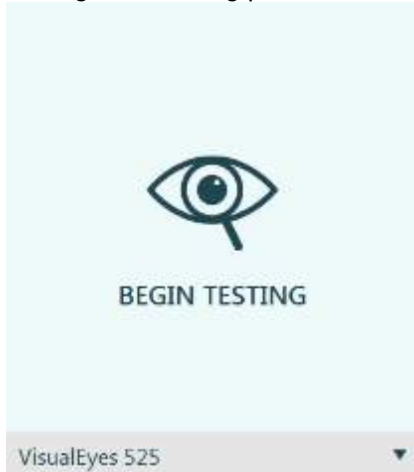


Figure 1.1.1 Begin Testing Button

The VisualEyes™ system has a default protocol defined by the product installed. VisualEyes™ 515 (VNG without oculomotor tests) and VisualEyes™ 525 (VNG with oculomotor tests) protocols with default settings are created that allows the user to begin testing immediately. The following tests and their order make up the default VNG test battery:

VisualEyes 515 Protocol:

- Calibration
- Spontaneous Nystagmus
- Positional
- Dix-Hallpike
- Calorics

VisualEyes 525 Protocol (includes the VisualEyes 515 protocol):

- Gaze
- Smooth Pursuit
- Saccade
- Optokinetic

If rotational chair hardware is available and licensed these additional tests will appear with the VisualEyes 515 or VisualEyes 525 protocol:

- Step Velocity
- Sinusoidal Harmonic Acceleration
- VOR Suppression
- Visual VOR

The process of creating custom protocols can be found in the Protocol configuration section of this manual, 7.1 Protocols.

Using the touch screen or mouse select the **Begin Test** and the first test in the list will be shown on screen (Figure 1.1.2).

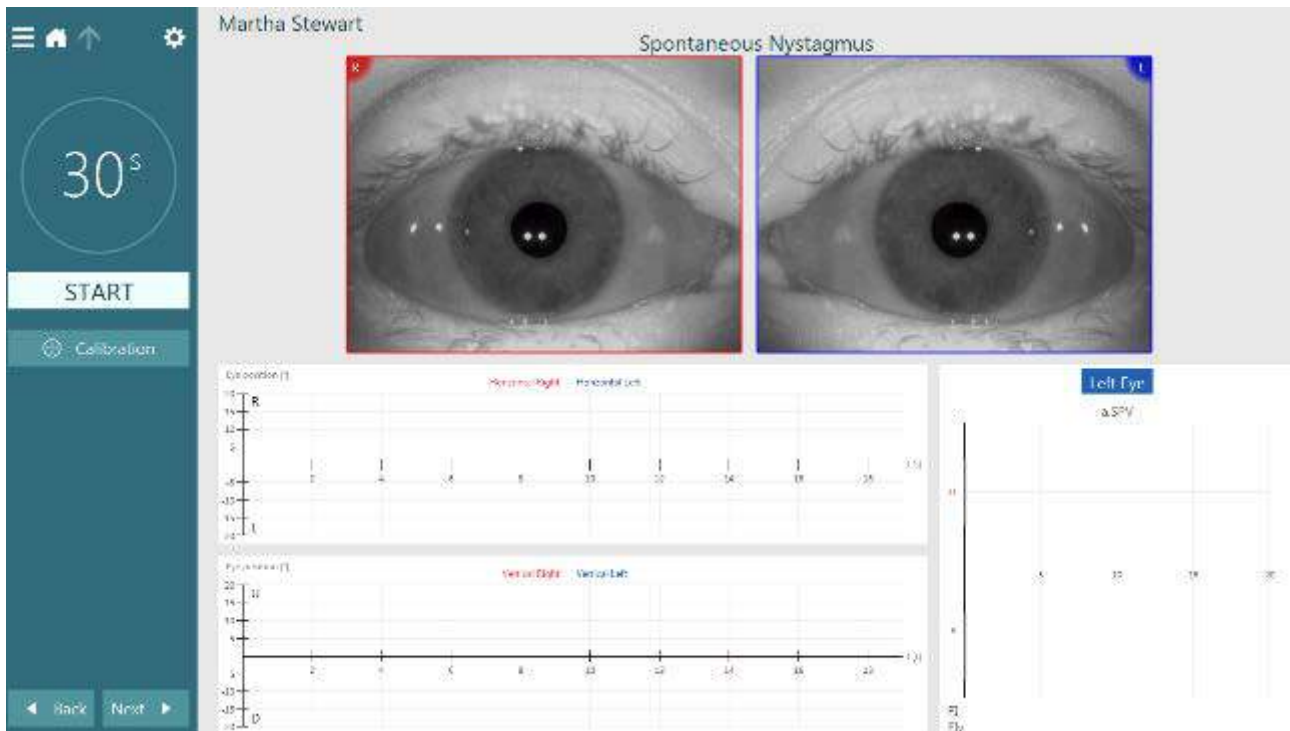


Figure 1.1.2 First test displayed

1.2 Moving through VisualEyes™

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

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 **irrigator handle button** on the Air Fx or Aqua Stim to start the irrigation and test. This is only available in caloric 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

- Home button will return to the main screen
- The up arrow button will exit an individual subtest and go to the test summary screen
- Remote control will navigate the buttons in pop up message windows, allowing the user to respond to pop up messages with the remote control



Figure 1.2.1 Test Navigation Bar

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. In caloric tests, the software will require confirmation of this request.

Rotational chair tests can be restarted using the Esc key on the keyboard, though the use of the RF Remote is ignored during rotational chair tests as a patient safety measure. The software will require confirmation of this request.

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.

1.3 Eye image adjustment

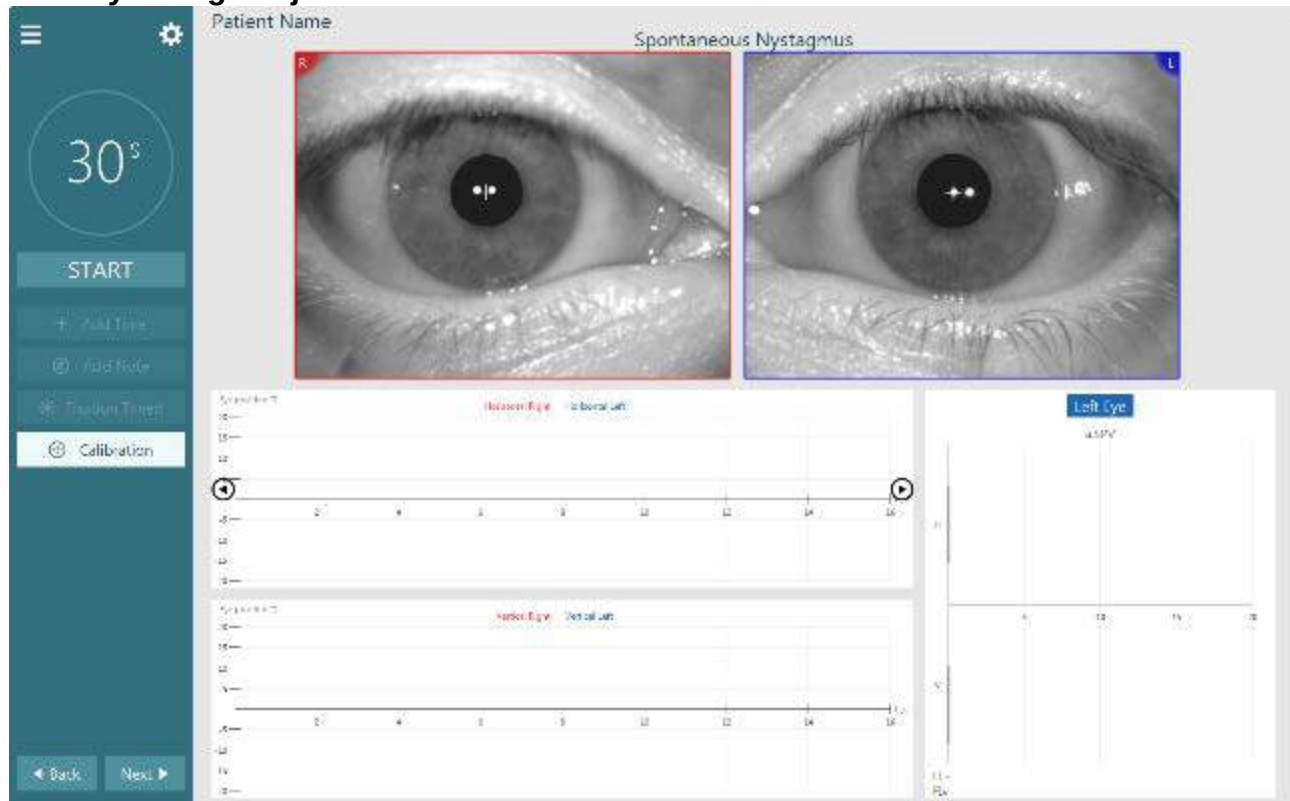


Figure 1.3.1 Test Screen Display (Spontaneous Nystagmus)

To see the eye image, select **Begin testing** from the main menu display. This will open the first test and the image of the patients eyes (Figure 1.3.1) will appear in the upper portion of the user display. Prior to beginning 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.

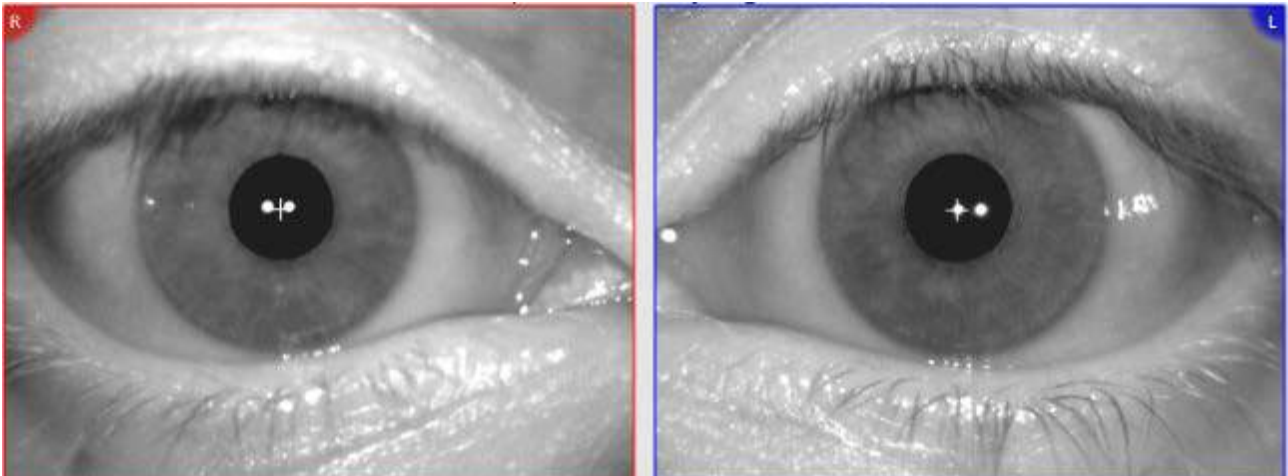


Figure 1.3.2 Eyes displayed

The inner canthus of the right eye should be seen on the right side of the red outlined eye image. The inner canthus of the left eye should be seen on the left side of the blue outlined eye image. The eye images have L and R captions in the corners, which refer both to the eye selected and the direction the eye is looking. (Figure 1.3.2)

Prior to launching VisualEyes™ make sure that the cameras are connected. If the cameras are disconnected an informational status will be displayed.

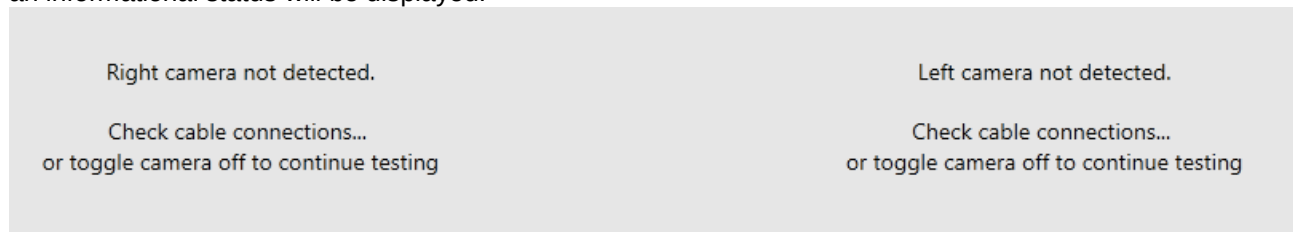


Figure 1.3.3 Cameras Disconnected Status

Should this appear for either camera, check the camera cables make a solid connection between the camera and the computer.

Side mounted cameras

Use the knobs on the camera cabinet to move the camera horizontally and vertically to center the eye image on the screen. (Figure 1.3.4).



Figure 1.3.4 Side mount cameras adjustment knobs

1. The upper knob moves the camera vertically.
2. The left knob moves the camera horizontally.
3. The center knob adjusts image focus.

The mirrors can also be rotated inward by holding the mirror edges and rotating inward to adjust for smaller faces and narrow inner-canthal spaces (e.g. with children). When the mirrors are rotated, the image will need to be re-centered and may need focus adjustment. (Figure 1.3.5)



Figure 1.3.5 Mirror adjustment for smaller faces

Top mounted cameras

The top mount camera goggle eye image is centered in the viewing area by clicking on or touching the center eyes button (Figure 1.3.6), which will appear in the top center of the image viewing area when touching the eye images or hovering over with the mouse. Once this button is clicked or touched, the eye will be centered in the viewing area.



Figure 1.3.6 Center eyes button

Front mounted cameras

Position the front mounted camera unit on the viewport with the fixation light at the top center. 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 1.3.7 Placement of Front Mount Camera in Goggles

1.4 Focus adjustment

VisualEyes™ system 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 1.4.1).

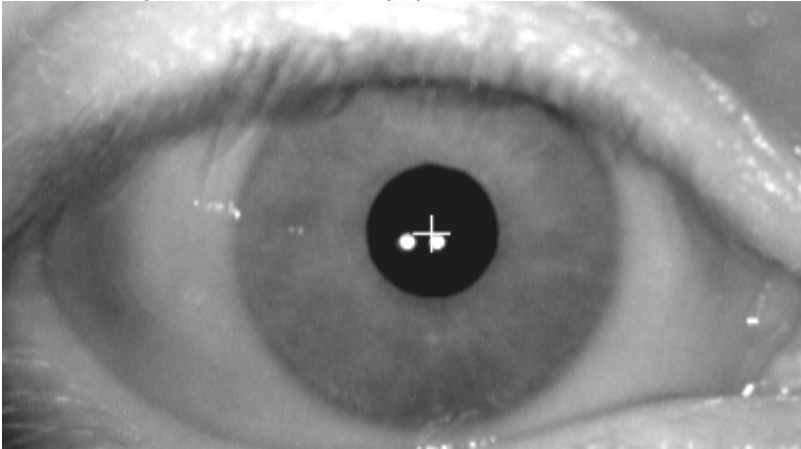


Figure 1.4.1 Pupil tracker (crosshair)

The camera image can be focused by adjusting the focus knob on each camera (Figure 1.4.2). 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.



Figure 1.4.2 Adjustment control for focusing eye image on each camera

Should the image not be optimally focused, the pupil tracker may fail to adequately record the eye movements, leading to poor test results.

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

1.5 Eye image contrast adjustment

The VNG 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, the automatic threshold adjustment can be turned off before or during recording by clicking the threshold adjustment button (Figure 1.5.1).



Figure 1.5.1 Threshold adjustment button

When the threshold adjustment button is selected, a scrollbar will appear for each eye's contrast level. By default the A button will be highlighted indicating the system is automatically adjusting the contrast threshold level. Slide the scrollbar value with the mouse or finger to the position where the crosshair is viewable. Have the look left, right, up, and down to verify the threshold level and adjust as necessary so the crosshair will track the pupil while looking in each direction. (Figure 1.5.2)

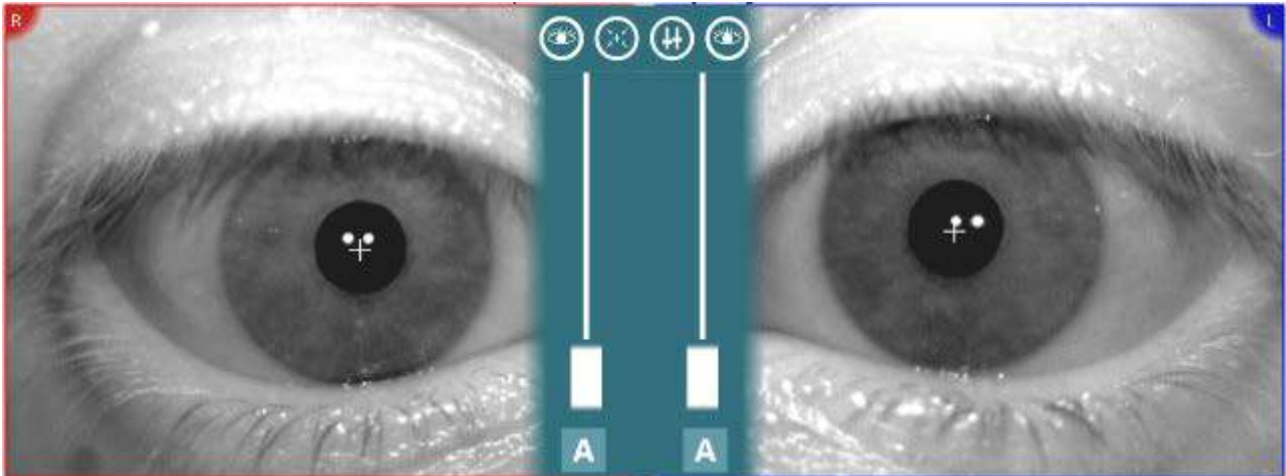


Figure 1.5.2 Threshold adjustment scrollbars

To reset it back to automatic threshold click the  icon below each slider.

1.6 Enlarging eye images

Enlarging the eye images can help the clinician clearly visualize the eye image during eye image adjustments and within different tests. Alternatively the eyes are displayed on the TV stimulus in VisualEyes 525 when no target is used, providing an even larger image of the eyes for viewing. Double clicking on one of the displayed eyes will enlarge the eye windows on the screen. (Figure 1.6.1). The eye position traces are hidden while the eye images are enlarged. To exit this viewing mode, double click on the eyes again.

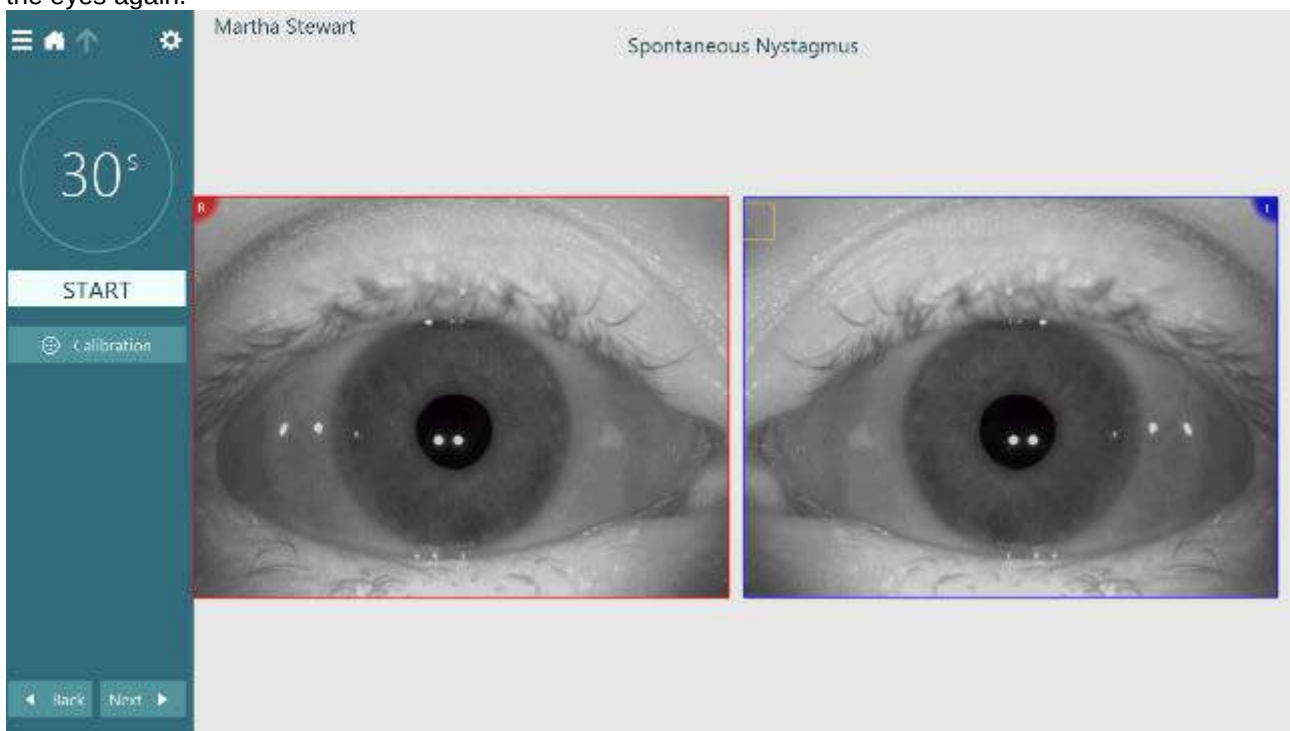


Figure 1.6.1 Enlarged eye images

1.7 Monocular vs binocular eye recordings

VisualEyes™ system can record in either monocular (one camera) or binocular (two cameras) mode. Monocular mode may be beneficial for those occasions needing to run a single eye test because one eye may be unable to be tested. (i.e. the eye is artificial or severe ptosis). To select an eye to ignore during testing, touch the eye images or hovering over with the mouse to display the eye tools menu (Figure 1.7.1). Click or touch the eye button for the eye to ignore during testing and the software will ignore the selected camera for the duration of testing. To track the pupil again, display the eye tools menu again and select the ignored camera.



Figure 1.7.1 Eye tools menu



Figure 1.7.2 Left eye selected and right eye ignored

1.8 Common test functions

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

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

START

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

STOP

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

Next ►

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

◀ Back

Timer

During testing (all tests) the timer will display how much time has elapsed or remains in the current test based on Count Style (Figure 1.8.1). 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 12.4 Timer settings.



Figure 1.8.1 Timer display

Further time may be added to the test during the procedure by pressing the **Add Time** button (Figure 1.8.2). This will add a further 30 seconds (default) to the time remaining on the counter.



Figure 1.8.2 Add Time button

1.9 Add Note

One can insert a note at a specific point in the raw trace, during or after testing by selecting **Add Note** (Figure 1.9.1). This can also be used as an event marker to identify a unique event within the recording.



Figure 1.9.1 Add Note button

The time at which the note is inserted is shown with the line 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.

1.10 Add tests

To insert additional tests into the current testing session, use the Add Test button accessed from the test menu on the testing screen.

Select the test menu button.



Figure 1.10.1 Test Menu button

The left side menu panel will display the currently test session. At the end of the list is the **Add Test** button.

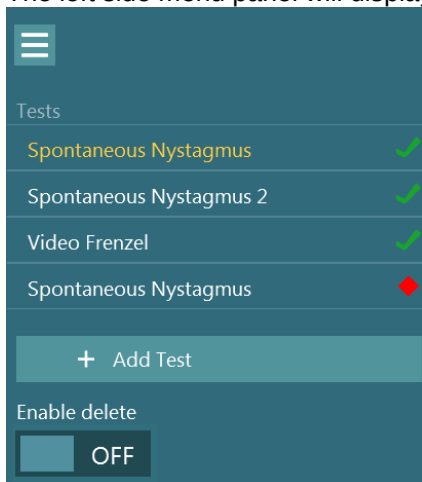


Figure 1.10.2 Test menu

Select the **Add Test** button (Figure 1.10.3).



Figure 1.10.3 Add Test button

This will present a list of tests to choose to be added to the session. (Figure 1.10.3)



Figure 1.10.4 Adding a test

Once the test is selected, it is added to the bottom of the patient's test session.

1.11 Delete tests

Tests with or without data can be removed from the session from the test menu allowing to clear irrelevant tests or deleting tests to replace with new customized tests.

Select the test menu button.



Figure 1.11.1 Test Menu button

The left side menu panel will display the currently test session. At the end of the list is the **Enable delete** option. Activate the **Enable delete** option. (Figure 1.11.2)

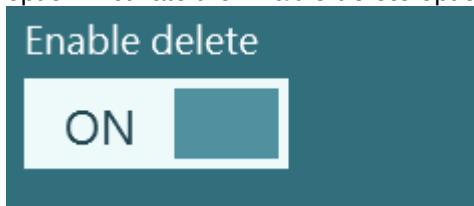


Figure 1.11.2 Enable delete option

This will present the list of performed tests with a  symbol. Clicking or touching this symbol will remove the test from the session. The current test cannot be deleted.

Note: Once deleted, the test data cannot be recovered.

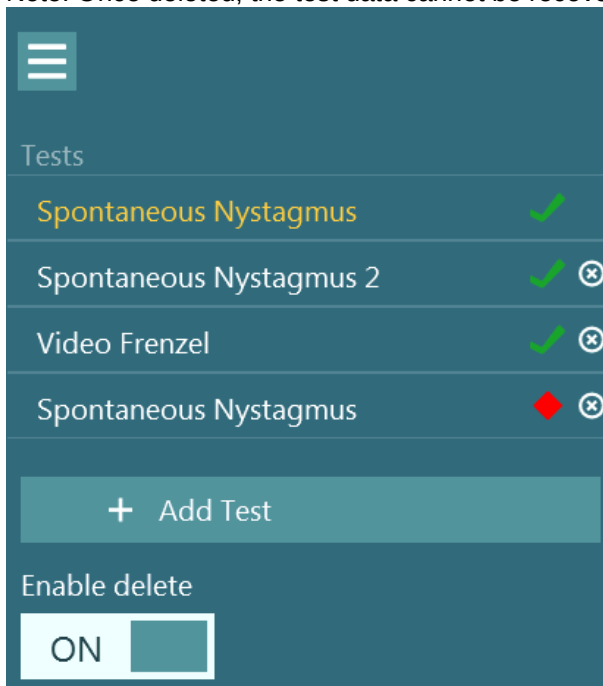


Figure 1.11.3 Test menu with delete option enabled

2 Calibration

Calibrations are particularly important in tests where eye movements are compared with a given stimulus of a known position and/or velocity (e.g. Saccade test). 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 Performing calibration

In the test screen side panel, click the **Calibration** button (Figure 2.1.1)

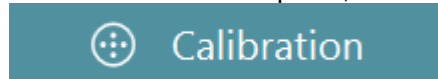


Figure 2.1.1 Calibration button

The Calibration dialog box will open (Figure 2.1.2)

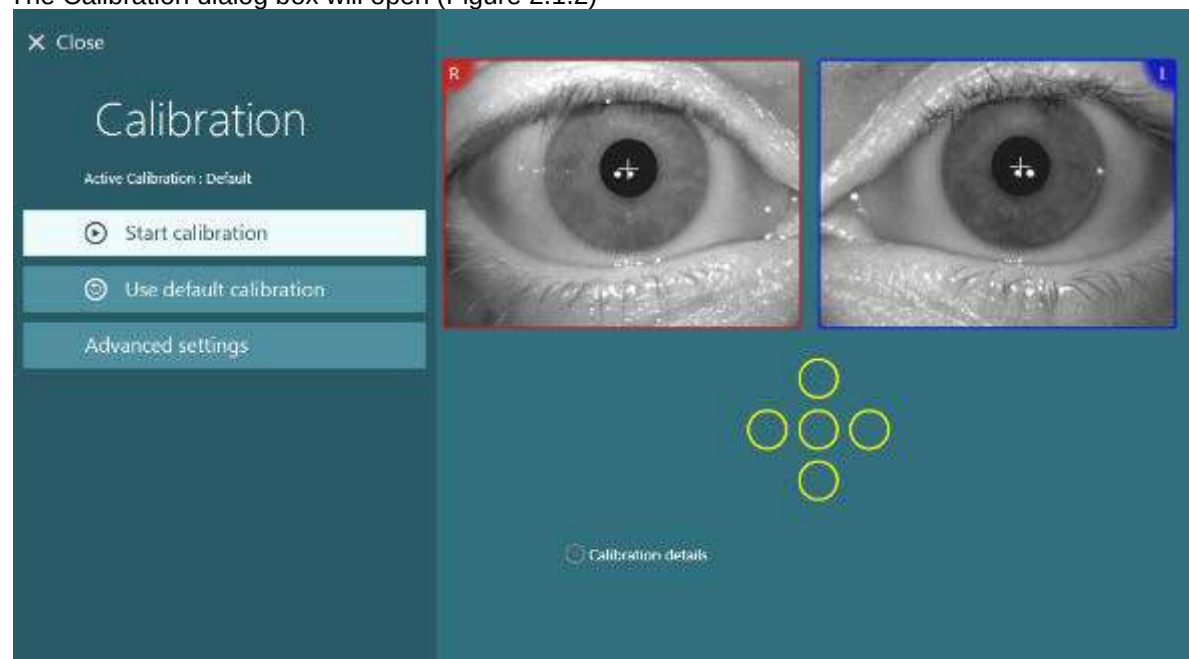


Figure 2.1.2 Calibration screen

Before beginning calibration, 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 2.1.3)

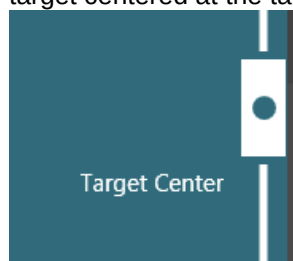


Figure 2.1.3 Target Center slider

The upper area of the dialog box 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 2.1.4)



Figure 2.1.4 Start calibration button

Ask the patient to look at the first calibration point. After a few seconds of fixation a target confirmed mark (Figure 2.1.5) 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 2.1.6)



Figure 2.1.5 Target confirmed mark

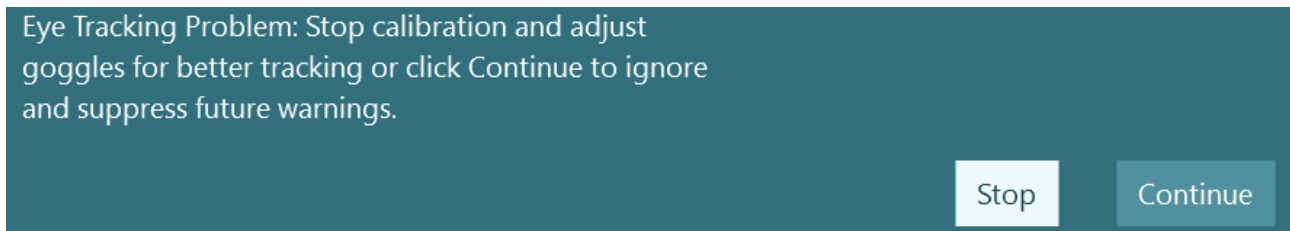


Figure 2.1.6 Eye tracking problem warning

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 2.1.7).



Figure 2.1.7 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.

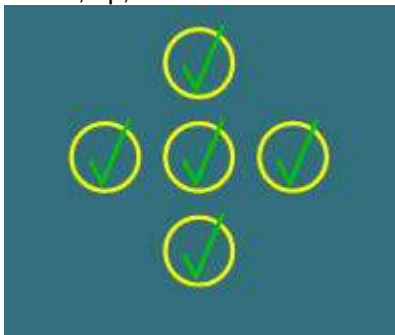


Figure 2.1.8 Calibration completed with all positions accepted

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 2.1.8)

Below the calibration diagram are the numerical results from the calibration separated by eye and direction. In cases where the calibration was unsuccessful, the numerical results may have additional information that explains why the calibration failed.



Figure 2.1.9 Calibration failure with values and failure reason

If the patient could not fixate on one or target positions, a red cross mark (Figure 2.1.10) 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 2.1.10 Unsuccessful target mark

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

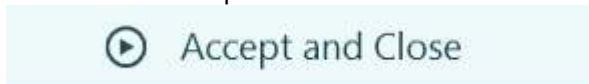


Figure 2.1.11 Accept calibration and close calibration screen button

2.2 Default calibration

Should a calibration be unable to be completed, use the default calibration option (Figure 2.2.1). This sets the VisualEyes™ system to use software default calibration settings which provide only an approximate calibration value. Be aware that results for oculomotor tests and nystagmus velocities need to be interpreted with caution.



Figure 2.2.1 Use default calibration button

2.3 Review calibrations

The patient's calibration traces (Figure 2.3.1) 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.

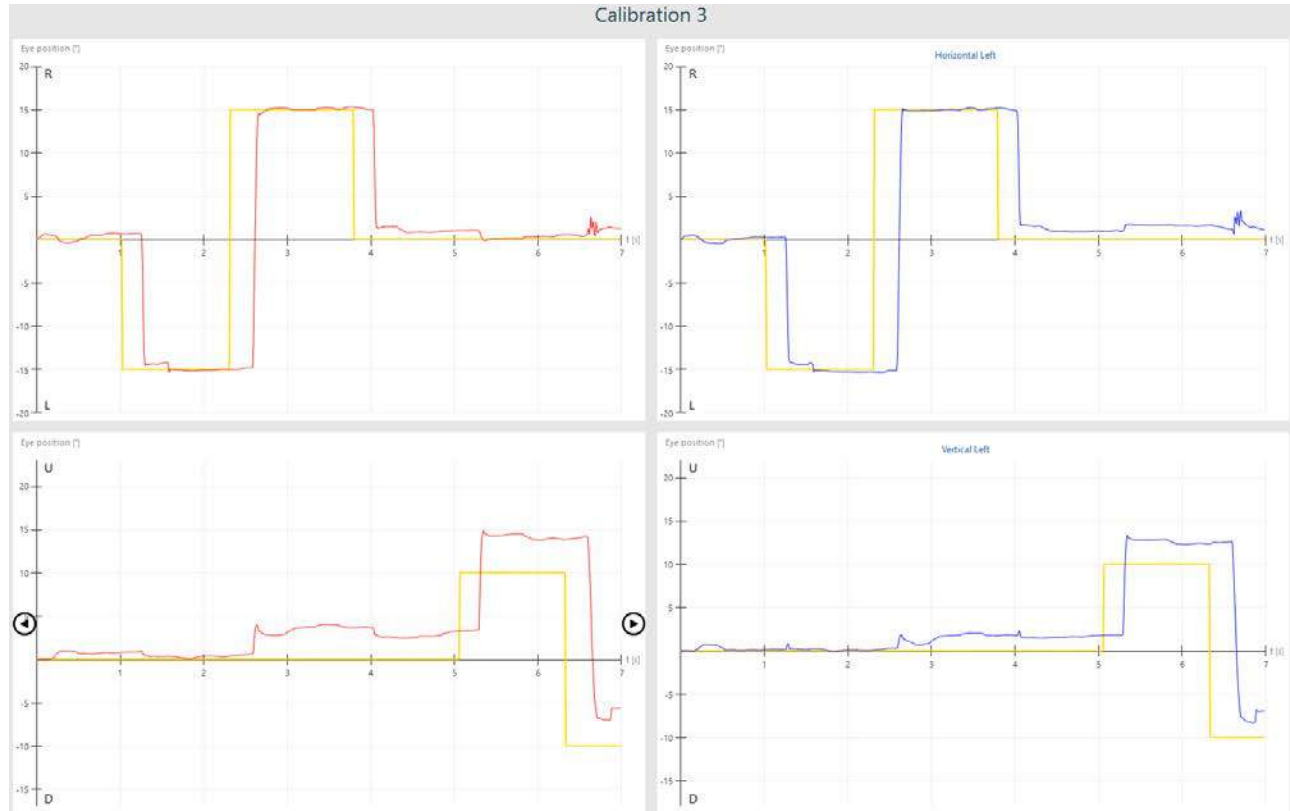


Figure 2.3.1 Calibration traces

The results can be printed for hardcopy storage (Figure 2.3.2).

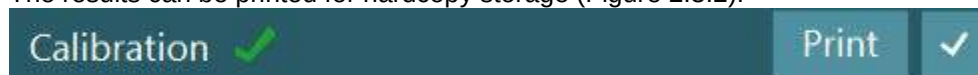


Figure 2.3.2 Print Calibration from Session Review screen

3 Testing

3.1 Overview

To start testing click on **Begin Testing** from the main menu. The first test in the chosen protocol is displayed. To begin testing with a different test in the protocol, select the desired test using the test menu button.



Figure 3.1.1 Test menu button

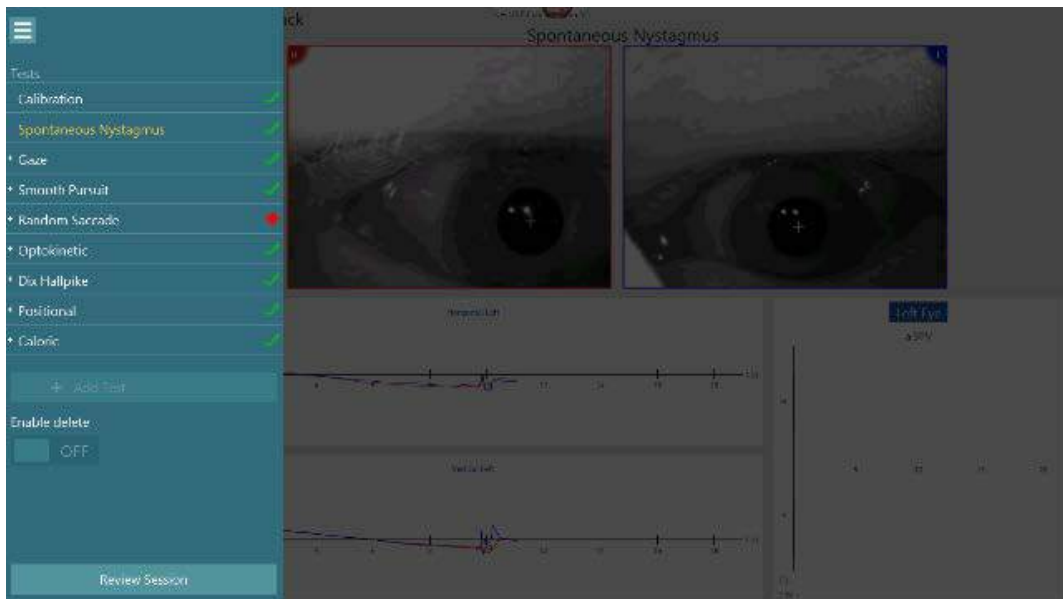


Figure 3.1.2 Session tree displayed

The left side panel displays a session tree, which shows all tests included in the current protocol (Figure 3.1.2).

- The current test is displayed in yellow text.
- Completed tests that fall within test thresholds are marked with a green checkmark. 
- Completed tests that fall outside test thresholds are marked with a red diamond. 
- Completed tests that have been marked as within limits when the software marked the test originally as falling outside test thresholds are marked with a green checkmark with pencil. 

Navigate to a particular test by clicking or touching the test title to perform (if incomplete) or review (if complete). By clicking or touching the plus button to the left of the test title, the test menu will expand to show the subtests available.

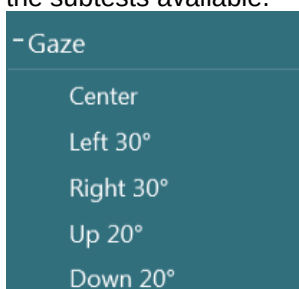


Figure 3.1.3 Expanded test, displaying subtests

VisualEyes™ VNG offers an easy way to visualize video eye and trace recordings during data collection and review. The general display shows the eye images in the top portion of the screen and directly below it the raw tracings for horizontal and vertical channels (Figure 3.1.4). The eye images are presented in real time in synchrony with raw eye movement traces.

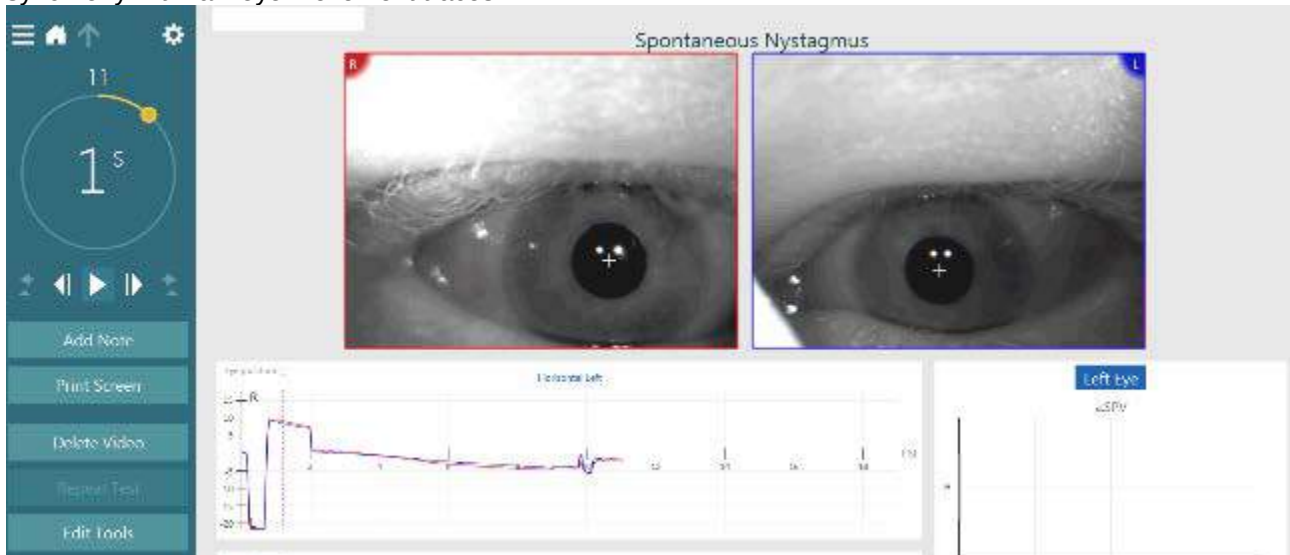


Figure 3.1.4 Test screen

Results are recorded and displayed in a large graphical display that shows the raw data tracing of the eye movements (Figure 1.35). The right eye movements are recorded in red and the left eye movements are recorded in blue. The stimulus position is shown in a yellow color.

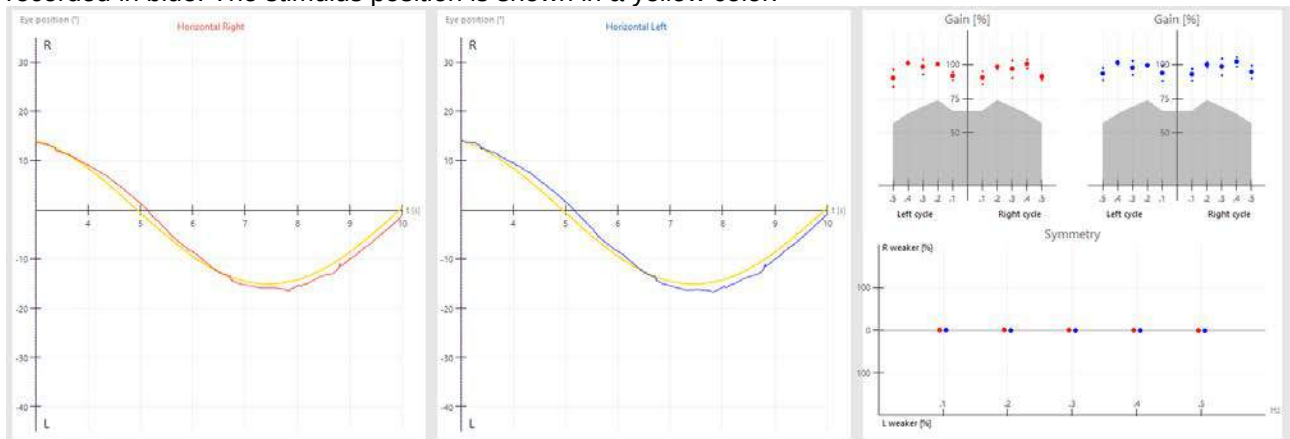


Figure 3.1.5 Waveform and results display

Both eye/s and raw tracings can be enlarged for easier viewing by double-clicking or double-touching the item of interest. The graphical area shows time (in seconds) on the horizontal axis and eye and or stimulus movement (in degrees) on the vertical axis. Direction labels on the graph show the direction of the waveform.

3.2 Nystagmus Marking and Peak Response

Nystagmus beats are marked by small triangles in the eye trace graphs. During data collection, the nystagmus beats are marked by triangles showing the inflection point between the slow and fast phases of the nystagmus beat. Triangles that point **upwards (below the tracing)** indicate right-beating nystagmus. Triangles that point **downwards (above the tracing)** indicate left-beating nystagmus.

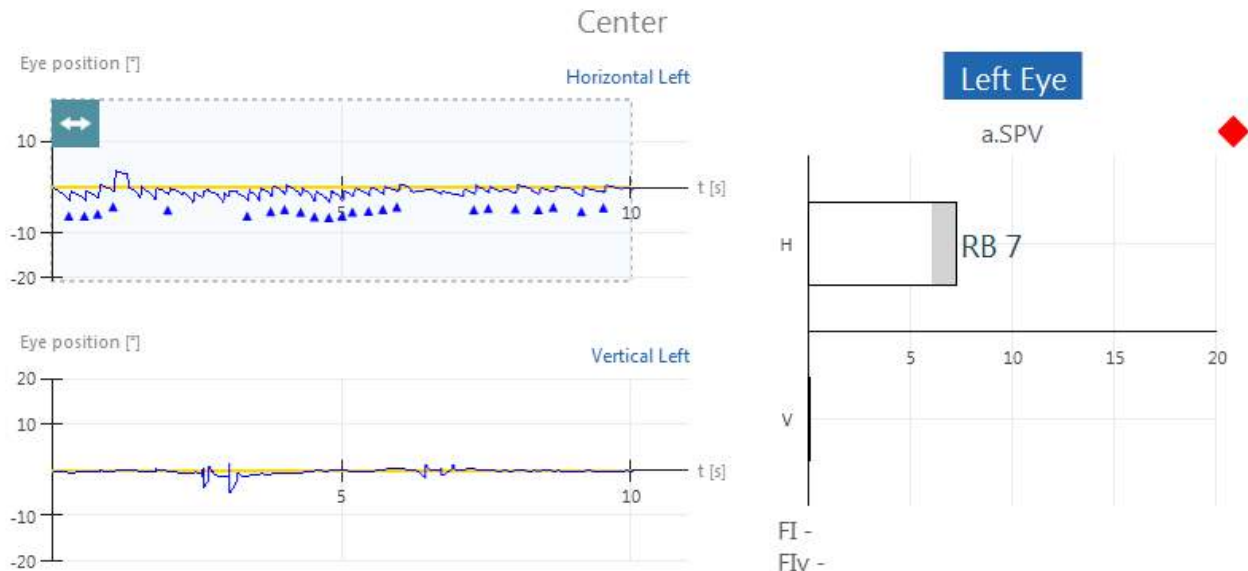


Figure 3.2.1 Nystagmus beats with triangles

After the test is complete, the software will color the nystagmus beats in green and remove the triangles if desired. This option is set in System Default Settings under General settings. See 12.5 General. If the option is not enabled, the waveform will display the triangle marks.

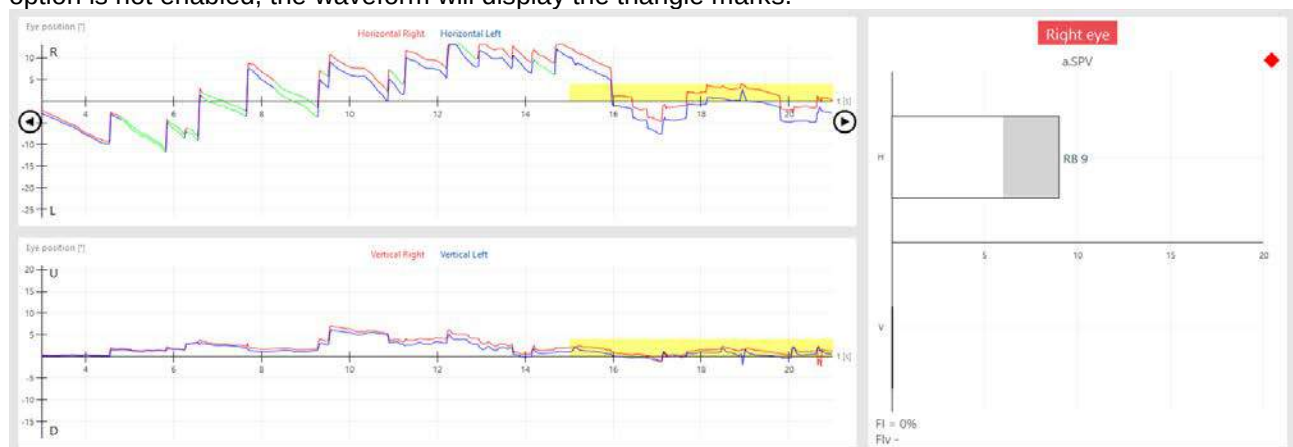


Figure 3.2.2 Nystagmus beats marked green

The a.SPV (average slow phase velocity) is determined by averaging the slow phase values of each nystagmus beat in the selected peak response time. Three beats in the selected peak response time are required to calculate a.SPV. The peak response time is specified in the test's settings. The a.SPV is measured in degrees/second and displayed in the result graph beside the waveform. In nystagmus tests the a.SPV graph only displays the results of one eye at a time. Clicking or touching the label for the eye selected will switch the a.SPV values for the other eye tested.

The peak response window is updated as the test progresses and is marked by a dashed window that is shaded in a light blue color (Figure 3.2.3) for the area with the largest a.SPV. This window can be moved to the desired area by using the scroll button in the upper left corner of the peak response window or reset to the software selected location using the reset button in the upper right corner of the peak response window.

NOTE: The waveform window can be scrolled quickly using the mouse scroll wheel.



Figure 3.2.3 Peak Response window

The time for determining peak response can be set in the test settings under Nystagmus parameters. The peak response cannot be longer than the allotted test time.

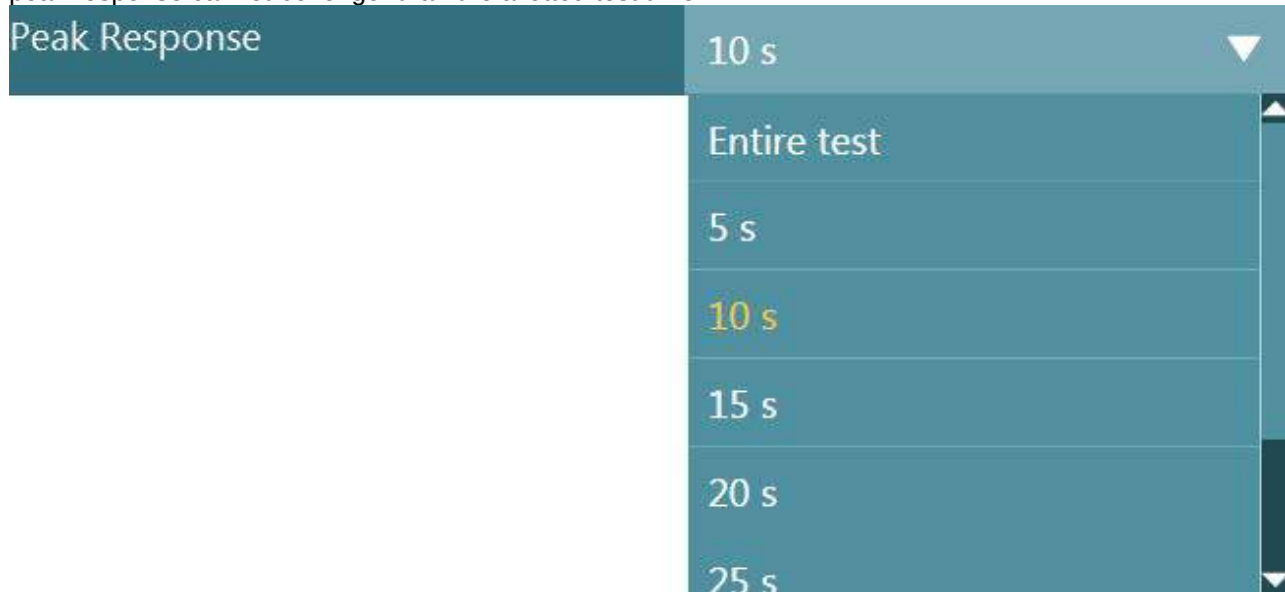


Figure 3.2.4 Peak Response times

3.3 Nystagmus Testing

Nystagmus tests (spontaneous, Dix Hallpike, Positional) measure the patient's nystagmic response when placed in different head and body positions. VisualEyes will measure the eye movements to detect the magnitude of nystagmus if present. In tests where the patient's nystagmus direction changes, the average slow phase velocity (a.SP.V) will be measured separately in each direction and the results will be displayed in the a.SP.V graph. Nystagmus tests are available in VisualEyes 515 and VisualEyes 525 configurations.

3.3.1 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.SP.V) graph to the right side of the data graph shows the a.SP.V 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.

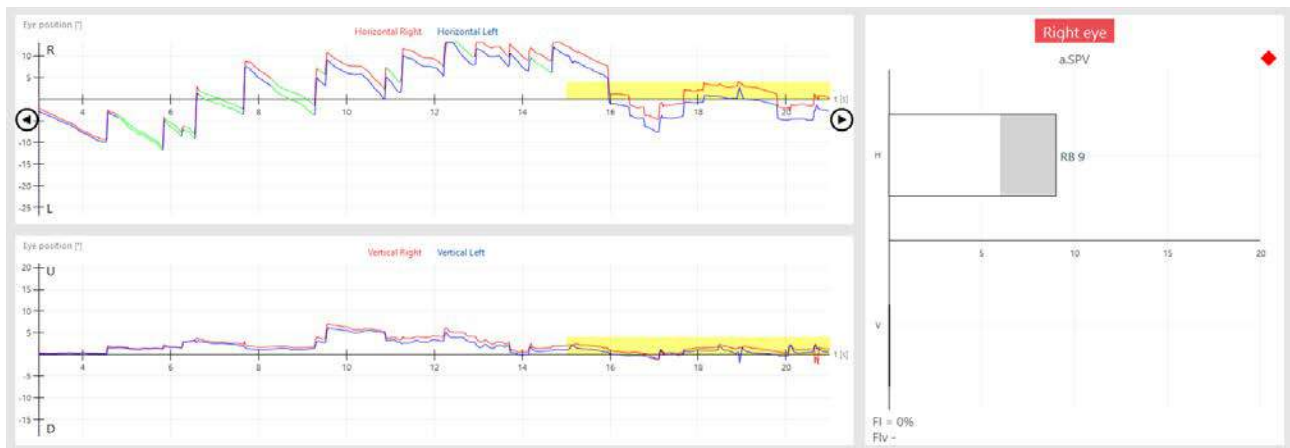


Figure 3.3.1 Spontaneous Nystagmus Waveform and a.SP.V graph

3.3.2 Dix-Hallpike test

The Dix-Hallpike test is a specific test to diagnose BPPV (benign paroxysmal positional vertigo).

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 limited to: blurred vision, numbness, weakness of the arms or legs and confusion.

The test is performed by starting the subtest and reclining the patient into the supine position with the head turned to the direction tested. 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. The test will then continue for another 60 seconds. The 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.

The Dix Hallpike test has two subtests, Left and Right. In the Dix Hallpike summary, the left test will be displayed on top and the right test will be displayed on bottom. Horizontal and vertical eye positions are separated. The eye selected can be switched for each test by clicking or touching on the eye title of the a.SP.V bar graph. (Figure 3.3.2).

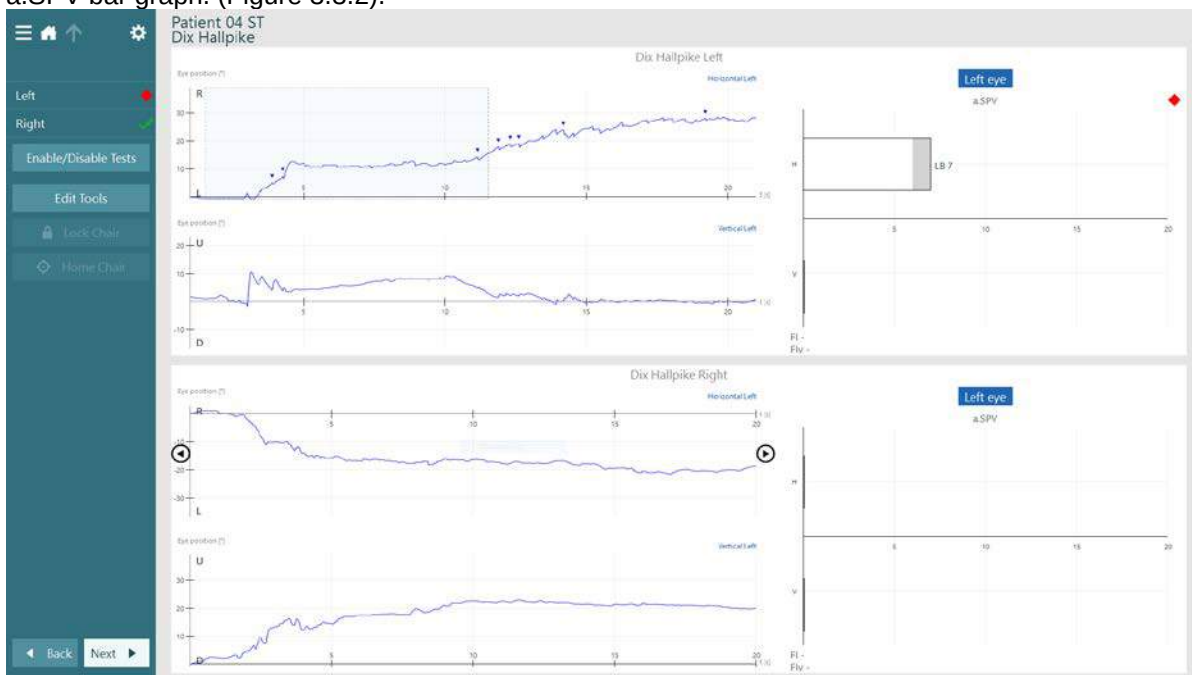


Figure 3.3.2 Horizontal and vertical eye positions in the Dix Hallpike summary

3.3.3 Positional test

The Positional tests allow the examiner to compare several measurements collected with the patient in a variety of head and body positions. Each subtest is set to record for 30 seconds. By default, the Positional test will record Supine, Head Right, Head Left, Body Right, and Body Left. Additional subtests of Bow and Lean are available.

Please note that Positional testing 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 limited to: blurred vision, numbness, weakness of arms or legs, confusion.

The Positional summary screen will display all of the subtests performed in a grid pattern. For each subtest one eye's results are displayed with the corresponding eye movements. Horizontal and vertical eye movements are separated. The Positional summary can contain a mix of left eye and right eye results, based on the selected eye from each subtest. To change the selected eye in a subtest, click or touch on the eye title for the a.SP.V bar graph.

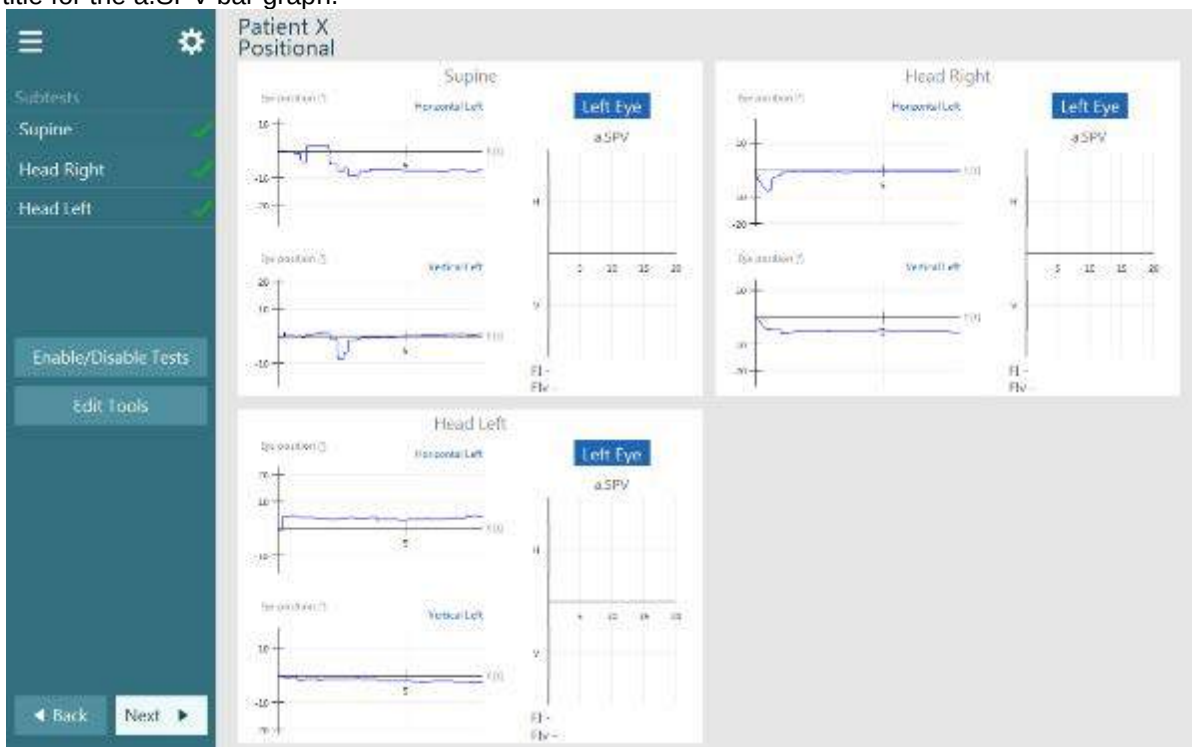


Figure 3.3.3 Positional summary screen

3.4 Oculomotor Testing

Oculomotor tests require the patient to follow a target stimulus or pattern. These tests require an external stimulus, such as a TV or projector, and are found in the VisualEyes 525 software configuration.

3.4.1 Gaze test

During a gaze test eye movements are measured while the patient is fixating on a stationary target. Each subtest has the patient look at a different target for a default time of 10 seconds. At the start of the test, the target is displayed in the center position of the screen (adjusted by the Target Center slider from Calibration if set) for two seconds, then the target will be displayed in the location specified by the subtest properties. The default Gaze test will test the following positions: Center, Left, Right, Up, and Down. Each cardinal gaze direction is set close to the maximum angle provided in each direction. With a widescreen television as the stimulus, the gaze angles tested horizontally will be approximately 1.8 times larger than the vertical angles. An optional Center2 subtest is provided for testing center gaze again after testing the cardinal gaze directions. By default the Gaze subtests are run automatically, therefore after testing the Center position, the software will proceed to the Left position, akin to the Calibration test. If additional time is required, the user can add time with the **Add Time** button.

The Gaze summary screen will display all of the subtests performed in a grid pattern. For each subtest one eye's results are displayed with the corresponding eye movements. Horizontal and vertical eye movements are separated. The Gaze summary can contain a mix of left eye and right eye results, based on the selected eye from each subtest. To change the selected eye in a subtest, click or touch on the eye title for the a.SP.V bar graph.

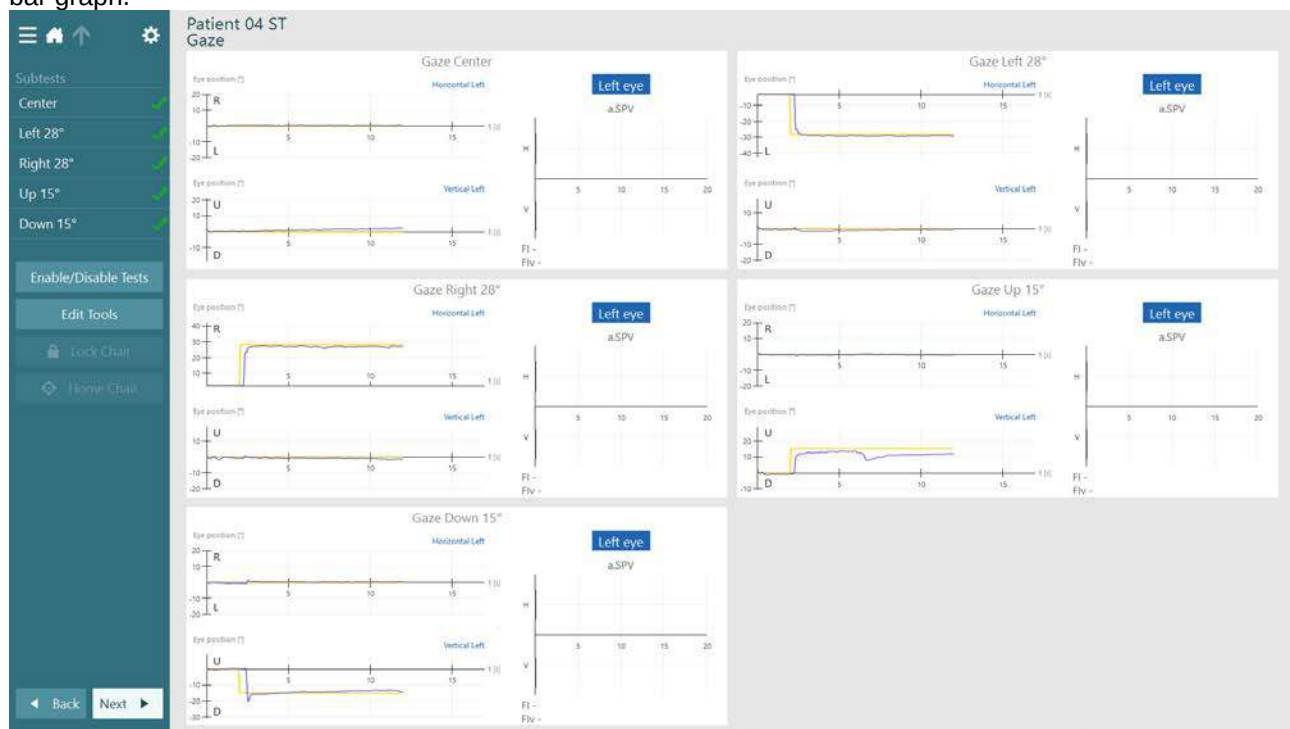


Figure 3.4.1 Gaze summary

3.4.2 Smooth Pursuit test

In the smooth pursuit test, the patient's eyes follow a target that is moving back and forth across the stimulus screen. The velocity of the target stimulus will increase with every two cycles. By default both left and right eyes will be displayed together in the waveform traces and the Gain and Symmetry graphs to allow the operator to see if the patient experiences disjugate eye movement. The test settings has the option to split the eyes into separate graphs if needed to better ascertain an eye's specific response. The default smooth pursuit test only tests horizontally. If desired the operator can elect to enable the vertical subtest as well.

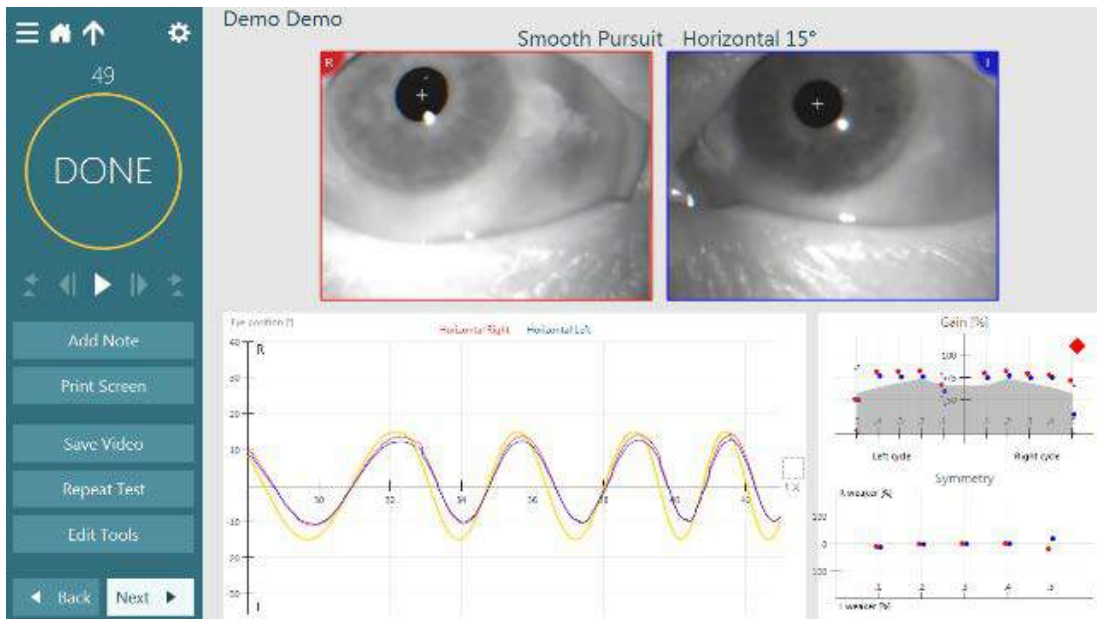


Figure 3.4.2 Smooth Pursuit subtest

The Gain value is given as a percentage value representing the ability of the patient to track the sinusoidal target without saccadic intrusions (short jumps in the eye position to catch up to the target). Each eye's gain is measured for each cycle and displayed on the gain graph as a small dot in either blue (for left eye) or red (for right eye). A larger dot is displayed on the gain graph representing the average of the eye's gain at the selected frequency (e.g. 0.1 Hz). Test thresholds based on age matched patient data studies are displayed as gray shaded areas and will vary based on the selected frequency. If the average gain value (large dot) from either eye falls into the shaded area of the gain graph, the software will mark the test as outside thresholds and use a red diamond.

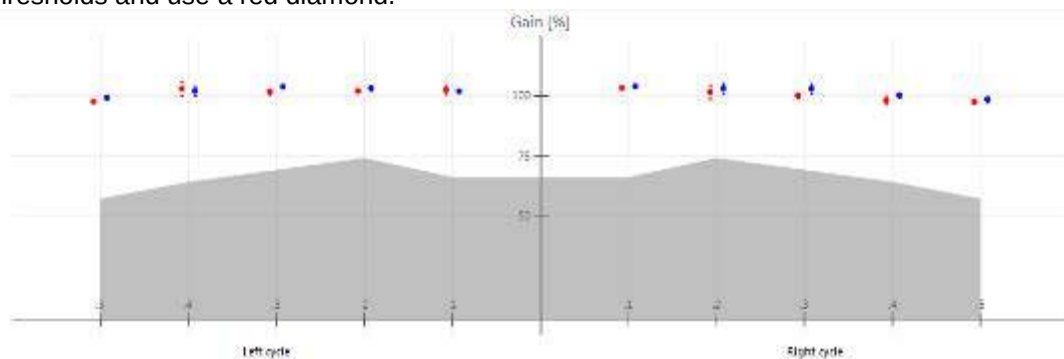


Figure 3.4.3 Gain graph with individual and average gain values

Optionally the Symmetry graph will compare the average left moving gain to the average right moving gain (up versus down in vertical subtests) and display this result for each eye and each frequency.

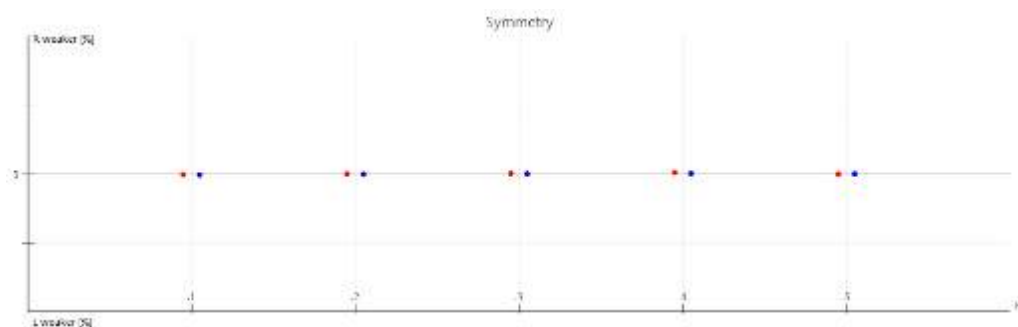


Figure 3.4.4 Symmetry graph

3.4.3 Saccade test

During the saccade test the patient's eyes have to follow randomly moving target jumping from side to side. The default Saccade test will have the target jump horizontally, but the test has optional vertical and combined (a mix of horizontal and vertical positions) subtests available. The patient must fixate on the target and then move to the next target with fast eye movements (saccades). Ideally, the saccades should consist of one single fast movement that leads to re-fixation on the next target. By default both eyes are displayed on the same waveform graph and analysis graphs to show if the patient exhibits any disconjugate eye movements. The test settings has the option to split the eyes into separate graphs if needed to better ascertain an eye's specific response.

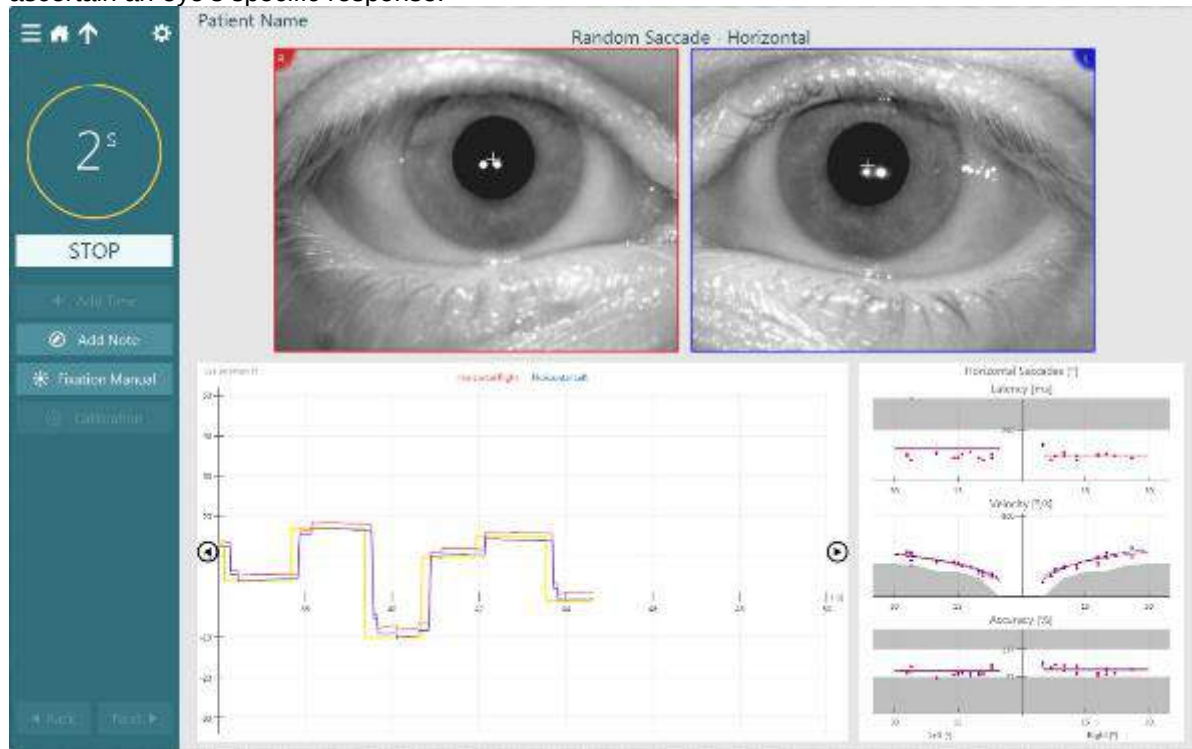


Figure 3.4.5 Saccade horizontal subtest

The saccades are automatically analyzed as the test is performed, and the results are displayed for latency, velocity and accuracy for each saccade. Each eye will be analyzed separately with results plotted for each eye (default) or for a selected eye (right or left).

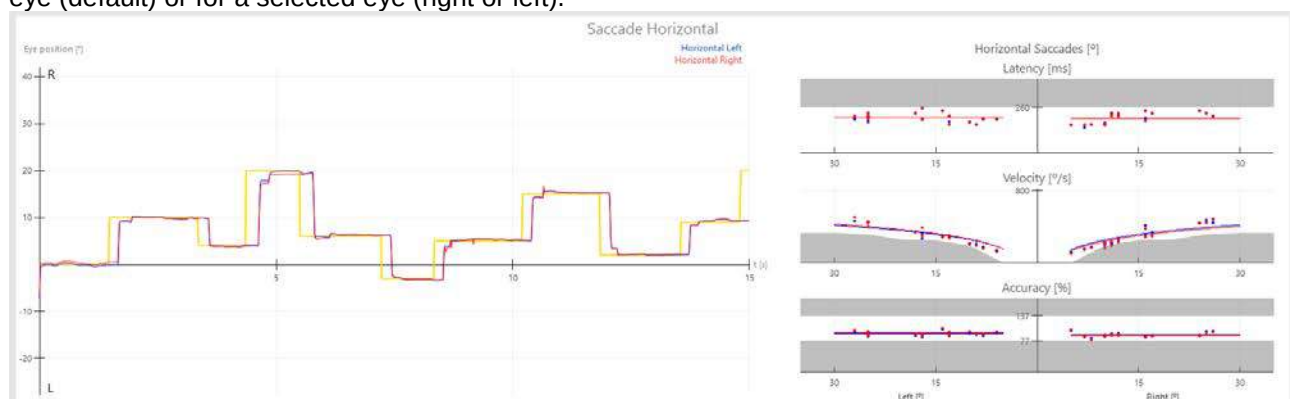


Figure 3.4.6 Saccade results horizontal subtest



Figure 3.4.7 Saccade results combined subtest

The three essential parameters (latency, velocity and accuracy) are analyzed and displayed for both eyes for horizontal and vertical saccades. If the Combined subtest is performed, the software will analyze the horizontal saccades separately from the vertical saccades (Figure 3.4.7). The results will display each saccade jump as a dot colored for the respective eye. Average lines for the Latency and Accuracy graphs are calculated for each direction (e.g. left versus right movements) of saccade jumps and regression curve fits are calculated for each eye and direction for the saccade Velocities. Test thresholds are available for horizontal saccades and will be marked in the graphs with gray shading. If one of the average lines or part of the regression curve fit falls into the shaded areas, the software will mark the analysis with a red diamond.

3.4.4 Optokinetic test

The Optokinetic test is used to examine eye movement during stimulation from a large, moving pattern. The VisualEyes™ 525 software can generate various stimuli patterns that can move across the TV or projection screen in horizontal or vertical directions.



Checker Board



Trains with Tracks



Spheres

During the slow phase of the nystagmus the eyes move with the velocity of the projection pattern. The eyes then make a fast corrective eye movement (saccade) back to center. This nystagmus continues to occur throughout the duration of the test. In the default Optokinetic test, the patient's ability is assessed in four tests following moving stimulus patterns at 20 degrees per second (left moving and right moving) and 40 degrees per second (left moving and right moving). An optional pair of tests at 30 degrees per second is also available. These velocities can be changed if desired, though it is recommended to test each direction at the new velocity which will then be shown in the Symmetry graph on the Optokinetic summary.

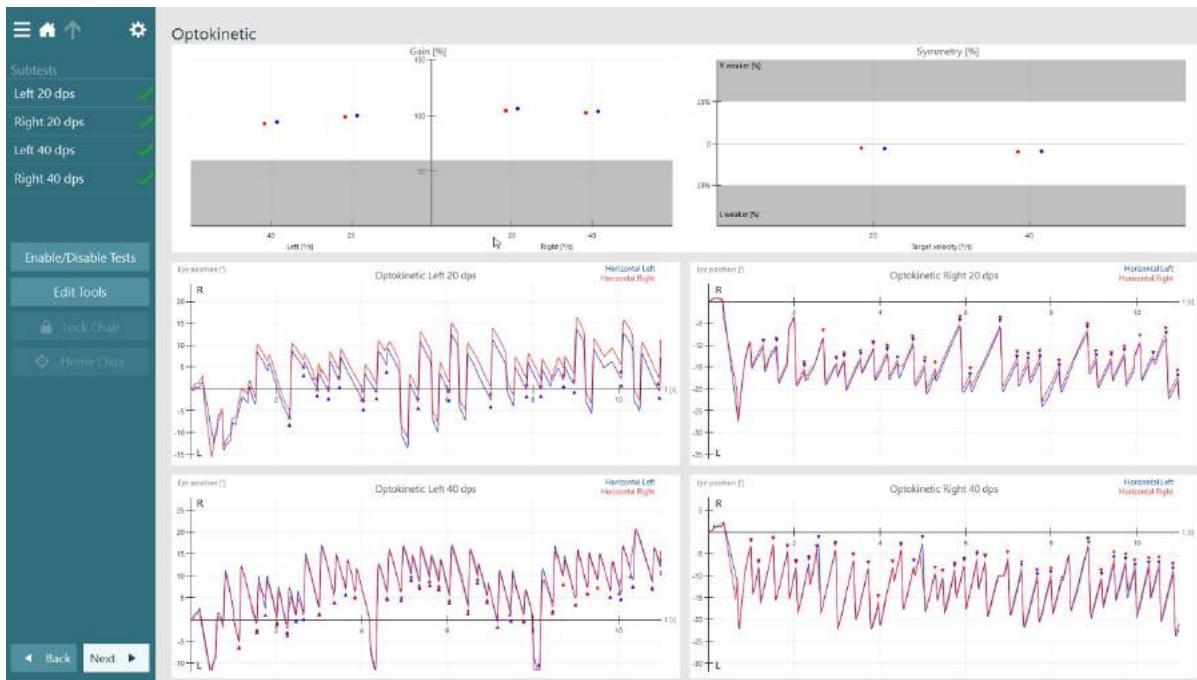


Figure 3.4.8 Optokinetic summary

The optokinetic subtest will display the stimulus pattern on the TV or projection screen. The test will last 15 seconds (though more time can be added with the **Add Time** button) and display the stimulus moving in the selected direction. Have the patient follow the targets as they go across the screen. Typically the patient will focus on the center 10 degrees of the stimulus, picking up the target as it comes from one side, then as the target leaves the patient's field of focus, the patient will go back and pick up the next target. The optokinetic test is considered fairly intensive, and may not be performed correctly by the patient on the first attempt. If the patient does not appear to be following the target and producing a noticeable nystagmus pattern, it may be needed to restart the test and instruct the patient again.

During data collection, the Gain graph will update with the patients response with an average gain for each eye. The average gain is defined as the patient's average slow phase velocity divided by the stimulus velocity as a percentage. In the Optokinetic summary, the average gain from each subtest will be compared with the other subtests and the results will be displayed in the Symmetry graph. If the average gain falls outside the test thresholds or the symmetry value at one of the velocity pairs falls outside the test thresholds, the test will be marked as outside thresholds and have a red diamond displayed.

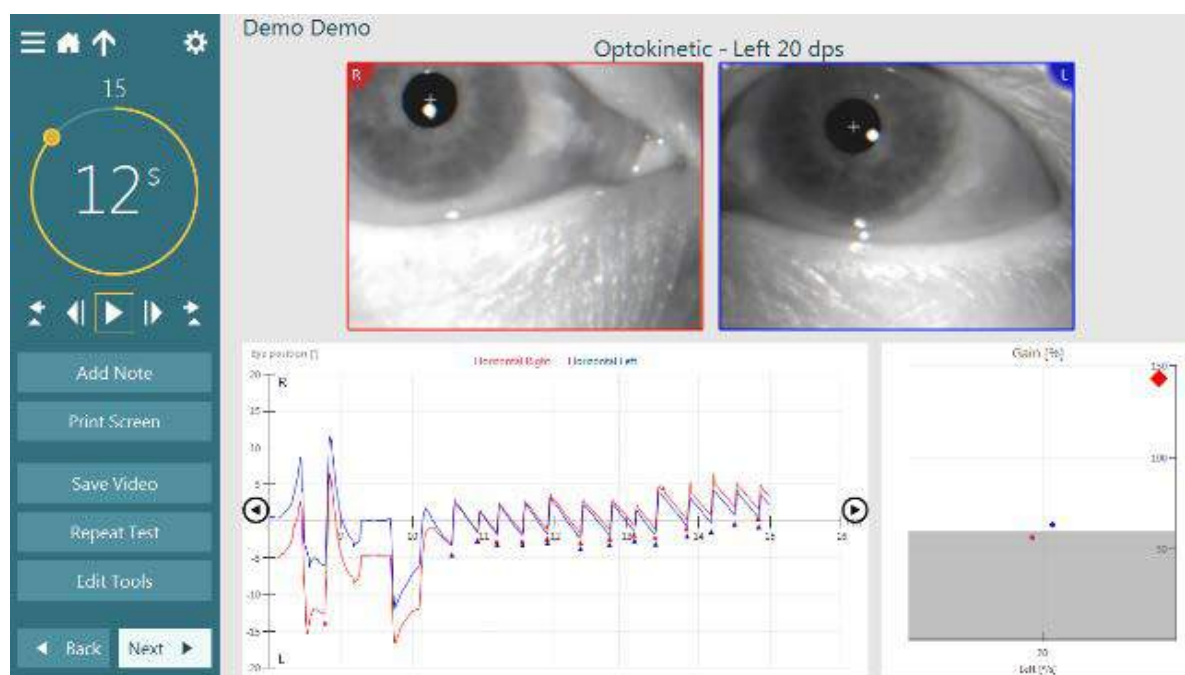


Figure 1.64 Optokinetic test display (during data collection)

3.5 Caloric testing

The caloric irrigation test acquires eye movement data during direct stimulation of the vestibular end organ using an air or water irrigator to provide a temperature controlled stimulus. Recorded data is analyzed for slow phase velocity and frequency of nystagmus beating and is displayed in various standard diagrams. Caloric testing is available in both VisualEyes 515 and VisualEyes 525 software.

Please note that Caloric testing is contraindicated in persons exhibiting the following:

- History of hypertension (uncontrolled, acute or de-compensated phase)
- History of cardiac problems (arrhythmias especially bradycardia or Stokes-Adams attack; acute or de-compensated phase) e.g. if someone has unstable angina, a recent myocardial infarction (within last 3-6 months) or is undergoing cardiac investigations
- Psychotic/neurotic disorders (acute or de-compensated phase)
- Epilepsy (acute or de-compensated phase)
- Eye surgery (within the previous 3 months)
- Ear surgery (within the previous 6 months)
- Perforated eardrum (water stimulation not allowed, air stimulation may be tolerated)

The caloric test will connect with the Air Fx air caloric irrigator or Aqua Stim water caloric irrigator based on the test configuration. If the clinic uses a third party caloric irrigator, the test will have to be configured for a manual irrigator setup where the operator runs the irrigator outside of software control. In either case the caloric irrigator should be turned on prior to starting the test.

The default caloric test will start with the right warm subtest. The connected irrigator should begin to warm up to the specific temperature as defined in the test settings. If using a third party irrigator, turn on the irrigator and have it reach the warm temperature setting. When the irrigator is ready to dispense the warm water or air, the Start button will become available.

When the test is ready to begin, use the button on the Air Fx or Aqua Stim handle to begin the irrigation and start recording in the software. If using a third party irrigator, start the test using the RF Remote or foot pedal then begin irrigation. As the irrigation proceeds, the software will record the patient's eye movements. As the nystagmus beats are detected, the software will calculate the slow phase velocity for the beats and display the velocity in the Pod View graph on the right side of the screen. The average slow phase velocity (a.SPV) will be calculated based on the peak response window settings (by default 10 seconds). As with nystagmus tests, the software will display triangles on the waveform indicating left beating or right beating nystagmus.

If the irrigation needs to be suddenly aborted, remove the speculum or silicone tube from the ear and direct stimulus flow elsewhere. The irrigator stimulus flow will continue until the pre-selected irrigation time has elapsed, at which time an indicator tone will sound and the irrigation will stop. Alternatively, press and hold the irrigator button for three seconds to abort the irrigation. A message will be displayed on the computer test screen asking "Are you sure you want to stop?". Click or touch yes to stop the recording. Click or touch no to continue recording.

After the irrigation has completed, remove the irrigator handle from the patient's side and have the patient begin alerting tasks to stay focused during the test and provide a stronger nystagmus response. As the patient continues alerting tasks, the patient's a.SPV will rise. Once the a.SPV begins to drop by 10% of the maximum value, the fixation light will come on inside the goggle. If the patient's maximum a.SPV value is too low (such as with cool air calorics), the software may not detect the drop in the response, so the operator must watch the Pod View and intercede with activating the fixation light (using the Fixation button on the RF Remote or the Fixation button on the screen). The fixation light will turn off after 10 seconds if activated automatically, otherwise the operator must turn off the fixation light manually after 10 seconds. This will allow the software to calculate the fixation index value. After the fixation light is turned off, the remaining nystagmus will still be tracked and recorded for post-fixation information.

When the test is completed, the software will either color the nystagmus slow phase portions of the waveform in green or leave the triangles depending on the System Default Settings. The peak response window will be displayed in the Pod View with a small dashed box in light blue color.

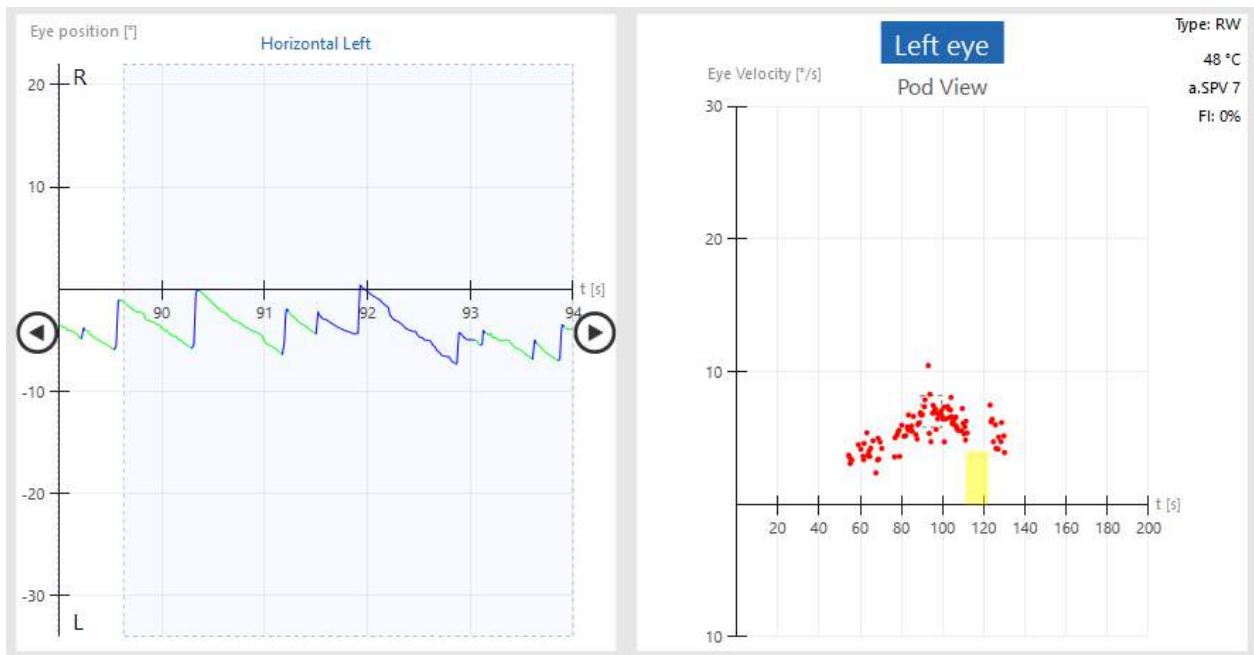


Figure 3.5.1 Caloric test results

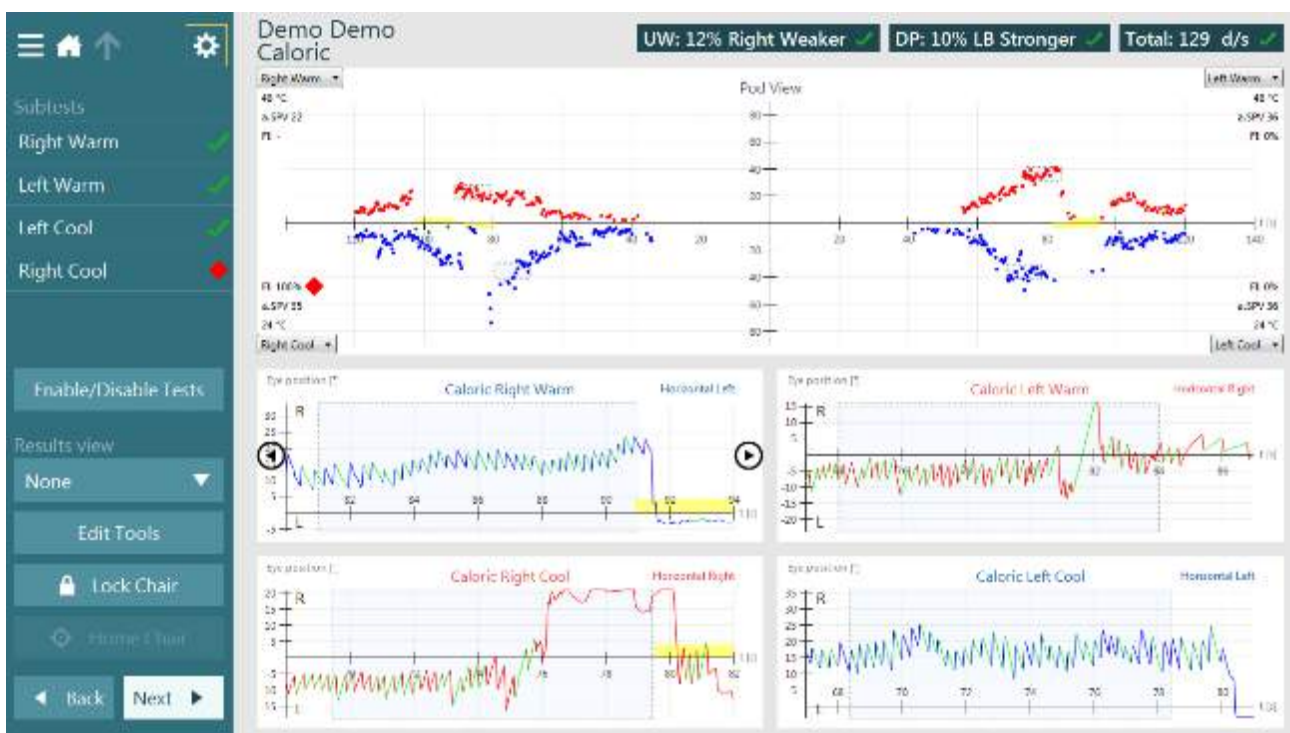


Figure 3.5.2 Caloric summary

As each caloric test is performed, the caloric summary will display the results of the caloric subtests together. The caloric summary can be a mix of left eye and right eye results as desired. These results are displayed in the right upper corner of the caloric results display (Figure 3.5.2).

Unilateral Weakness (UW)

Unilateral Weakness is a calculated value that compares the nystagmus strength induced by irrigation of the left ear with that of the right ear. It is calculated automatically by the software.

The unilateral weakness is given in percent [%]. The default threshold level is 25%.

Directional Preponderance (DP)

Directional Preponderance is a calculated value that compares the nystagmus strengths in the right beating direction with the nystagmus strengths in the left beating direction.

The directional preponderance is given in percent [%]. The default threshold level is 30%.

Fixation Suppression Index (FI)

The fixation suppression index (FI) quantifies the ability of a patient to deliberately suppress nystagmus by fixating on a given target. It is determined just after the peak response by switching on the fixation light within the mask (the default protocol automatically turns on the fixation lights at the appropriate time). This time interval is shaded in yellow on the graph.

The value for FI is represented as a percentage with the test threshold of 50% used as a cut-off value. 0% indicates perfect nystagmus suppression during fixation, 50% indicates complete failure of fixation suppression.

Spontaneous Nystagmus Correction (SPN)

If the Spontaneous Nystagmus subtest is performed inside the Caloric test, the software can correct the nystagmus values using the nystagmus value when the patient is laying in the supine position. If the patient experienced nystagmus in the supine test of the Positional test or during the Spontaneous Nystagmus test, then change the test settings to include the Spontaneous Nystagmus subtest. After the Spontaneous Nystagmus subtest is performed, the Spontaneous Nystagmus switch will become available. The graphs will then display the corrected x-axis for adjusting the caloric response due to the patient's latent nystagmus.

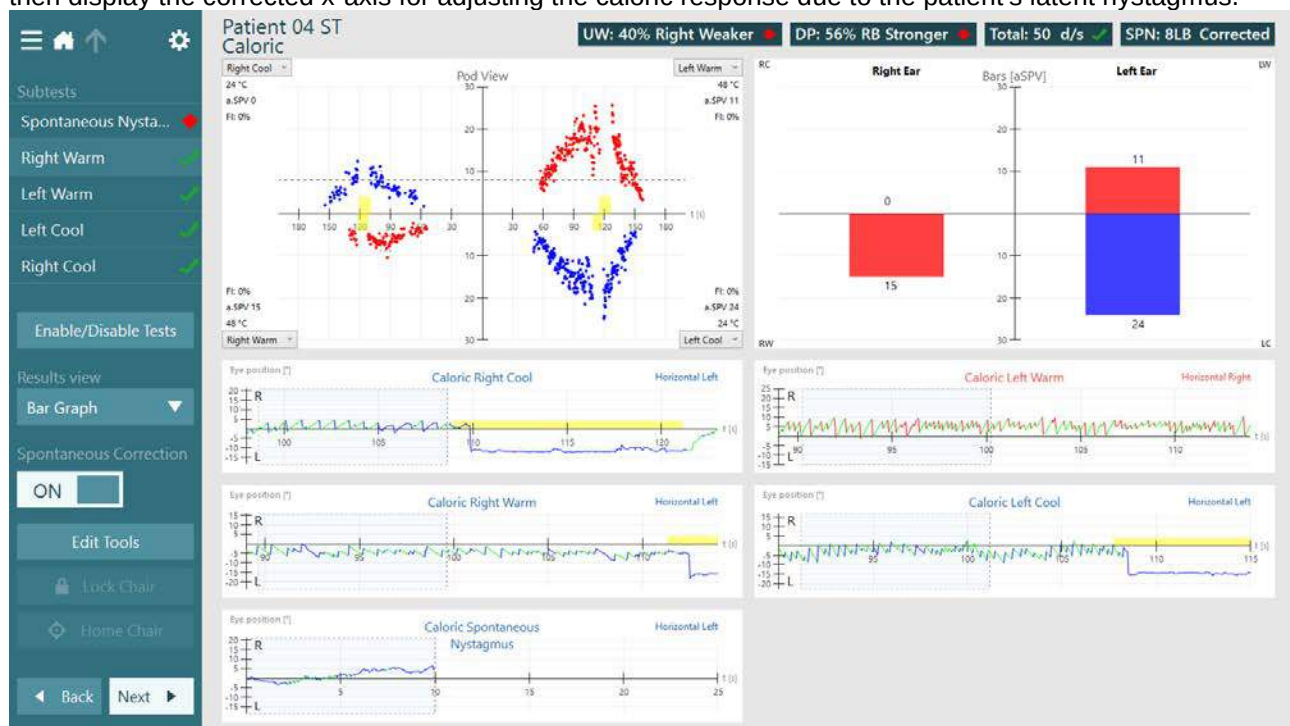


Figure 3.5.3 Caloric summary with Spontaneous Nystagmus correction enabled

Monothermal Warm Screening Test (MWST)

If only two warm irrigation subtests are performed, the system will calculate a MWST value based on these subtests. It is not a separate test to the caloric, but will be calculated automatically in the default protocol set up or anytime the 2 warm caloric tests are performed as the first 2 tests.

When both warm tests are complete, the software will automatically generate an MWST score.

If the clinician moves on to perform cools, then the MWST score is replaced with a UW score.

The default suggested value is 30%. If the maximum result exceeds 30% then an out of threshold symbol (red diamond) will be present for this test.

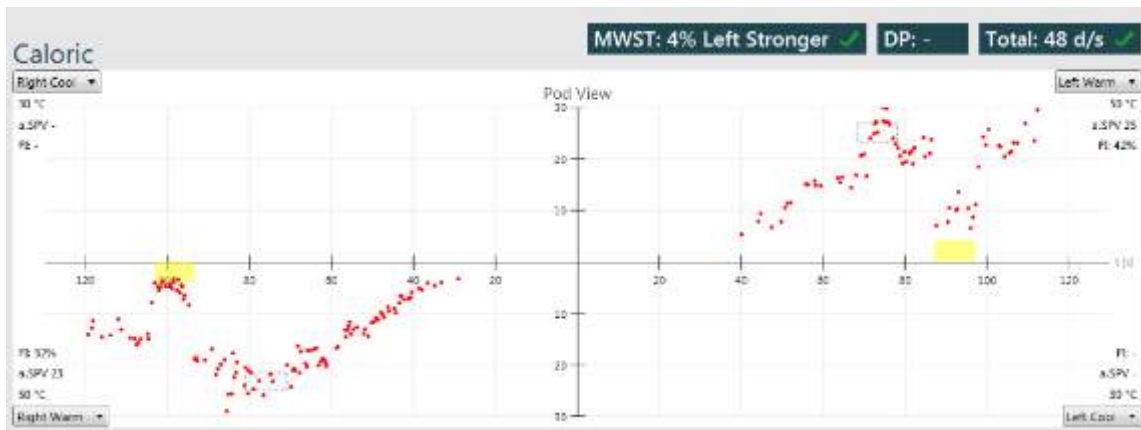


Figure 3.5.4 Caloric summary results for MWST

Caloric Results Views

The caloric results may be displayed in a number of different standard diagrams. In addition to the Pod View, the caloric results can be displayed in the Bar graph and Freyss line graph. In certain regions the additional options of Scherer, Claussen, and Haid-Stoll graphs are available. To select an additional view, use the Results View selection box and choose the desired view.



Figure 3.5.5 Caloric Results View selection box

All diagrams are positioned in the upper portion of the review screen next to the pods diagram.

Pods

In the pod diagram, the slow phase velocity (SPV) of horizontal nystagmus beats are plotted over time.

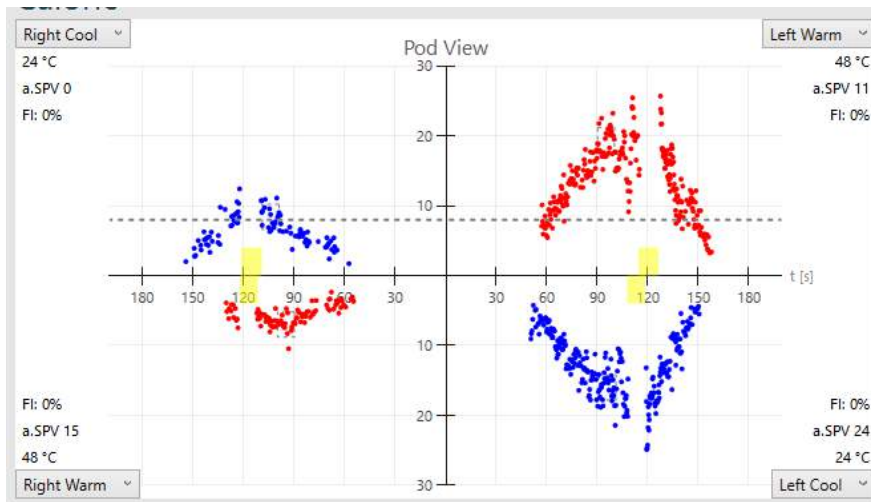


Figure 3.5.6 Pod View

The horizontal axis represents time (seconds) and the vertical axis is the SPV (degrees). In the corner of each quadrant is an area that displays temperature of irrigation, a.SPV and FI.

In subjects with normal vestibular function this specific arrangement of data plots results in a shape similar to the outlines of a pea pod. Click on a beat in the pod diagram, to open the edit mode.

Normally nystagmus beats are illustrated by triangles in the same color as the waveform. However, if data collected is contradictory to what would be expected, i.e. warm irrigation of the right ear resulting in all left-beating nystagmus, triangles will appear in a green color to alert the examiner of the unexpected outcome: An alert message will also appear indicating an unexpected result.

Bar graph

The bar graph represents the average slow phase velocity during the peak response of each irrigation. Warm irrigations are indicated in red color and cool irrigations in blue. The graph is divided in two, with one side displaying the right eye and the opposite the left eye. The vertical axis displays the average slow phase velocities, which correspond to the height of each individual bar. The numerical value defines the maximum average slow phase eye velocity.

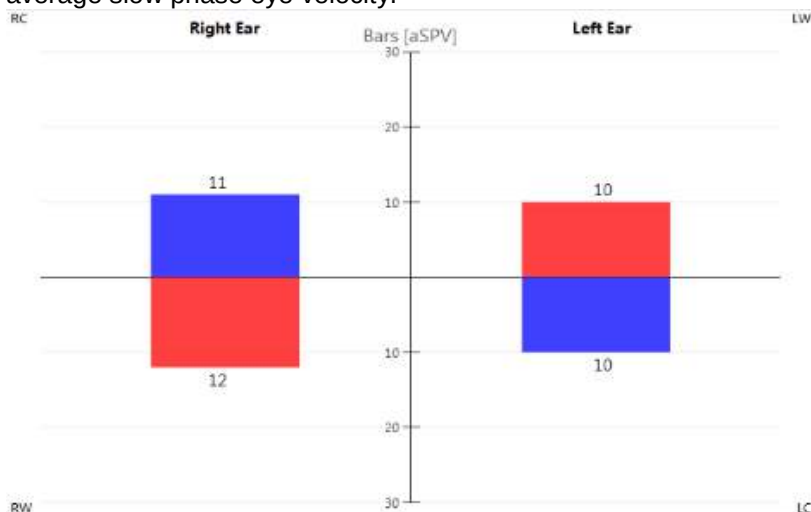


Figure 3.5.7 Bar graph

Freyss diagram

The Freyss Diagram graphically represents the average slow phase velocities (a.SPV) during the peak response of each irrigation.

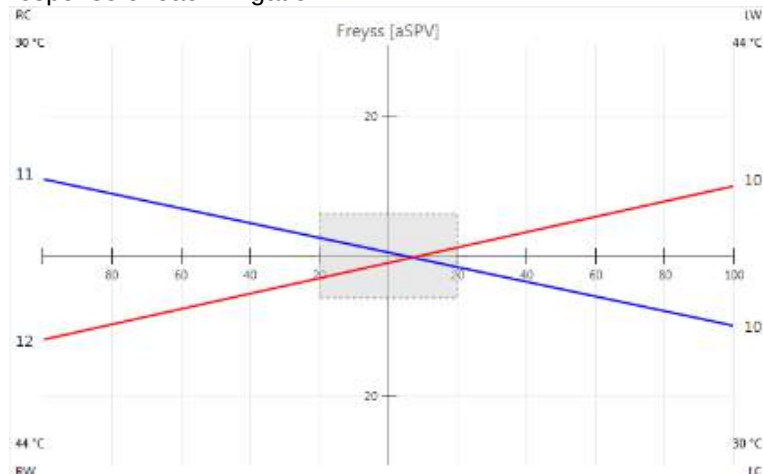


Figure 3.5.8 Freyss diagram

On the left vertical axis, the a.SPV calculated for the irrigations of the right ear are plotted; data points on the right vertical axis show the a.SPV values for left ear irrigations.

The rectangular box in the center of the Freyss diagram outlines the Unilateral Weakness cut-off value.

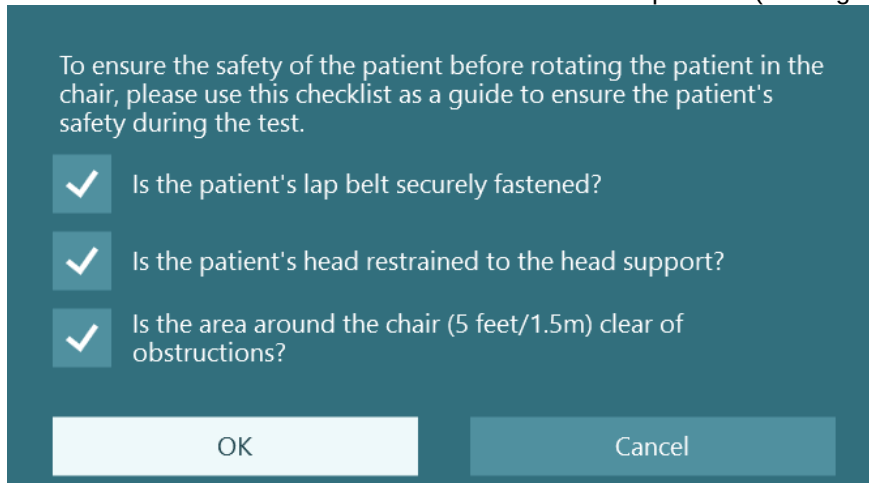
The diagram is completed by two lines: one connecting the data points obtained for the two warm irrigations, the other one connecting the data points representing the two cool irrigations. The two lines described above will intersect either to the left or to the right of the rectangle in patients with UW larger than the threshold value.

3.6 Rotational Chair Testing

Rotational chair testing is available in licensed VisualEyes 515 and VisualEyes 525 systems that utilize a reclining chair. The Nydiag 200 and System 2000 Reclining chairs utilize FireWire cameras, and the Orion Reclining chair utilize USB cameras.

3.6.1 Safety checks prior to beginning rotary chair tests

Prior to beginning the first rotary chair test in the reclining rotary chair, a safety checklist will be presented to ensure the safety of the patient before the chair is set into motion. Please use the checklist as a guide to ensure patient safety during the test. Check each box after performing the task. The chair will not be able to move until all boxes are checked and the OK button is pressed (see Figures below).

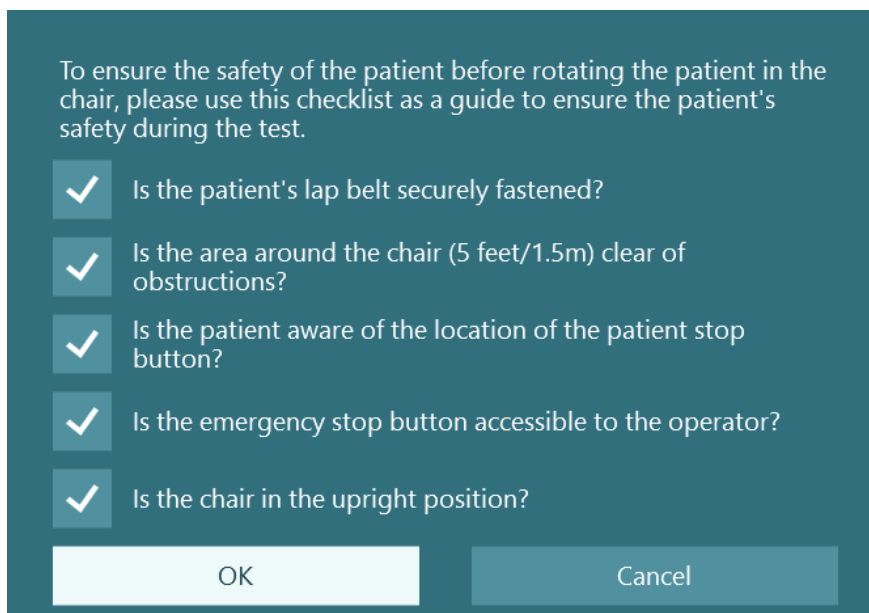


To ensure the safety of the patient before rotating the patient in the chair, please use this checklist as a guide to ensure the patient's safety during the test.

- ☒ Is the patient's lap belt securely fastened?
- ☒ Is the patient's head restrained to the head support?
- ☒ Is the area around the chair (5 feet/1.5m) clear of obstructions?

OK Cancel

Figure 3.6.1 Safety checklist for Orion and System 2000 Reclining chairs



To ensure the safety of the patient before rotating the patient in the chair, please use this checklist as a guide to ensure the patient's safety during the test.

- ☒ Is the patient's lap belt securely fastened?
- ☒ Is the area around the chair (5 feet/1.5m) clear of obstructions?
- ☒ Is the patient aware of the location of the patient stop button?
- ☒ Is the emergency stop button accessible to the operator?
- ☒ Is the chair in the upright position?

OK Cancel

Figure 3.6.2 Safety checklist for Nydiag 200 chair

3.6.2 Sinusoidal harmonic acceleration (SHA) test

During the Sinusoidal Harmonic Acceleration (SHA) test the patient is positioned in the rotary chair and is rotated in a sinusoidal pattern alternating from left to right. Analysis of the vestibular response is performed by recording the eye movements with VisualEyes™ VNG goggles in a fixation-denied condition. The patient is rotated in alternating directions at multiple individual frequencies.

The frequencies most often tested during SHA test are the octave frequencies 0.01 Hz, 0.02 Hz, 0.04 Hz, 0.04 Hz, 0.16 Hz and 0.32 Hz. The frequency of 0.64 Hz is also available.

The responses are displayed in real-time (in relation to the stimulus). The eye position and eye velocity results are plotted within the test window along with two summary graphs showing gain and phase results for the frequency being tested. (See Figure 1.86.

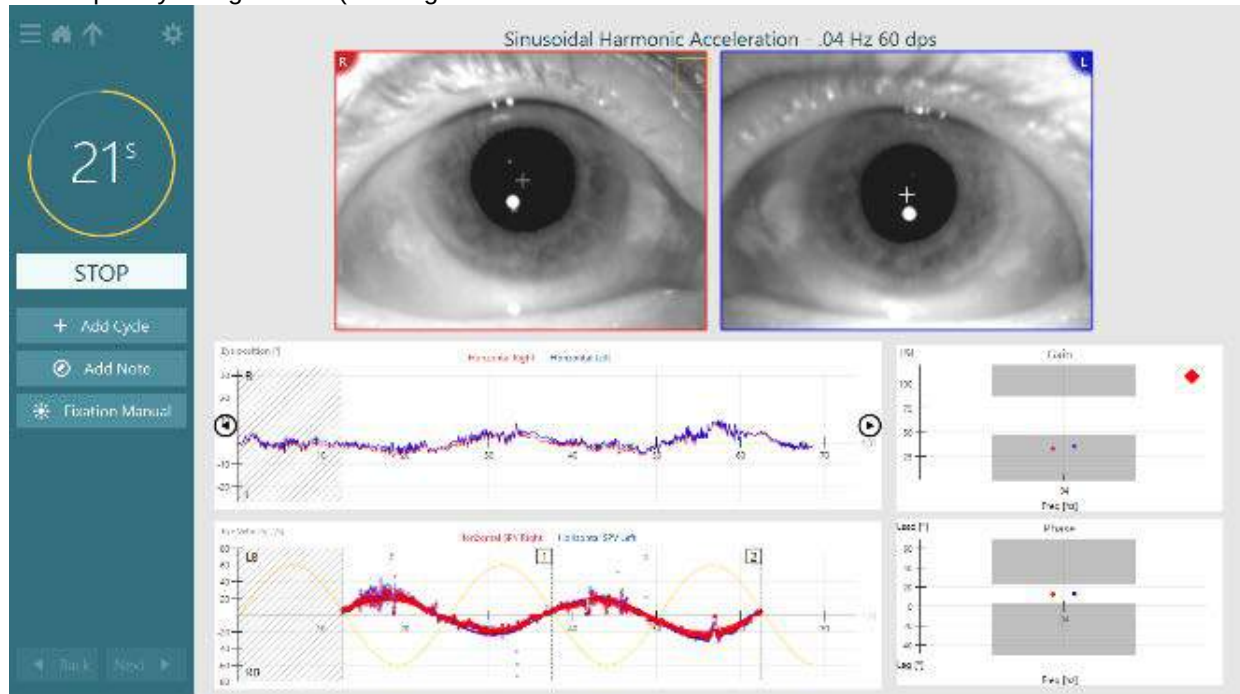


Figure 3.6.3 Sinusoidal Harmonic Acceleration testing

To begin the testing procedure select 'Begin Testing' from the main VisualEyes™ menu.

The SHA test will be available within the protocol or may be selected directly from the side menu panel by tapping the 'hamburger' icon in the upper left corner of the test screen to view the test battery list. Select SHA to begin testing. This will open the first frequency within the Sinusoidal Harmonic Acceleration test sequence. Alternatively, if the examiner chooses to perform the SHA test frequencies out of sequence, tap the plus sign to the left of SHA which will expand to show all subtests and select the desired frequency (Figure 3.6.4).



Figure 3.6.4 Expanded test battery view

Example Instruction for the Patient:

"You will feel yourself rotating back and forth slowly in the chair. While you are rotating, I will be asking you several questions to keep you alert. We will test different frequencies and the entire test will take a few minutes. Please keep your eyes open the entire time."

To begin the test:

1. Select 'Start' from the left menu panel.

START

2. The timer will begin counting down. The length of test time is pre-defined by the number of cycles selected for the test frequency.

The chair will activate and begin moving in a sinusoidal pattern.

Camera recordings will begin at the onset of chair movement.

The stimulus and eye movements will be displayed in real-time (see Figure 1.86).

While the test is active, it is possible to add cycles to continue testing beyond the protocol-specified number

+ Add Cycle

of SHA cycles. Click or touch the button to add a cycle, which will increase the test time by the number of seconds associated with one full cycle of SHA rotation for that given frequency.

To abort the chair rotation prior to test completion, click or touch the Stop button. A message will be displayed on the computer test screen asking "Are you sure you want to stop?". Click or touch yes to have the recording end. Click or touch no to continue recording the tracing.

Once the test is complete a summary test results page will appear (Figure 3.6.5).

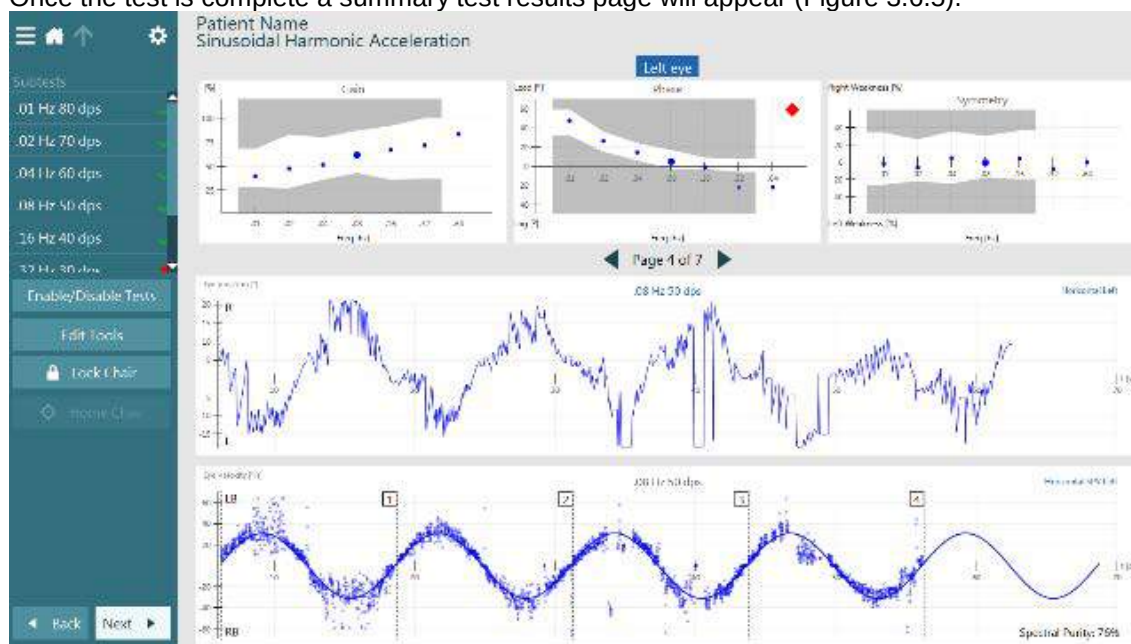


Figure 3.6.5 Sinusoidal Harmonic Acceleration summary

Sinusoidal Harmonic acceleration analysis is performed on cycles of pendular movement for specific frequencies. One complete cycle represents the pendular movement period consisting of acceleration/deceleration in one direction, and acceleration/deceleration in the opposite direction.

Please note: The first half cycle (hatched region) is excluded from the analysis for improved test reliability.

Analysis of eye movements is performed separately for the right and left eyes and the results are displayed separately. Left eye results are displayed by default. The displayed results can be changed to the right eye by selecting the eye title in the top center of the summary test results screen (Figure 3.6.6).

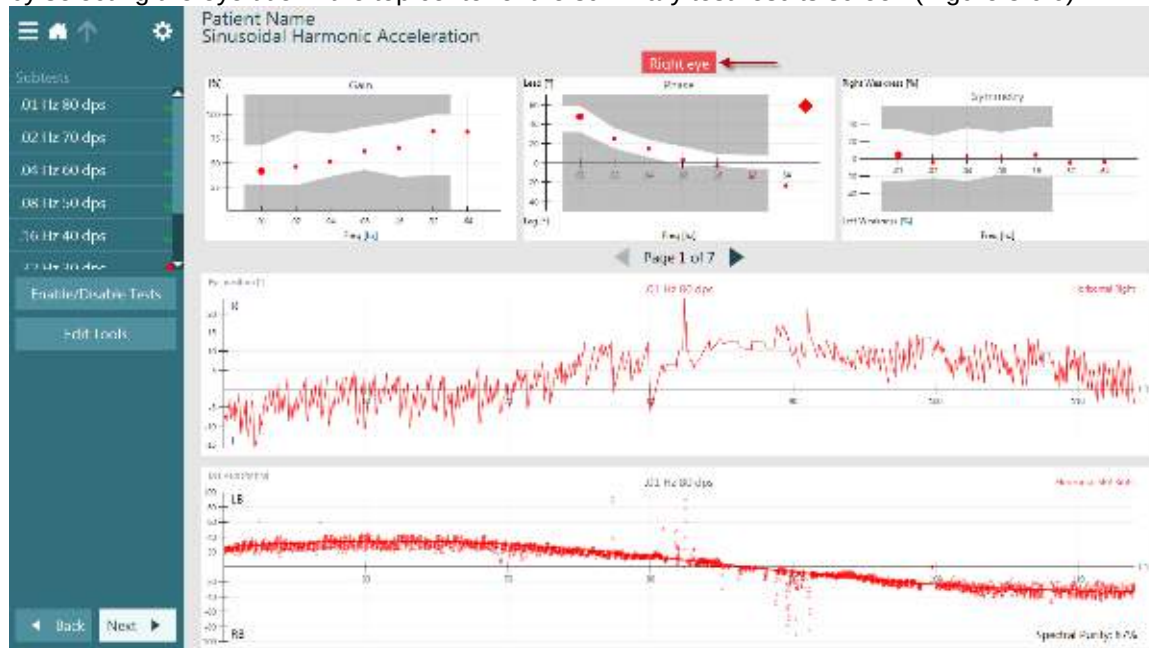


Figure 3.6.6 Right eye results for Sinusoidal Harmonic Acceleration test

The summary test results screen displays various analyses. The top portion of the summary results screen displays plots for Gain, Phase and Symmetry. These parameters are explained in detail in the following section.

Phase

Phase is the value, in degrees, to which compensatory eye movements lead or lag movement of the head. As such, phase measurements characterize the timing relationship between motion of the head and the resulting Vestibular Ocular Reflex (VOR) response, allowing for the quantification of the phase lead or lag. Mathematical functions are used to calculate the phase shift between the reclining chair stimulation (head movement) and the eye response. The resulting values are plotted within the phase graph (Figure 3.6.7).

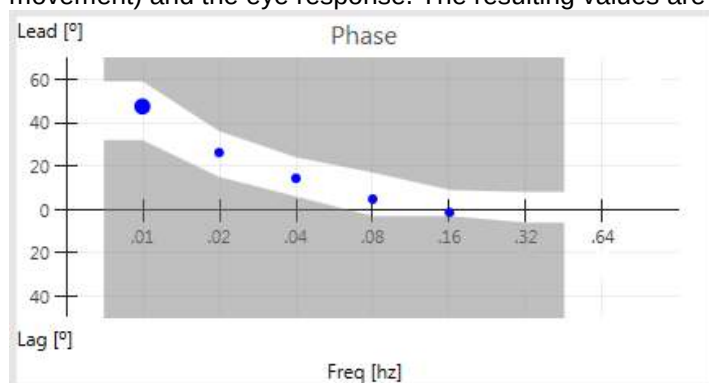


Figure 3.6.7 Phase graph

Phase values are expressed in degrees ($^{\circ}$). A positive value indicates a phase lead. Values within the white region of the graph are considered to be within suggested threshold levels and those in the grey shaded regions are considered to be outside of the suggested threshold levels or criteria. When data points fall in the grey shaded regions, the graph will be marked with a red diamond to indicate that the patient's data was outside of the suggested threshold level.

Phase $< 0^{\circ}$

Eye movement lags the head movement.

Phase > 0°

Eye movement leads the head movement

Gain

Gain measurement provides an indication of the responsiveness of the peripheral vestibular system. If the function of the (VOR) is to produce an eye movement that compensates for head movement, then under perfect conditions the slow phase eye velocity of the response to rotation should be a mirror image of head velocity producing a gain of 60 %.

The gain is the relation between amplitude of the sine wave function (generated from the eye-movement data) and the amplitude of the sine wave function fitted to the reclining chair data.

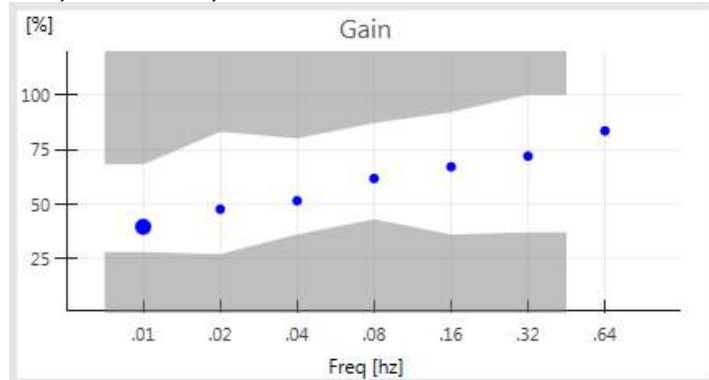


Figure 3.6.8 Gain graph

Gain values are expressed as a percentage (%). Values within the white region of the graph are considered to be within suggested threshold levels and those in the grey shaded regions are considered to be outside of the suggested threshold levels or criteria (Figure 3.6.8). When data points fall in the grey shaded regions, the graph will be marked with a red diamond to indicate that the patient's data was outside of the suggested threshold level.

Symmetry

The Symmetry is measured as the difference between maximum left-beating and right-beating eye velocities divided by the total of the left- and right-beating maximum slow phase eye velocities.

Values describing asymmetry of response are calculated by comparing slow-phase eye velocities with right-moving rotation and left-moving rotation. Calculation is based on the average maximum slow phase velocity for left and right cycles.

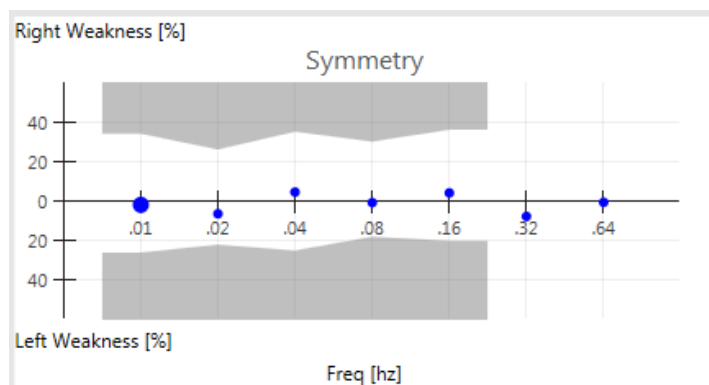


Figure 3.6.9 Symmetry graph

Values displayed in the Symmetry Graph are provided as a percentage (%). Values within the white region of the graph are considered to be within suggested threshold levels and those in the grey shaded regions are considered to be outside of the suggested threshold levels or criteria (Figure 3.6.9). When data points fall in the grey shaded regions, the graph will be marked with a red diamond to indicate that the patient's data was outside of the suggested threshold level.

Graph numerical values

Exact numerical values can be obtained by tapping on or hovering over the individual data point within the Gain, Phase, and Symmetry graphs (Figure 3.6.10).

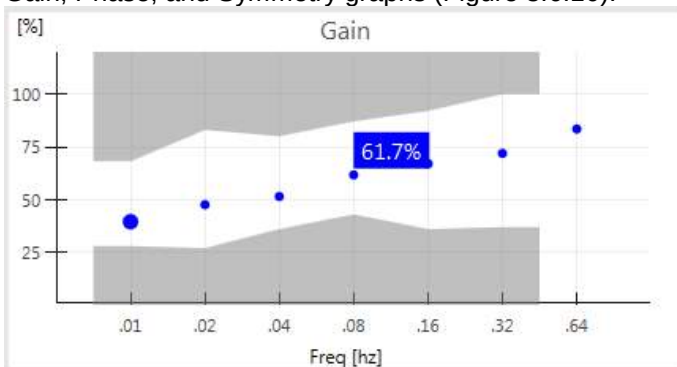


Figure 3.6.10 Numerical value for specific data point

The largest data point represents the frequency (Hz) page that is currently being displayed. Tapping on a smaller data point will then display the data for that frequency. Alternatively, tap the arrows next to the page numbers to move to results for other frequencies (Figure 3.6.11).

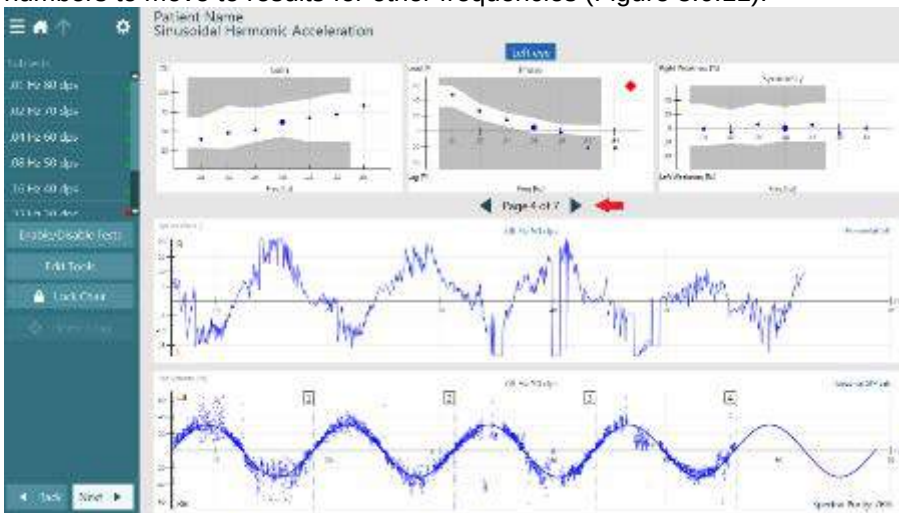


Figure 3.6.11 Changing page numbers in Sinusoidal Harmonic Acceleration summary

Eye position display

In the middle portion of the summary results screen, the eye position ($^{\circ}$) tracing is displayed. The eye position tracing (Figure 3.6.12) represents eye movement during chair rotation and is displayed as a function of eye position in degrees (y-axis) over time in seconds (x-axis).

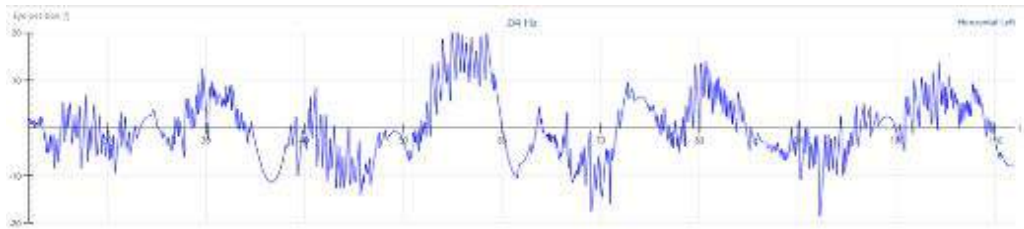


Figure 3.6.12 Eye position trace

Eye velocity display

The eye velocity in $^{\circ}/s$ (blue) relative to stimulus chair velocity (yellow) is displayed beneath the eye position tracing (Figure 3.6.13).

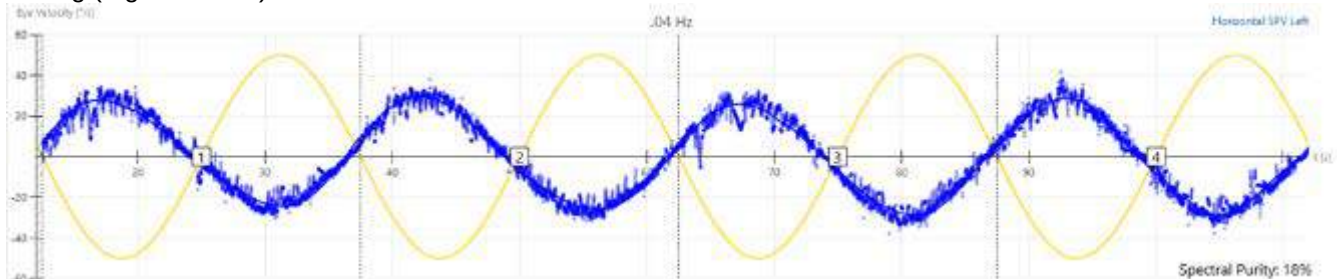


Figure 3.6.13 Display showing detailed individual cycles for eye velocity vs. stimulus velocity

This graphical display provides a detailed individual cycle view for the examiner to see the patient's results in relation to the stimulus. The user can also view the cycle numbers in this display. VisualEyes™ software may display the stimulus and eye movement data opposite one another (as shown above) or overlapping each other, depending on user preference. This preference can be selected within the Sinusoidal Harmonic Acceleration protocol setup. Both viewing methods are designed to provide the user with an easy way to analyze results and cross check gain, phase and symmetry.

Alternatively, a concise combined cycles view can also be selected (Figure 3.6.14). When this view is selected, the eye position tracing is not available. This view can be selected within protocol setup.

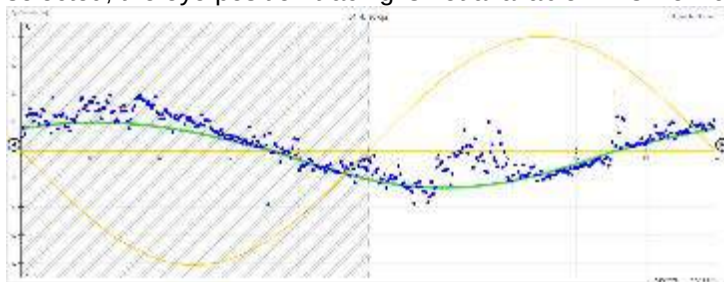


Figure 3.6.14 Concise Combined Cycles view

When further details for review are needed, the examiner can select an individual frequency from the left side menu to see both eyes displayed together for the selected frequency. This view allows the examiner to add notes, review or delete eye video recordings, print the screen, and edit the results for a specific frequency.

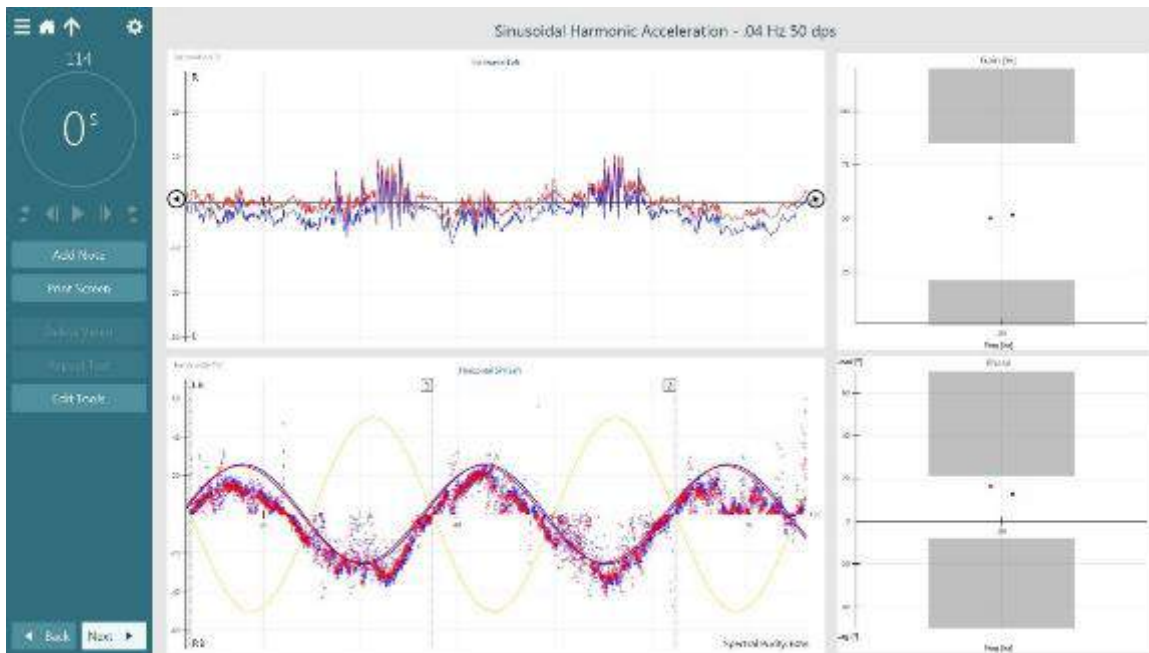


Figure 3.6.15 Review individual SHA frequency

Spectral purity

A spectral purity value for each given frequency tested can be viewed in the lower right corner of the eye velocity display (Figure 3.6.16). The spectral purity of the evoked nystagmus may be useful to indicate whether the test values have been influenced by artifact, for instance from failure to adequately alert the patient or from calibration errors affecting the peak eye velocity measurements. The higher the spectral purity value, the more reliable the sinusoidal harmonic acceleration result. Values are displayed as a percentage (%).

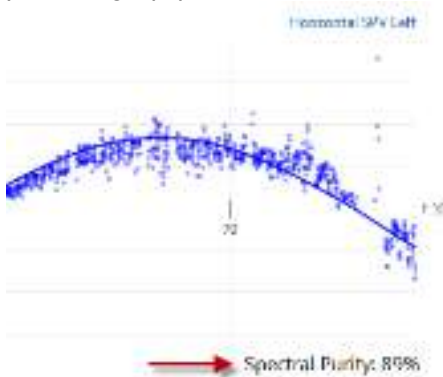


Figure 3.6.16 Spectral purity value

3.6.3 Step rotation test

During the Step Rotation test, the patient is positioned on a motor driven reclining chair that, after an initial acceleration ($60^\circ/\text{s}^2$), rotates at a constant speed for 60 seconds or until the patient has adapted to the rotation and the examiner stops the chair. When the chair is stopped it decelerates at ($60^\circ/\text{s}^2$) and the exam moves into the second step of the Step Rotation test, which involves recording the patient's eye movements during no chair rotation. The test continues with rotation at a constant speed in the opposite direction to the first step, and then a final stopped condition for a total of four recorded conditions for each speed tested. Eye movements are recorded with VisualEyes™ VNG cameras and results are displayed in real-time on screen.

The speeds of rotation most often tested Step Velocity test are $6^\circ/\text{second}$ and $140^\circ/\text{second}$. The speed of $60^\circ/\text{second}$ is also available.

Eye movements are recorded with VisualEyes™ VNG cameras and the responses are displayed in real-time. The patient's eyes, along with both eye position tracings (°) and eye velocity tracings (°/s) are visible during the testing procedure. The chair velocity information can be viewed in the left menu panel, as well as above the patient's eyes (Figure 3.6.17).

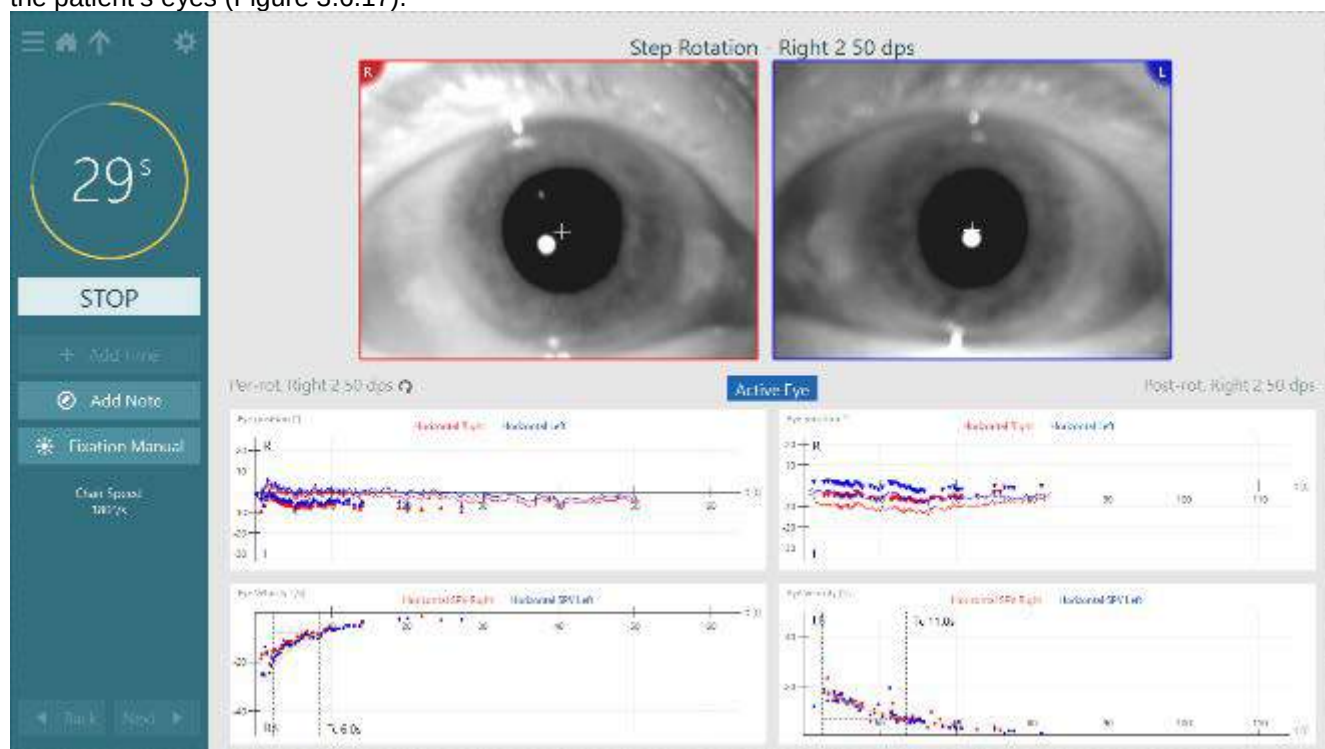


Figure 3.6.17 Step rotation testing

To begin the testing procedure select 'Begin Testing' from the main VisualEyes™ menu.

The Step Rotation test will be available within the protocol or may be selected directly from the side menu panel by tapping the 'hamburger' icon in the upper left corner of the test screen to view the test battery list. Select Step Rotation to begin testing. Alternatively, if the examiner chooses to perform the Step Rotation test velocities/directions out of sequence, tap the plus sign to the left of Step Rotation which will expand to show all subtests and select the desired velocity and direction (Figure 3.6.18).



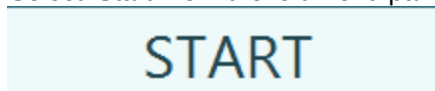
Figure 3.6.18 Expanded test battery view

Example Instructions for the Patient:

"You will feel yourself rotating in one direction for several seconds. During the rotation, I will be asking you several questions to keep you alert. As you are rotating, you may feel as though you are slowing down. When the chair stops, you will feel as though you are rotating in the opposite direction. There will be four segments and each segment will take approximately 1 minute. Please keep your eyes open during the entire test."

To begin the test:

1. Select 'Start' from the left menu panel.



2. The timer will begin counting down. The amount of time is pre-defined by the test parameters.

The chair will activate and begin accelerating to a constant velocity in the selected direction.

Camera recordings will begin at the onset of chair movement.

The stimulus and eye movements will be displayed in real-time.

Once the per-rotary selected speed and direction has been completed the chair will automatically stop after a pre-determined time. The recording will continue into the post-rotary segment. If the per-rotary segment in the opposite direction has not yet been completed the software will automatically start the last per-rotary segment in the opposite direction immediately following the pre-defined stop time for the post-rotary segment. Again, after the final per-rotary condition has been completed the chair will automatically stop and the final post-rotary segment will begin recording. Each segment is pre-defined to last 60 seconds. If the examiner chooses to stop prior to 60 seconds, tap the "Stop" tab from the left menu panel to move into the next test segment. Once the test is complete a summary test results page will appear (Figure 3.6.19).

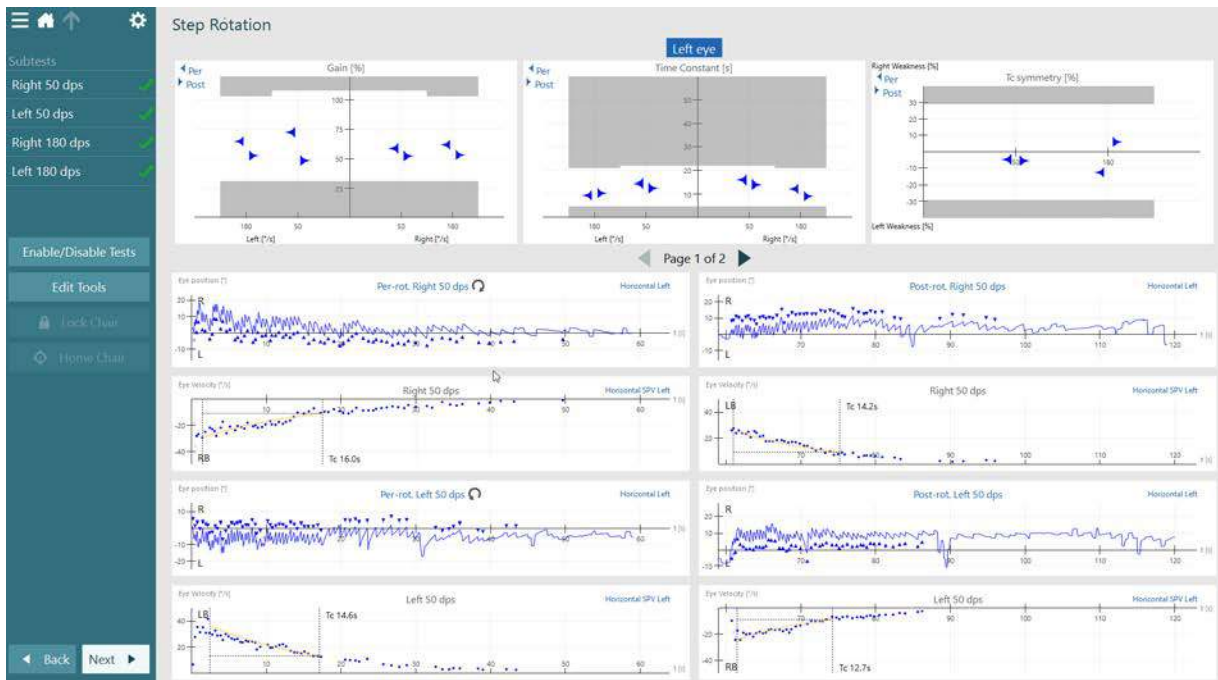


Figure 3.6.19 Step rotation summary

If the examiner has selected to move the chair to zero position after testing, then the chair will move to zero position after all four segments for an individual Step Velocity test have been completed.

It is optional to perform a spontaneous test as part of the Step Test battery. This can be selected in Step Test setup. If the spontaneous test is performed within the Step Test battery, then the option to toggle for spontaneous nystagmus correction becomes available in the left panel menu (Figure 3.6.20). When spontaneous correction is toggled on, it will adjust the responses based on the nystagmus a.SP.V collected during the spontaneous subtest. The degree and direction of correction will be displayed in the upper right corner of the summary results screen.

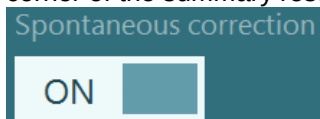


Figure 3.6.20 Step test Spontaneous correction

Analysis of per-rotatory segments (acceleration + constant chair speed period) are separated from the post-rotatory segments (deceleration + chair stopped). One complete analysis consists of per and post-rotary segments for rotations in both directions at a single speed.

Analysis of eye movements is performed separately for the right and left eyes and the resulting waveforms are displayed separately. Left eye results are displayed by default. The displayed results can be changed to the right eye by selecting the eye title in the top center of the summary test results screen (Figure 3.6.21).

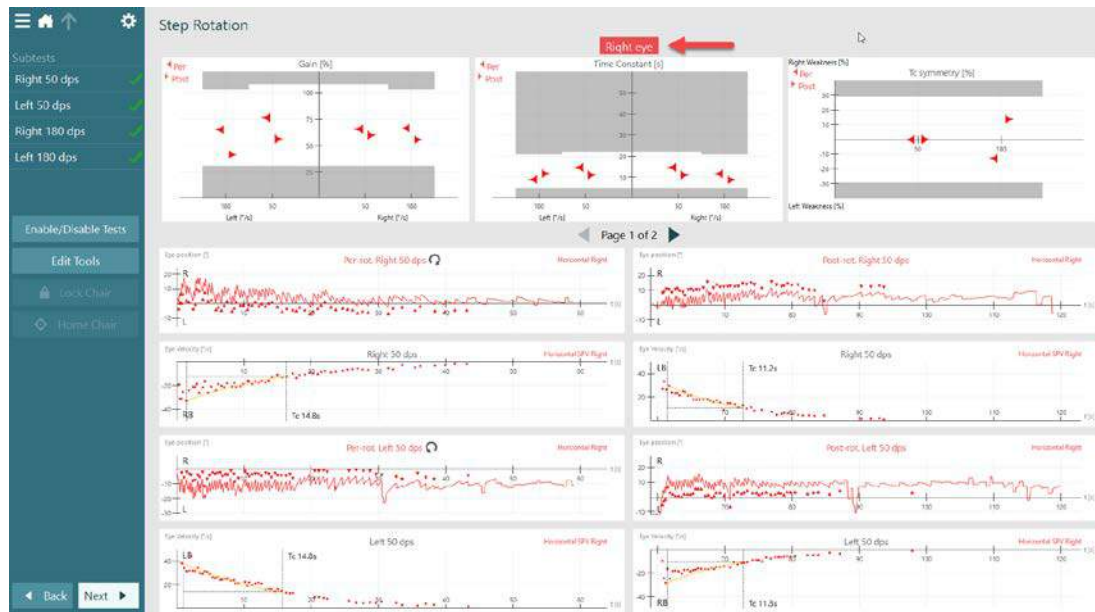


Figure 3.6.21 Right eye results for Step Rotation test

The summary test results screen displays various analyses. The top portion of the summary results screen displays plots for Gain, Time Constant, and Time Constant Symmetry. These parameters are explained in detail in the following section.

Gain

Gain is the relation between the patient's maximum slow phase velocity (SPV) of nystagmus and the maximum velocity of the rotary chair (stimulus). A total of four gain values will be present for each Step Rotation speed tested (per-rotary left, post-rotary left, per-rotary right, post-rotary right).

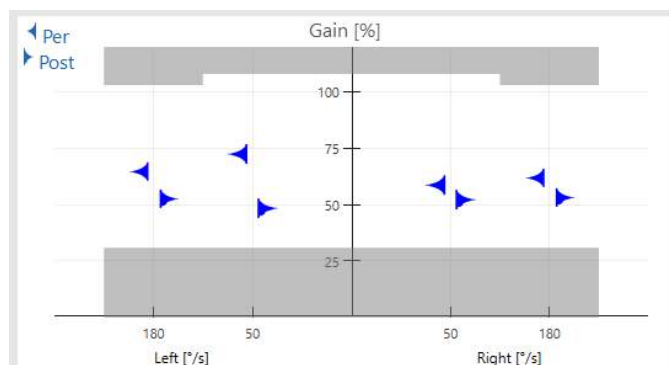


Figure 3.6.22 Gain graph

The gain values are expressed as a percentage (%). Values within the white region of the graph are considered to be within suggested threshold levels and those in the grey shaded regions are considered to be outside of the suggested threshold levels or criteria (Figure 3.6.22). When data points fall in the grey shaded regions, the graph will be marked with a red diamond to indicate that the patient's data was outside of the suggested threshold level.

Time constant (Tc)

Time constant is the value, in seconds, that represents the amount of time it took for the response to reach 33% of its maximum SPV value.

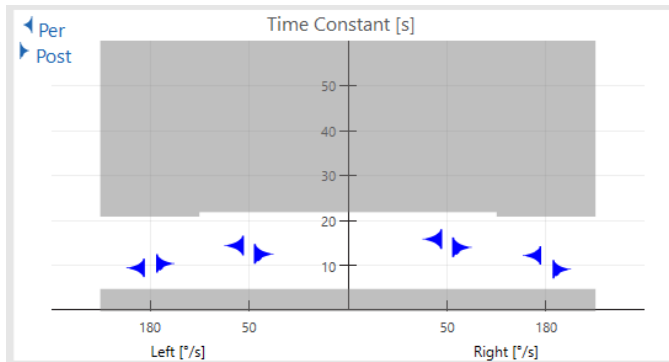


Figure 3.6.23 Time constant graph

Time constant values are expressed in seconds (s). Values within the white region of the graph are considered to be within suggested threshold levels and those in the grey shaded regions are considered to be outside of the suggested threshold levels or criteria (Figure 3.6.23). When data points fall in the grey shaded regions, the graph will be marked with a red diamond to indicate that the patient's data was outside of the suggested threshold level.

Tc symmetry

Tc symmetry provides a way to compare the time constants during chair rotations to the left with time constants during chair rotations to the right. Tc Symmetry is calculated for per- and post-rotatory comparisons.

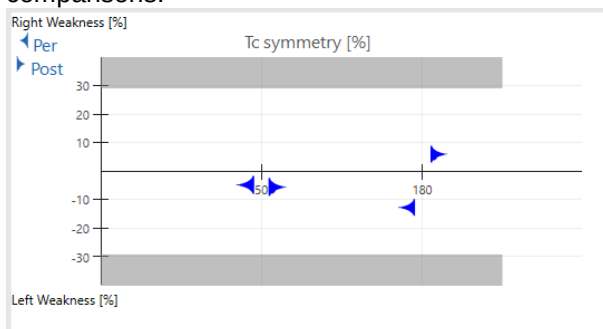


Figure 3.6.24 Symmetry summary plot

Tc symmetry values are expressed as a percentage (%). Values within the white region of the graph are considered to be within suggested threshold levels and those in the grey shaded regions are considered to be outside of the suggested threshold levels or criteria for Tc symmetry (Figure 3.6.24). Data points that fall in the upper grey shaded region are suggestive of a right weakness and data points that fall in the lower grey shaded region are suggestive of a left weakness. When data points fall in the grey shaded regions, the graph will be marked with a red diamond to indicate that the patient's data was outside of the suggested threshold level.

Graph numerical values

Exact numerical values can be obtained by tapping on or hovering over the individual data point within the Gain, Tc, and Tc Symmetry graphs (Figure 3.6.25).

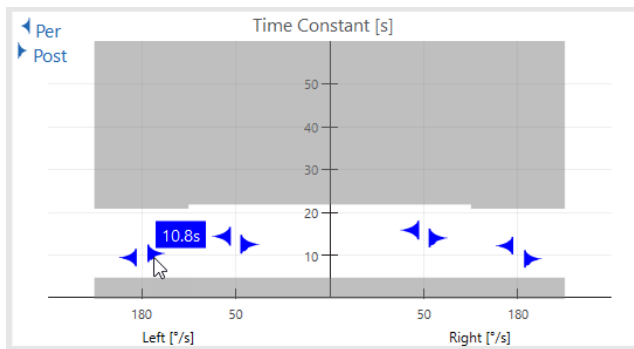


Figure 3.6.25 Numerical value displayed

The largest data points represents the velocity (°/sec) page that is currently being displayed. Tapping on a smaller data point will then display the data for that velocity. Alternatively, tap the arrows next to the page numbers to move to results for other velocities (Figure 3.6.26).

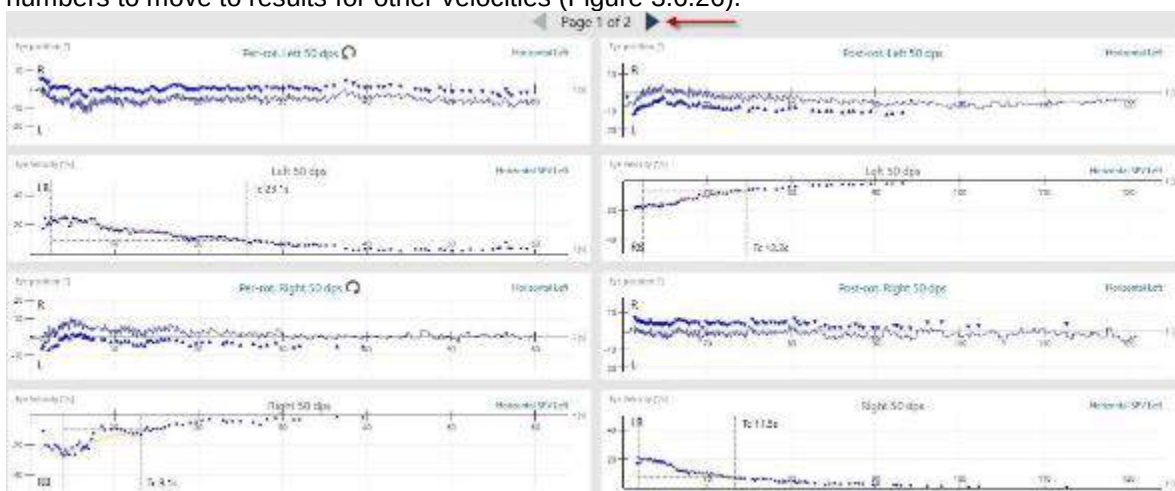


Figure 3.6.26 Changing page numbers in Step Rotation summary

Eye position and eye velocity display

The raw eye position tracings and corresponding slow phase velocity (SPV) results are displayed underneath the Gain, Time Constant, and Tc Symmetry graphs on the summary test results screen. These are placed one above the other for simplified viewing of all segments within a single Step Rotation speed tested.

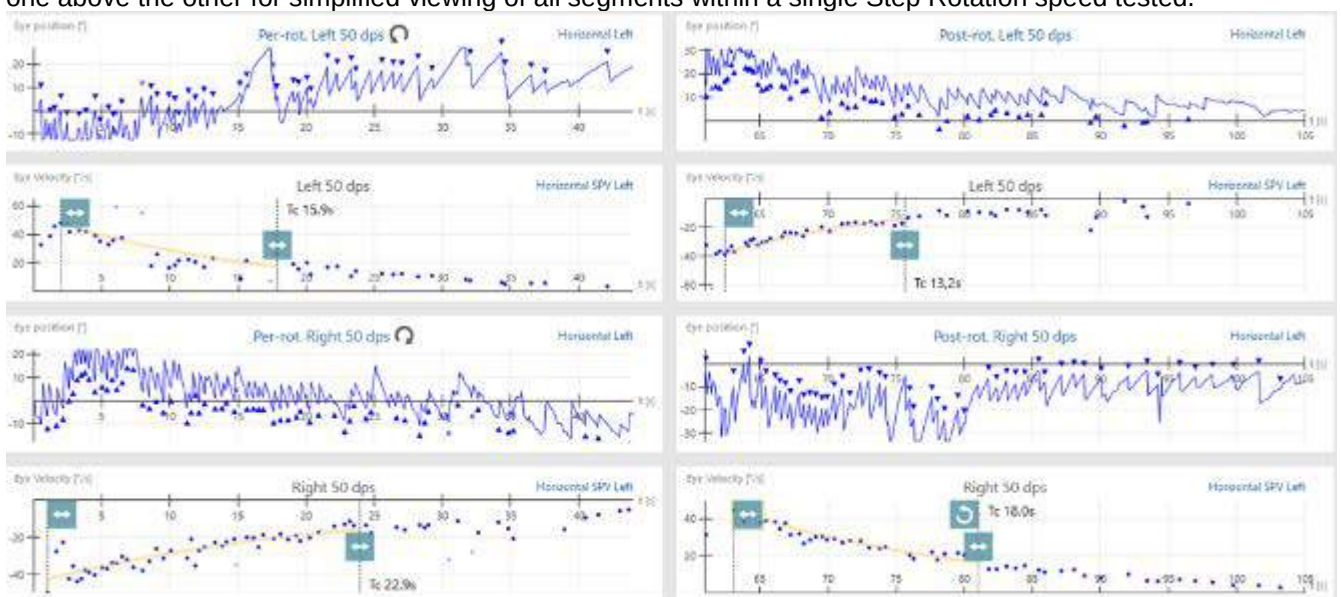


Figure 3.6.27 Raw eye movement data and time constant data for per and post rotary stimuli

The upper portion displays the raw eye position tracing for the specific condition (per/ post-rotary and its relative velocity). Nystagmus beats are marked with triangles to identify left/right beating nystagmus (Figure 3.6.28).

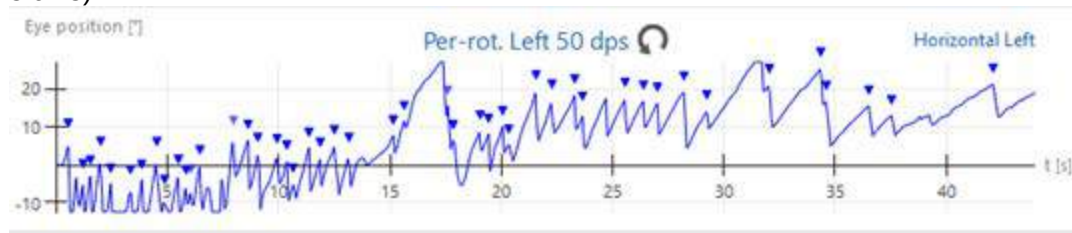


Figure 3.6.28 Raw eye movement data trace with identified nystagmus

The lower portion displays data points for the corresponding SPV values for the detected beats of nystagmus as they reduce from a peak value to their relative time constant (T_c), or 37% of the maximum generated response. The initial vertical dashed line represents the point at which the peak maximum response was detected. The second vertical dashed line represents the point at which the response declined by 37% of the maximum peak response. The horizontal dashed line represents the amount of time between the two vertical dashed lines and indicates the time constant for that segment of the Step Rotation test. The yellow line represents the curve fit from the peak maximum evoked response to the T_c in seconds. The T_c numerical value is displayed next to the dashed line (Figure 3.6.29).

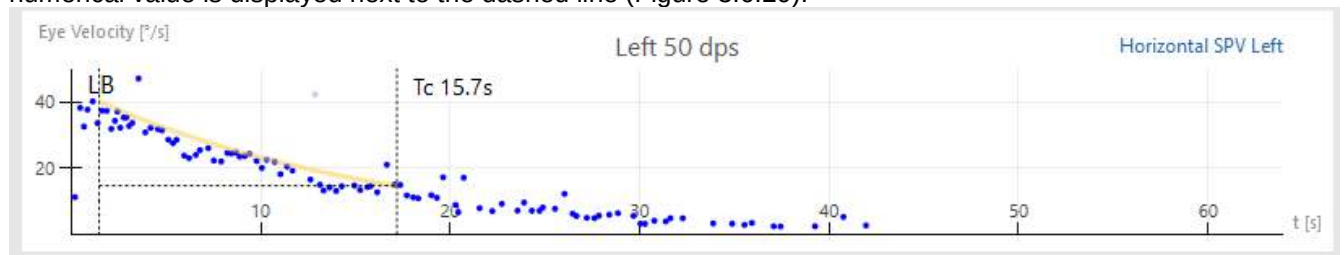


Figure 3.6.29 Eye velocity graph displaying peak response declining to 37% of its maximum (T_c)

SCEP calculations

Slow cumulative eye position (SCEP) information can be optionally displayed. SCEP is calculated by numerically integrating the area under the actual slow-phase velocity of the patient's RVS response. This integration starts from the point of initial SPV until end SCEP. Enabling this feature allows SCEP information for each step to be available within the eye velocity graph, along with the T_c information (Figure 3.6.30). SCEP calculation is not enabled by default, but can be enabled within Step Test setup.

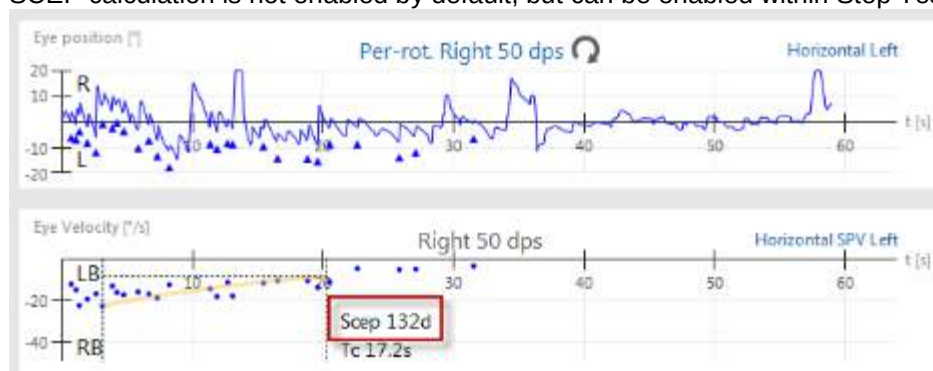


Figure 3.6.30 SCEP calculation

When further details for review are needed, the examiner can select an individual velocity and direction from the left side menu panel to see both eyes displayed together for the selected segment (Figure 3.6.31). This view allows the examiner to review both the per- and post-rotary segments for the selected Step Rotation test, add notes, review or delete eye video recordings, print the screen, and edit the results for a specific segment.

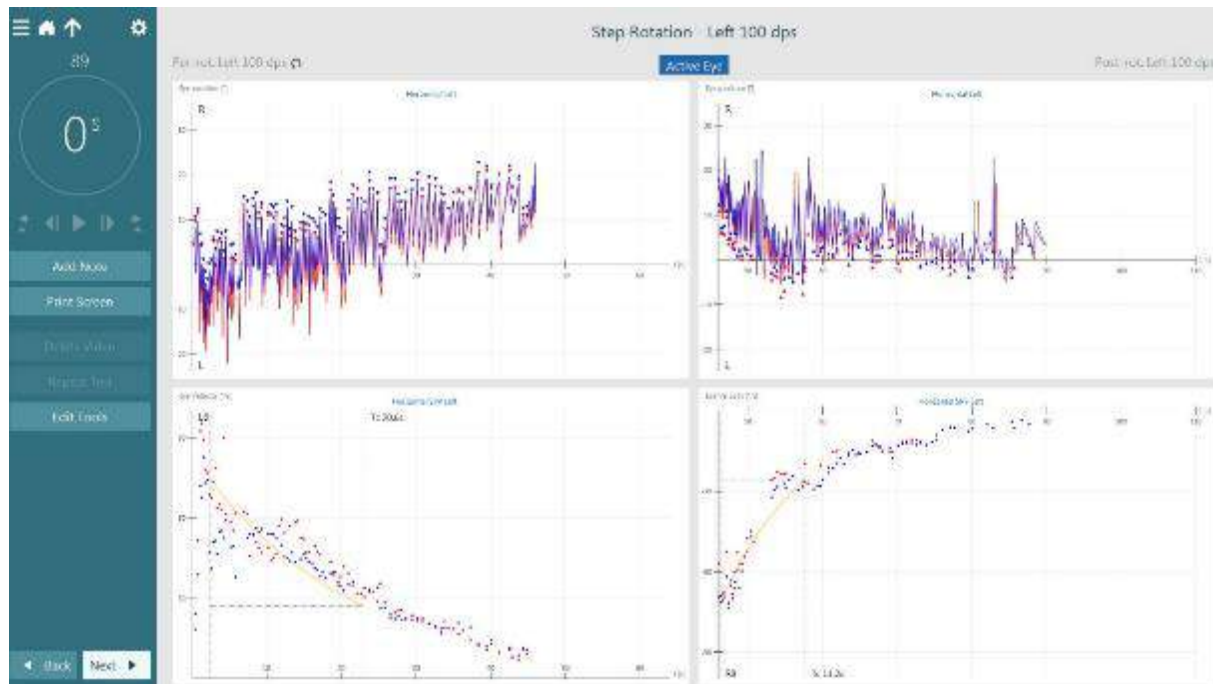


Figure 3.6.31 Review individual Step Rotation segment

3.6.4 VOR suppression test

During VOR Suppression, the patient is rotated in the same sinusoidal alternating pattern as in the SHA test, but this time with a fixation light illuminated within the VisualEyes™ VNG goggles so as to assess the patient's ability to suppress the Vestibulo-Ocular Reflex (VOR) while rotating.

The available test frequencies are octave frequencies from .01 Hz up to .64 Hz. By comparing the patient's vision-denied SHA results to the VOR suppression results at the same frequency of rotation, a percentage of gain reduction can be calculated. A failure to sufficiently suppress the VOR can be an indicator of possible central pathology.

Eye movements are recorded with the VisualEyes™ VNG cameras and the responses are displayed in real-time. The patient's eyes, along with eye position tracings (°), eye velocity tracings, and two graphs for gain (%) and reduction (%) are visible during the testing procedure (Figure 3.6.32).

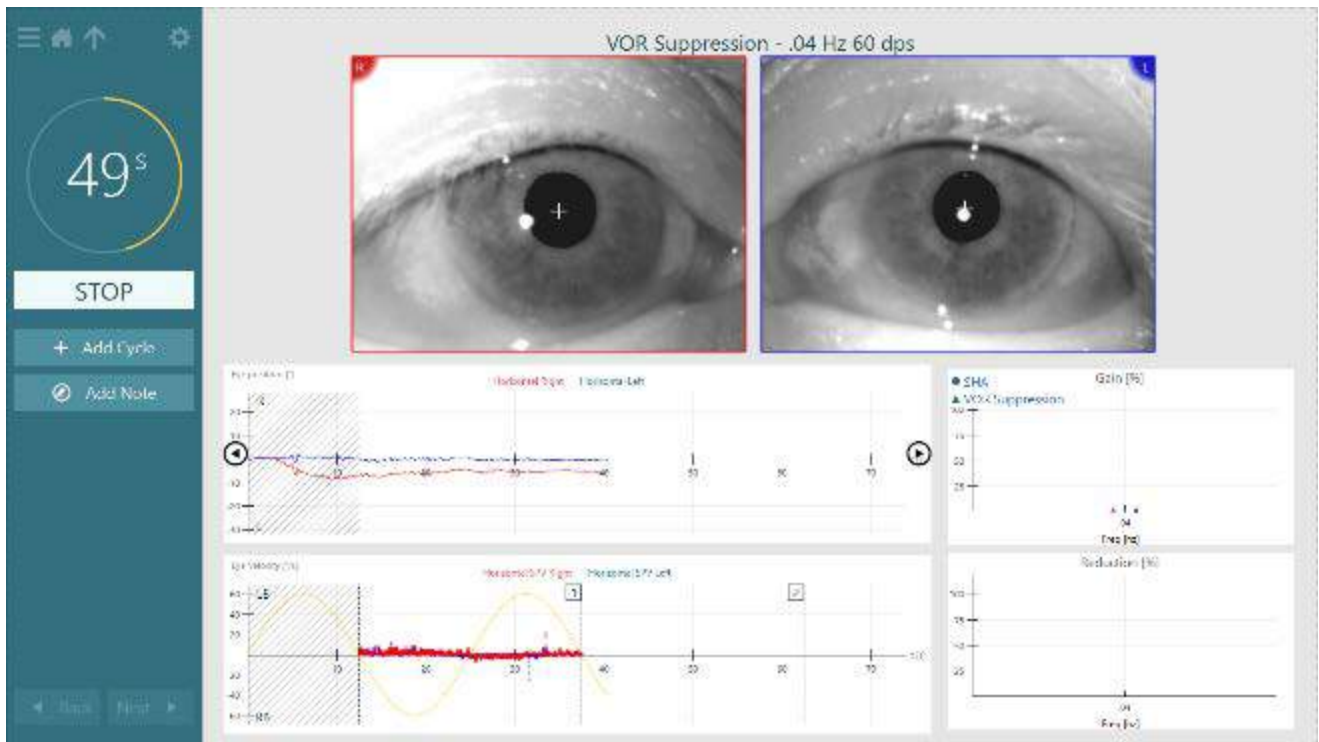


Figure 3.6.32 VOR Suppression testing

The VOR suppression test will be available within the protocol or may be selected directly from the side menu panel by tapping the 'hamburger' icon in the upper left corner of the test screen to view the test battery list.

Example instructions for the patient:

"You will feel yourself rotating back and forth slowly in the chair. During the rotation, you will see a small light appear within the mask. Please keep your eyes open and focused on the light during the entire test. Try to prevent the light from 'bouncing' around in your view."

To begin the test:

1. Select 'Start' from the left menu panel.
2. The timer will begin counting down. The test time is pre-defined by the number of cycles selected for the test frequency.

The chair will activate and begin moving in a sinusoidal pattern.

Camera recordings will begin at the onset of chair movement.

The fixation light will also appear within the goggles.

The stimulus and eye movements will be displayed in real time (Figure 3.6.33).

Once the test is complete a summary test results screen will appear.

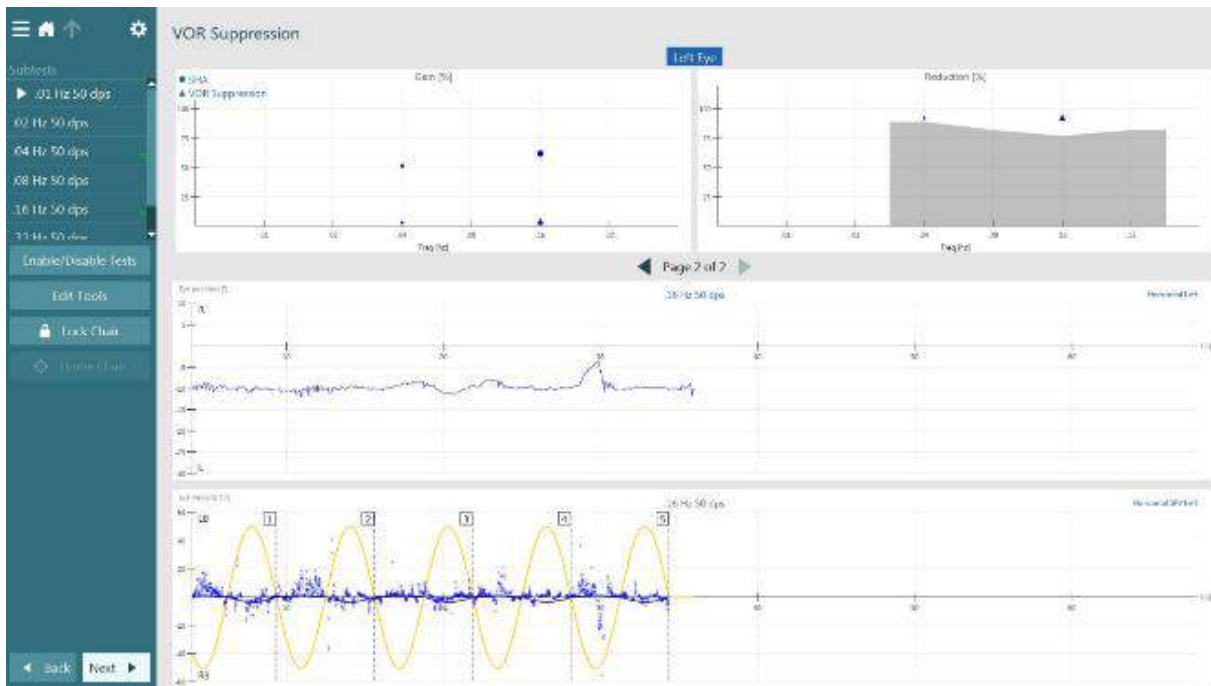


Figure 3.6.33 VOR suppression summary

A patient with normal VOR suppression results will produce a tracing that shows significantly reduced nystagmus as the patient is rotated from left to right in the chair. The data points for each frequency tested will appear as triangles in the Gain (%) and Reduction (%) graphs. The circular data points represent the previously recorded SHA results.

Please note: The first half cycle (hatched region) of each frequency tested is excluded from analysis for improved test reliability.

Analysis of eye movements is performed separately for the right and left eyes and the results are displayed separately. Left eye results are displayed by default. The displayed results can be changed to the right eye by selecting the eye title in the top center of the summary test results screen.

The summary test results screen displays various analyses. The top portion of the summary results screen displays plots for Gain, Reduction. These parameters are explained in detail in the following section.

Gain

The software will automatically compare the patient's gain during a VOR suppression test to the gain during a Sinusoidal Harmonic Acceleration at the same frequency so that both can be plotted on the VOR Suppression gain graph. Sinusoidal Harmonic acceleration results are plotted with circles and VOR suppression results are plotted with triangles (Figure 3.6.34).

VOR Suppression gain is simply the raw value for the ratio of maximum slow phase nystagmus velocity to head (chair) velocity. The lower the gain value, the better the patient was able to suppress his/her nystagmus by fixating on a target during SHA rotation. An inability to sufficiently suppress the VOR is indicative of possible central vestibular pathology.

Values are expressed as a percentage (%).

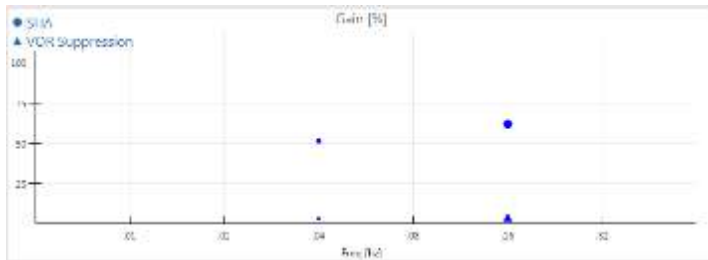


Figure 3.6.34 Gain graph with VOR and VOR Suppression tests

Gain reduction

The percent gain reduction result is obtained by comparing any given frequency of rotation with no visual fixation to the gain result at the same frequency of rotation with visual fixation. Percent gain reduction is a percentage by which the nystagmus has reduced as a result of fixating on a target. Among the normal population, it is not uncommon to see % Gain Reduction of 50%.

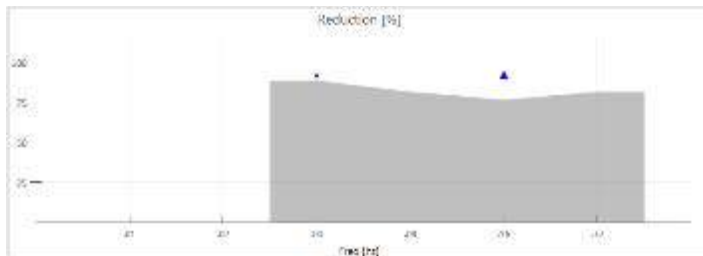


Figure 3.6.35 Gain reduction graph

The percent reduction results are plotted with triangles. Values are expressed as a percentage (%).

Graph numerical values

Exact numerical values can be obtained by tapping on or hovering over the individual data point within the Gain and Reduction graphs (Figure 3.6.36).

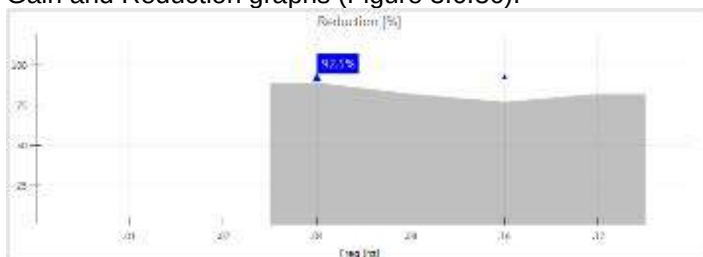


Figure 3.6.36 Numerical value displayed

The largest data point represents the frequency (Hz) page that is currently being displayed. Tapping on a smaller data point will then display the data for that frequency.

Eye position display

In the middle portion of the VOR Suppression summary results screen, the eye position ($^{\circ}$) tracing is displayed. The eye position tracing (Figure 3.6.37) represents eye movement during chair rotation and is displayed as a function of eye position in degrees (y-axis) over time in seconds (x-axis). The tracing should appear relatively flat if the patient is able to suppress the nystagmus while fixating.

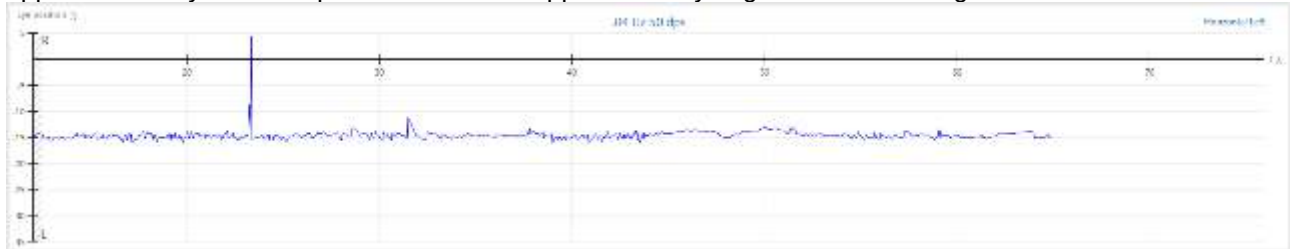


Figure 3.6.37 Eye position trace

Eye velocity display

The eye velocity in $^{\circ}/s$ (blue) relative to stimulus chair velocity (yellow) is displayed beneath the eye position tracing (Figure 3.6.38).

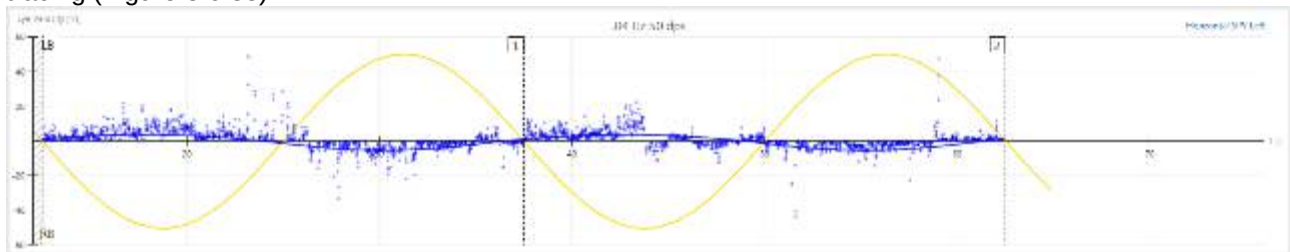


Figure 3.6.38 Display showing detailed individual cycles for eye velocity vs. stimulus velocity

This graphical display provides a detailed individual cycle view for the examiner to see the patient's results in relation to the stimulus. The user can also view the cycle numbers in this display. The eye velocity should be relatively flat compared to the stimulus chair velocity if the patient is able to suppress the nystagmus while fixating.

3.6.5 Visual VOR test

Visual VOR test requires the patient to be moved in a pendular motion, as in sinusoidal harmonic acceleration with the addition of a visual stimulus on screen. The fixation cover is removed from the goggles for this test and the patient is required to focus on a stationary target on the oculomotor screen during chair rotation from right to left and vice versa. This test provides the user with more information about the calibration, system function, as well as the patient's central vs. peripheral vestibular function.

The test can be performed at any SHA frequency, but is most commonly performed at 0.32 Hz, which is frequency defined in the VisualEyes™ 515/525 default protocol.

The Visual VOR test will be available within the protocol or may be selected directly from the side menu panel by tapping the 'hamburger' icon in the upper left corner of the test screen to view the test battery list.

Example Instructions for the Patient:

"You will feel yourself rotating back and forth slowly in the chair. During the rotation, you will see a target appear on the screen in front of you. Please keep your eyes open and focused on the target during the entire test."

To begin the test:

1. Select 'Start' from the left menu panel.
2. The timer will begin counting down. The test time is pre-defined by the number of cycles selected for the test frequency.

The chair will activate and begin moving in a sinusoidal pattern.

Camera recordings will begin at the onset of chair movement.

The target will be displayed on the secondary monitor.

The stimulus and eye movements will be displayed in real time.

Once the test is complete a summary test results screen will appear (Figure 3.6.39).

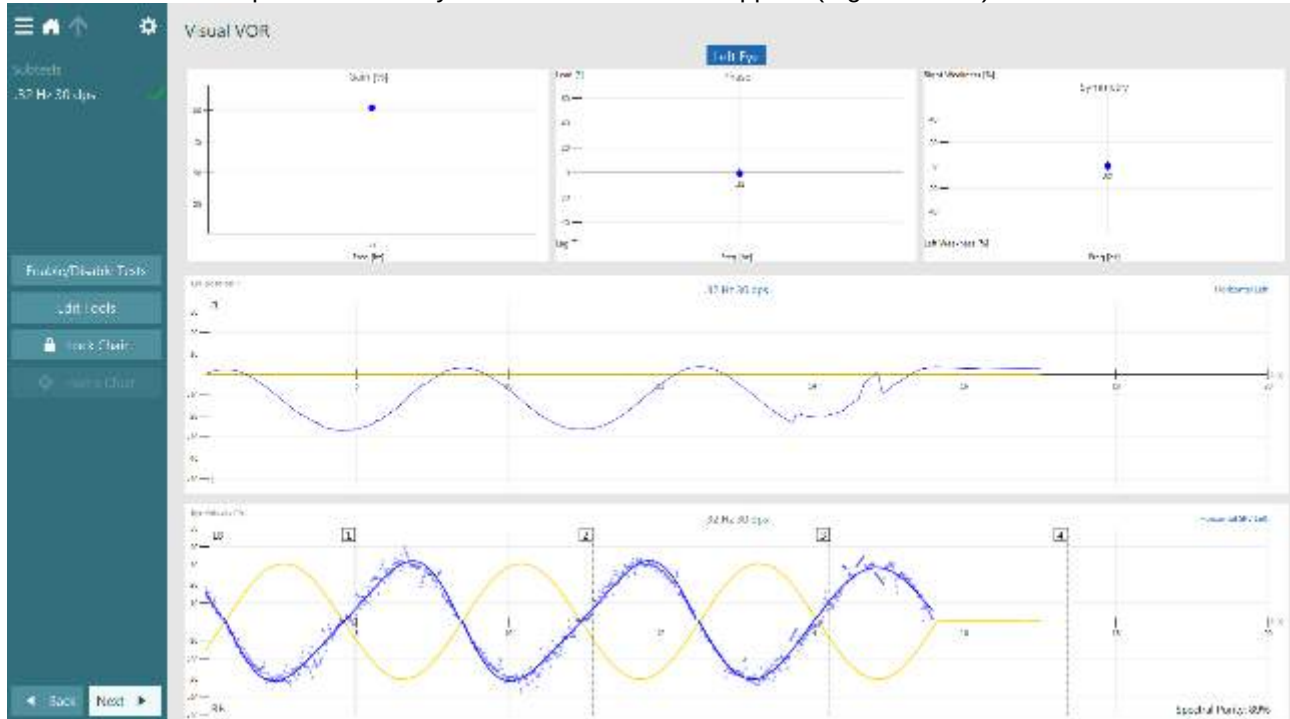


Figure 3.6.39 Visual VOR summary

A patient with normal Visual VOR results will produce a tracing that resembles a sinusoid that mirrors the sinusoid of chair movement. When the VOR is functionally as expected, the patient's eyes will move equal and opposite to the chair while he/she is focused on a stationary target. Visual VOR analysis is performed in a similar manner to SHA in that gain, phase and symmetry are calculated. The data points for each frequency tested will appear as circles in the graphs.

Please note: The first half cycle (hatched region) of each frequency tested is excluded from analysis for improved test reliability.

Analysis of eye movements is performed separately for the right and left eyes and the results are displayed separately. Left eye results are displayed by default. The displayed results can be changed to the right eye by selecting the eye title in the top center of the summary test results screen.

The summary test results screen displays various analyses. The top portion of the summary results screen displays plots for Gain, Phase and Symmetry. These parameters are explained in detail in the following section.

Gain

Gain (%) is the ratio of maximum slow phase eye velocity to maximum head (chair) velocity. If the function of the Vestibular Ocular Reflex (VOR) is to produce an eye movement that compensates for head movement, then under perfect conditions the eye velocity of the response to rotation should be a mirror image of head velocity producing a gain of 60 % (Figure 3.6.40).

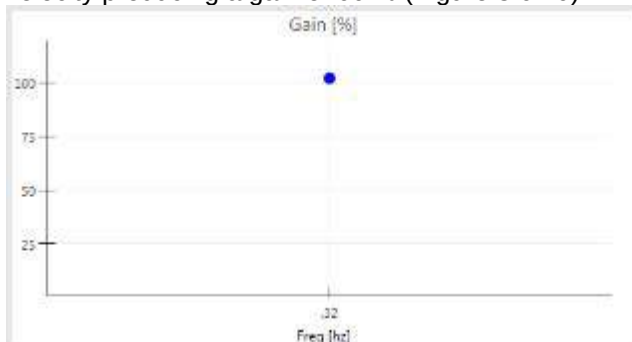


Figure 3.6.40 Visual VOR Gain graph

Phase

Phase (°) displays the timing relationship between the motion stimulus and the ocular response to that stimulus (Figure 3.6.41). Abnormal phase is associated with physiological damage to the VOR. The magnitude of the deviation from normal correlates with the severity of damage.

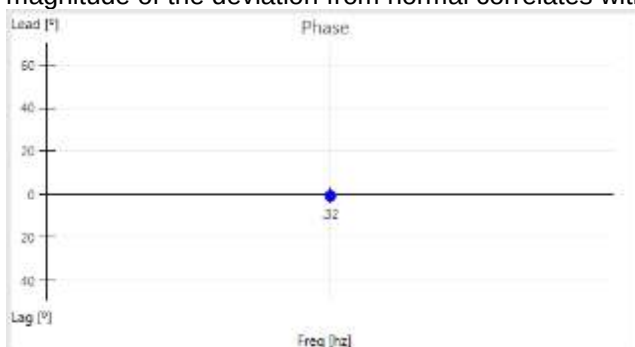


Figure 3.6.41 Visual VOR Phase graph

Symmetry

Symmetry (%) indicates the presence of an imbalance in the system and helps to identify which side is weaker (Figure 3.6.42). A normal finding would present with the data point positioned on the zero line.

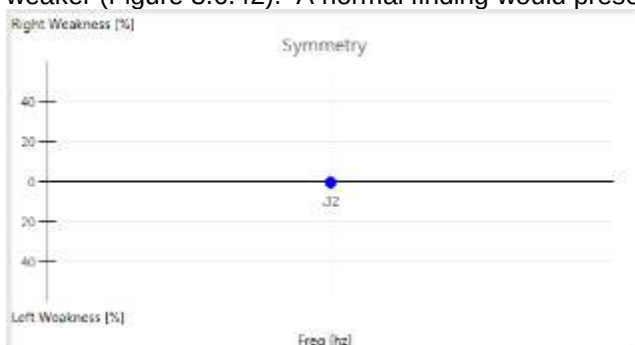


Figure 3.6.42 Visual VOR Symmetry graph

Eye position and eye velocity displays

Below the Gain, Phase, and Symmetry graphs are the eye position and eye velocity displays, just as in SHA and VOR Suppression (Figure 3.6.43). The eye position tracing should resemble a sinusoid. The eye velocity should appear as a mirror image to chair velocity.

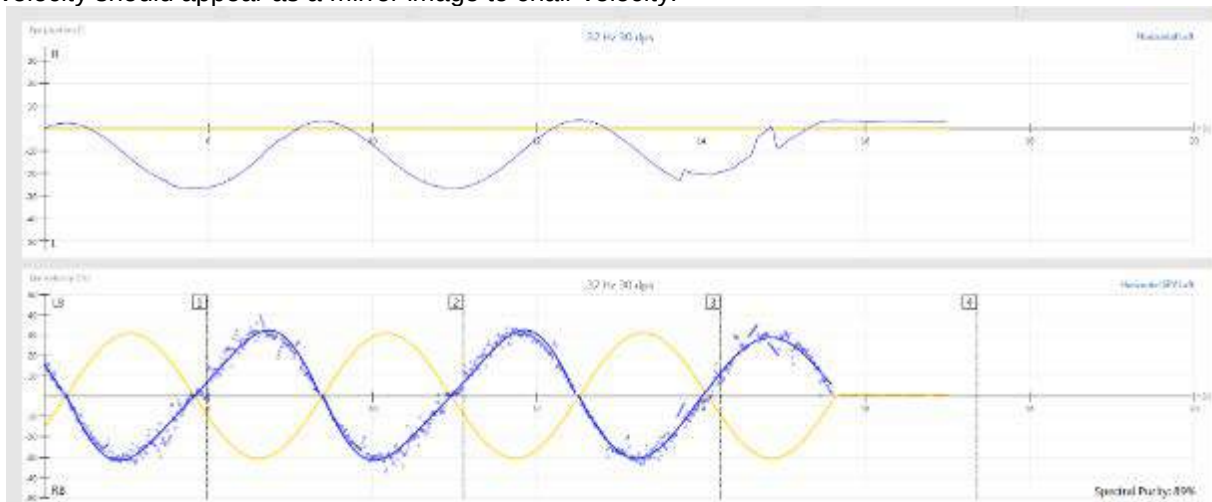


Figure 3.6.43 Visual VOR eye position and eye velocity displays

Spectral purity

A spectral purity value for each frequency tested can be viewed in the lower right corner of the eye velocity display (Figure 3.6.44). The spectral purity of the evoked nystagmus may be useful to indicate whether the test values have been influenced by artifact. The higher the spectral purity value, the more reliable the Visual VOR result. Values are displayed as a percentage (%).

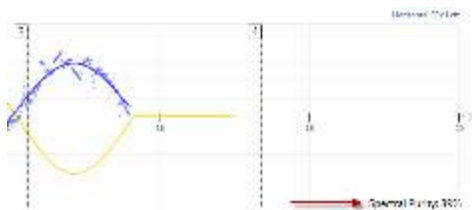


Figure 3.6.44 Spectral purity value

4 Patient session

4.1 Selecting a session

VisualEyes™ VNG software easily allows review of current and or previous sessions for the selected patient. To review a previous patient session, select the **Patient Sessions** button (Figure 4.1.1) from the main screen.

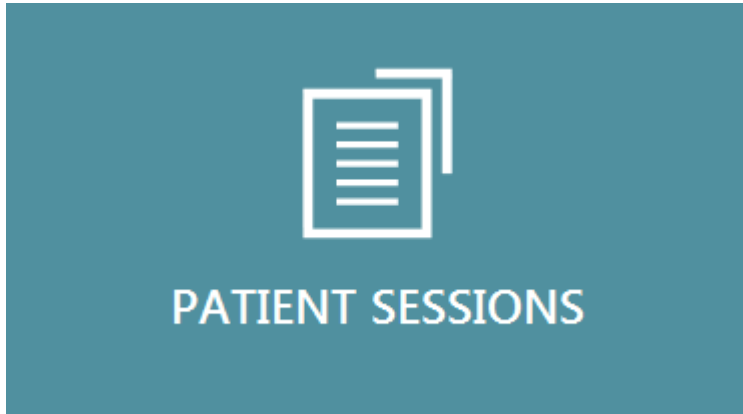


Figure 4.1.1 Patient Sessions button

The Patient Sessions screen displays a list of all patient session in the side panel menu. Selection of a specific session date will display the tests performed on that date and an indication of whether the test results were completed (green checkmark). When completed and test is outside of threshold it will be marked with a red diamond.

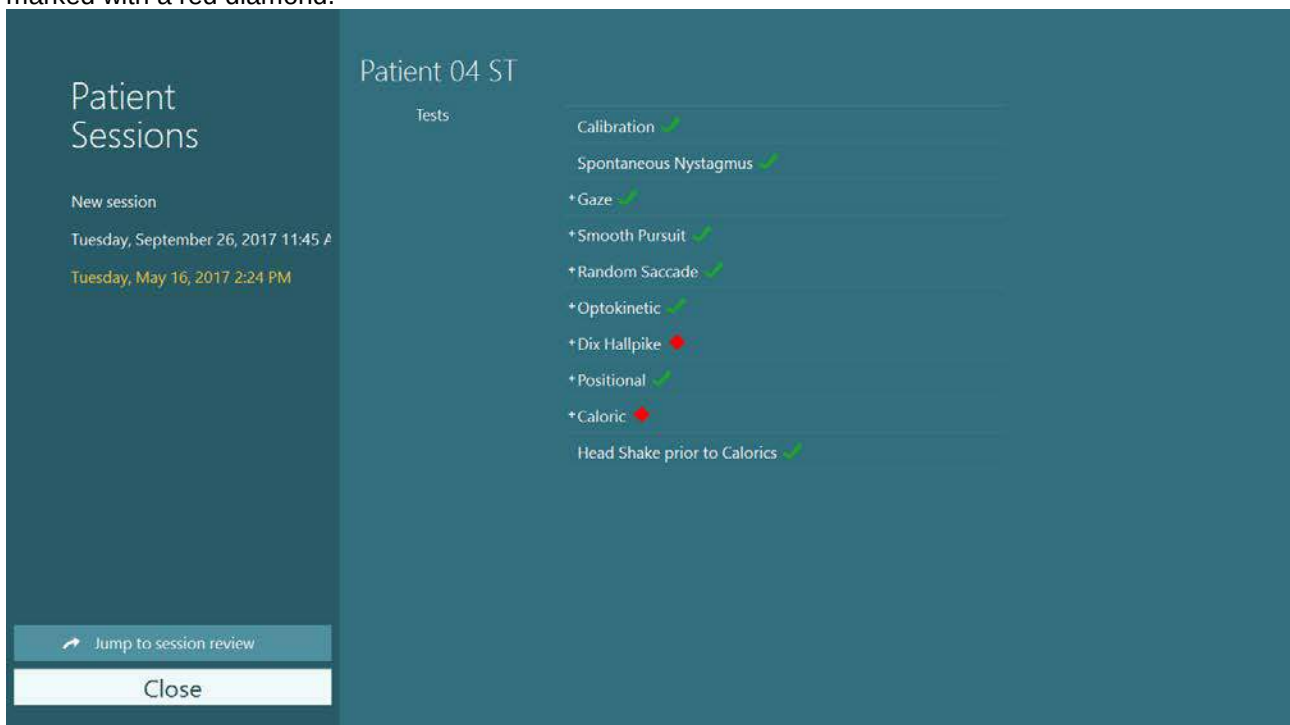


Figure 4.1.2 Patient Sessions screen

After selecting the patient session from the listing, click on the Jump to session review button to go to the Session Review screen.

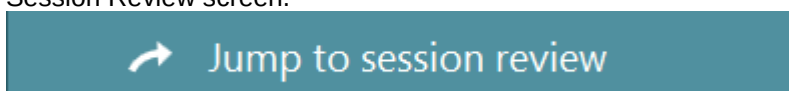


Figure 4.1.3 Jump to session review button

5 Video recordings

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 Manager.

- Select **Configuration**
- Select **Protocol Manager**
- Highlight the protocol from the list for editing
- Select a test from the protocol
- Within the Summary Parameters screen, click the gear icon next to the subtest
- Select **Test Parameters** option

Test Parameters

- 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™ 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.

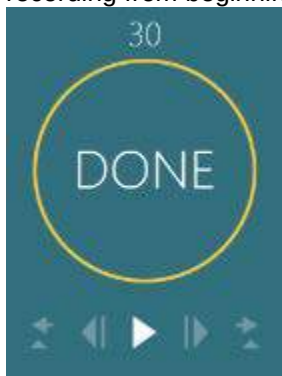


Figure 5.2.1 Video playback display

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 eye tracker (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.

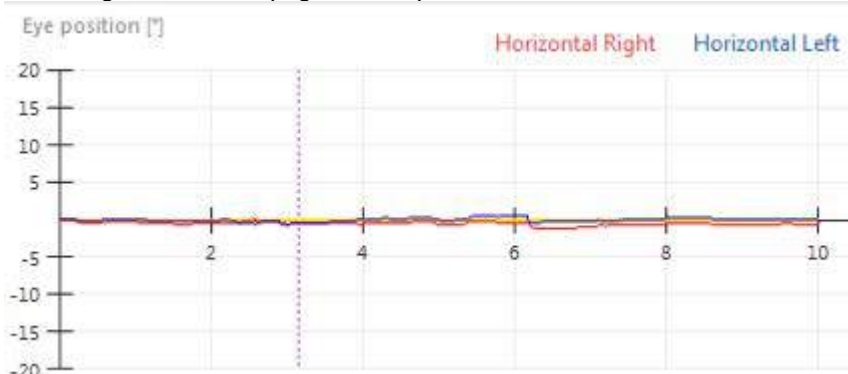


Figure 5.2.3 Dashed line indicating point of video playback

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).

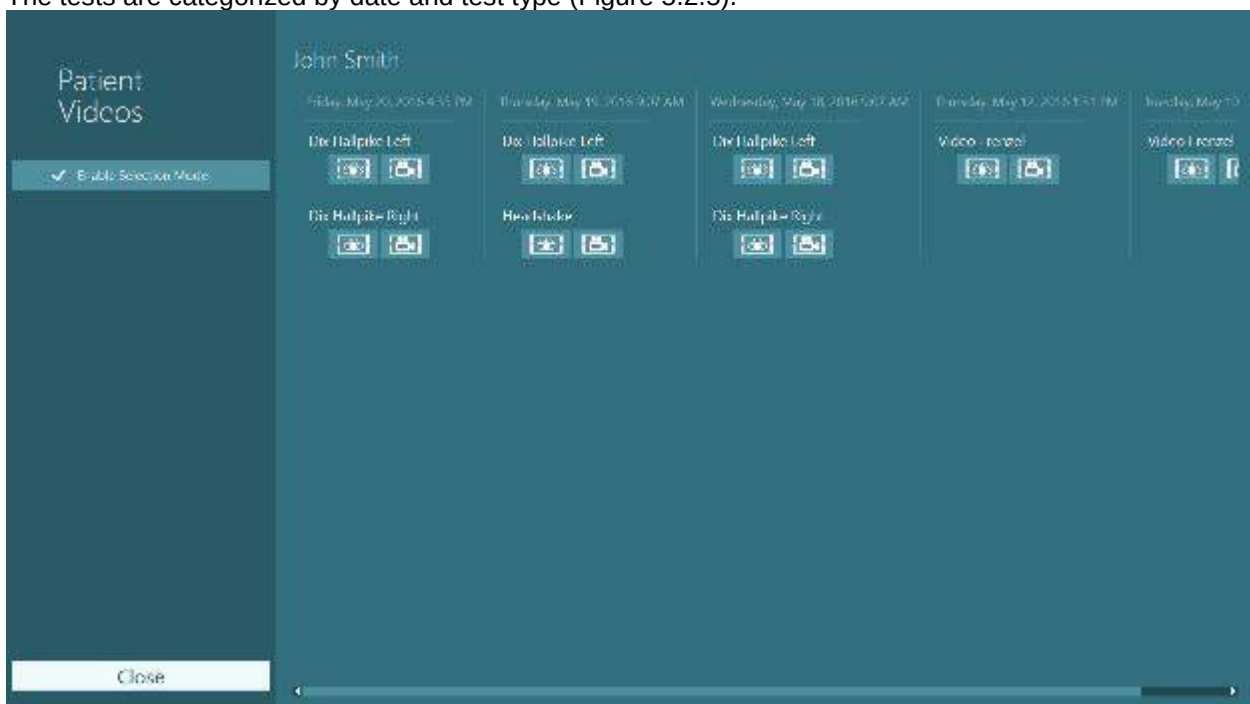


Figure 5.2.5 Patient videos display categorized by date and type of test

To playback the video click on the video file of interest. It will be launched in a compatible video player.



Video of eye recordings (no raw data).



Videos of room recording

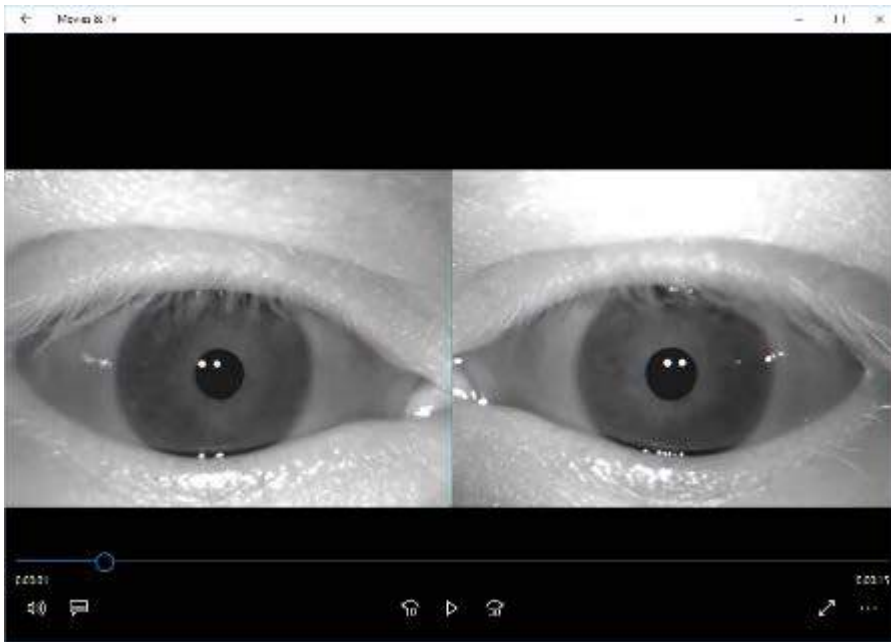


Figure 5.2.6 Video playback within a compatible video player

5.3 Delete selected patient videos

Should it be decided that the video recording for a specific test is of low importance (i.e. normal) it can be deleted after the test is complete.

Select the **Delete Video** from the side bar menu.

A prompt to confirm removal will appear (Figure 5.3.1):

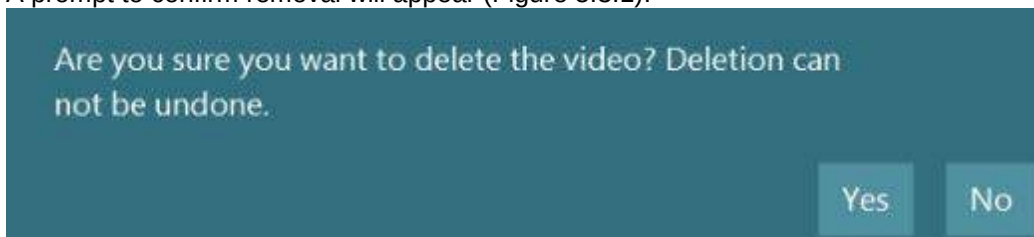


Figure 5.3.1 Warning to delete video

Select **Yes** to continue or **No** to cancel.

The user can delete the videos from the Patient Videos menu:

- Open **Patient Videos**
- Select **Enable Selection mode**



This will allow choosing the videos that are to be deleted from VisualEyes™.

- Touch or click the videos for removal. Both room and eye recordings can be deleted.
- The files will highlight yellow to indicate that these are the chosen files for removal



Figure 5.3.2 Highlighted selected videos

- Select the **Delete Selected Videos** option



- Prior to removal a prompt will appear, confirming removal of selected videos



Figure 5.3.3 Prompt confirming removal of selected videos

- Touching or clicking OK will delete the videos permanently from the VisualEyes™ system

5.4 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 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.

To export selected videos:

- Open **Patient Videos**
- Select **Enable Selection Mode**



This will allow the user to choose the videos that are to be exported from VisualEyes™ onto another storage device.

- Touch or click the videos of interest for export, which can be room and eye recordings
- The files will highlight yellow to indicate that these are the chosen files for export (Figure 5.4.1)



Figure 5.4.1 Highlighted selected videos

Select the **Export Selected Videos** button.



Figure 5.4.2 Export Selected Videos button

The Export Video Files dialog will be displayed. Select the destination directory for exporting the files of interest (Figure 5.4.2). 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 5.4.3 Destination selection for export video files

When Export is complete a dialogue message will appear confirming successful transfer of video files: 'Export succeeded'.

6 General and 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™ VNG 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 (nystagmus, oculomotor etc...) (for more information see configuration section). 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).

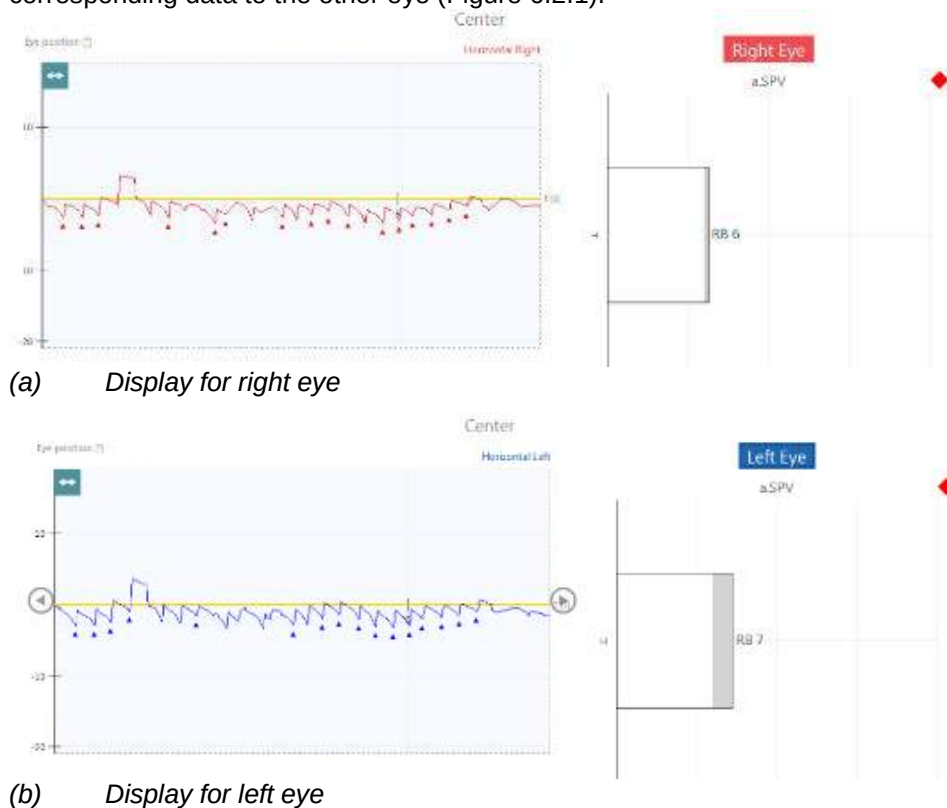


Figure 6.2.1 Results display for right (a) and left (b) eyes

VisualEyes™ VNG suite provides the option of displaying individual eye traces (i.e. right or left only) for all nystagmus tests. The default SPV indicator (a.SP.V 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' in the test settings:



Figure 6.3.1 Pupil Diameter option

6.4 Editing nystagmus

There is an **Edit Tools** item (Figure 6.4.1) for editing the nystagmus in the recordings. This menu will be available in spontaneous, gaze, optokinetic, positional, Dix Hallpike, caloric, and step rotation tests.

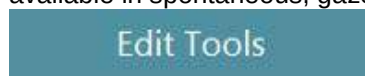


Figure 6.4.1 Edit Tools button

The editing options in this menu include:

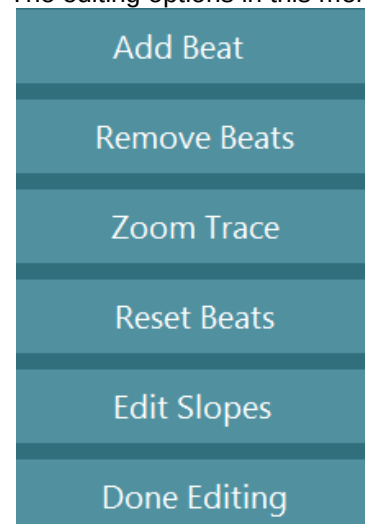


Figure 6.4.2 Edit Tools menu for nystagmus configuration

6.4.1 Add Beats



Selecting this function allows insertion of nystagmus beats that were not originally detected by the nystagmus algorithm (Figure 4.1).

- 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

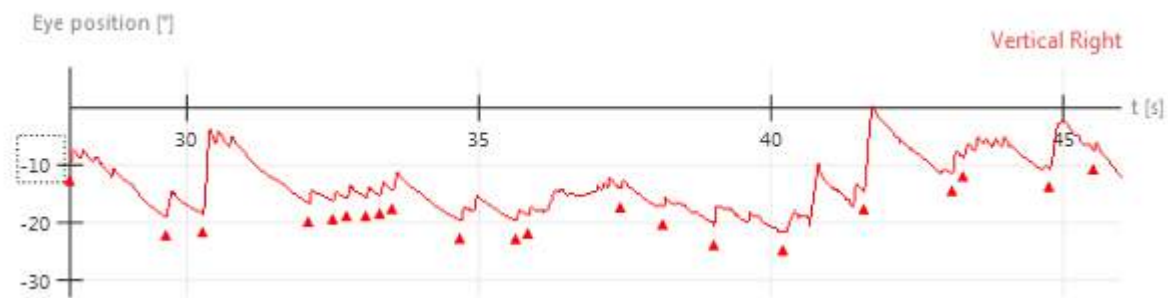


Figure 6.4.3 Added beats to nystagmus trace

6.4.2 Remove Beats

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

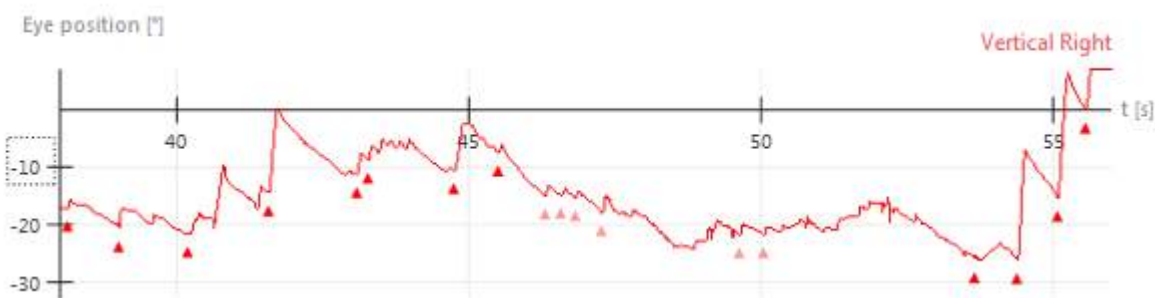


Figure 6.4.4 Removed beats are greyed out

6.4.3 Zoom Trace

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 6.4.5 and Figure 6.4.6). 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.

- Select 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

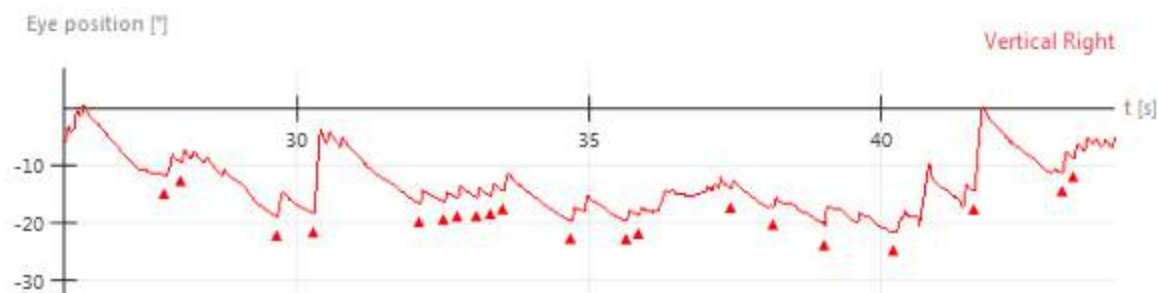


Figure 6.4.5 Gaze test Right 30 degrees raw results (no zoom)

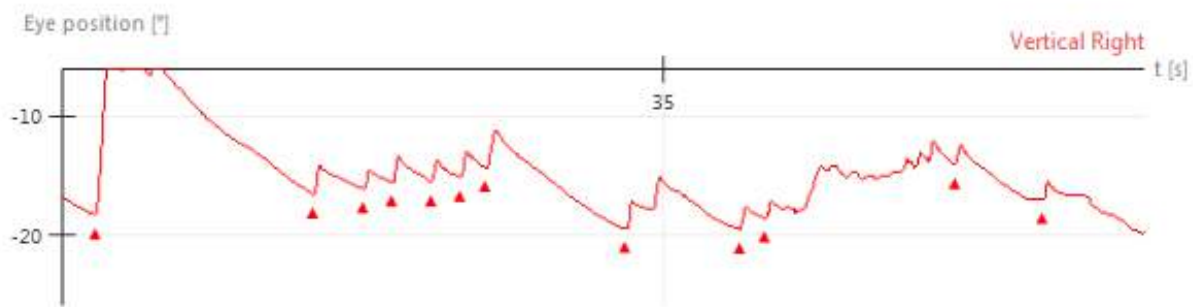


Figure 6.4.6 Gaze test Right 30 degrees 2X magnification (time and amplitude)

6.4.4 Reset Beats

Reset Beats

This feature resets the waveform back to the original software analysis. (Figure 6.4.7 and Figure 6.4.8).

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

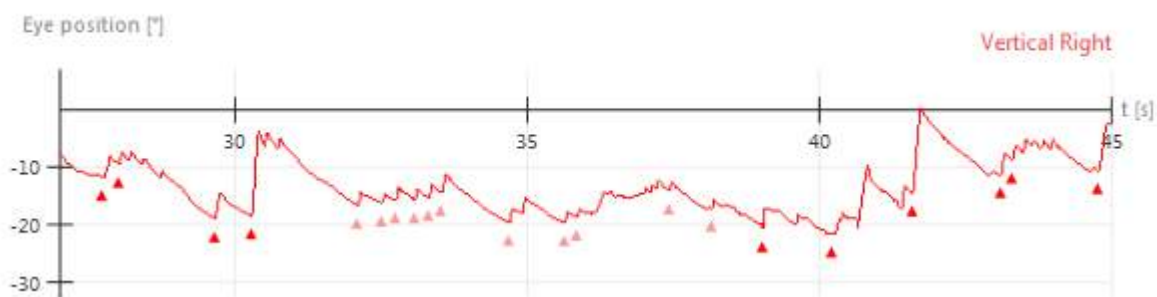


Figure 6.4.7 Nystagmus waveform with removed beats

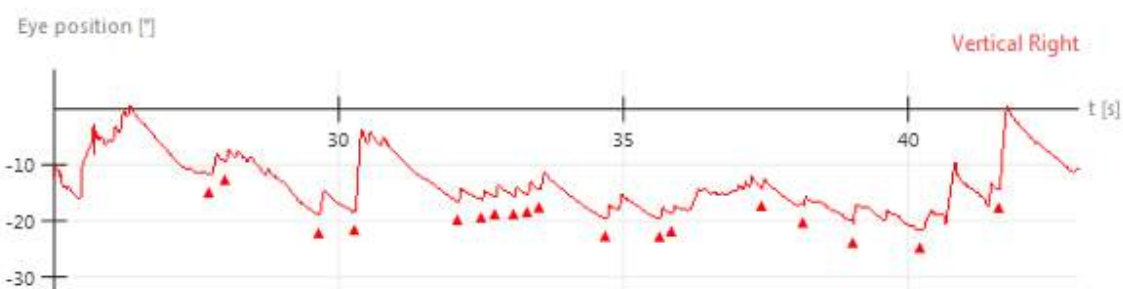


Figure 6.4.8 Nystagmus reset to original software analysis

6.4.5 Edit Slopes

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 6.4.9)



Figure 6.4.9 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, the slope line color changes from green to red. Accepting the new value will change the slope line color to green

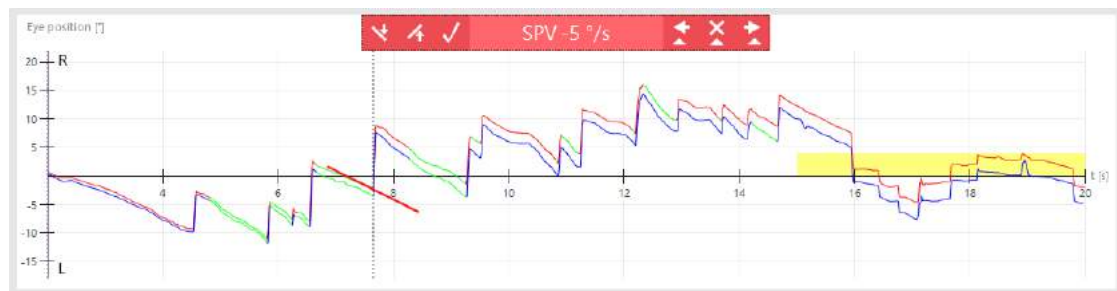


Figure 6.4.10 Editing selected nystagmus slope

- 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 12.5 General), the current test settings 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

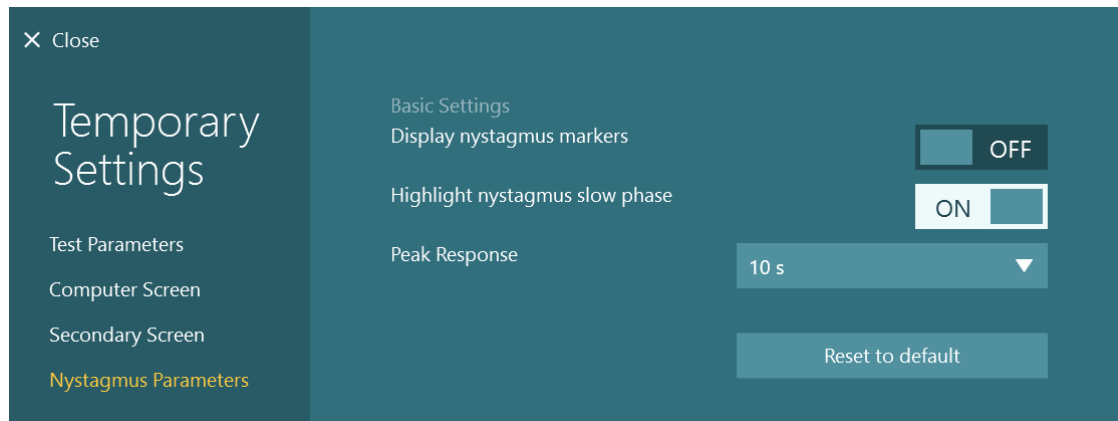


Figure 6.4.11 Nystagmus Parameters

- This will give a quick view of the actual slow phase velocity of the nystagmus (Figure 6.4.12)

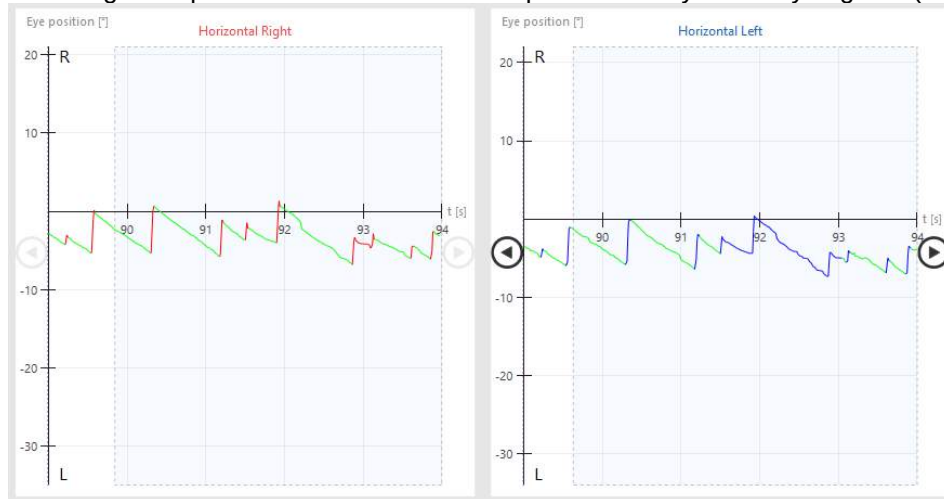


Figure 6.4.12 Slow phase velocities highlighted and eyes split into separate graphs

6.4.6 Done Editing



Figure 6.4.13 Done Editing button

This function saves the edits made to the data and hides the editing tools.

6.5 Editing saccade test results

Editing tools are available for viewing and editing the saccades. These tools are accessed after the data collection is complete by selecting the **Edit Tools** button. These tools are also available from the Saccade summary view. If accessed from the Saccade summary, select the tool then select the test to edit.



Figure 6.5.1 Edit Tools button for Saccade tests

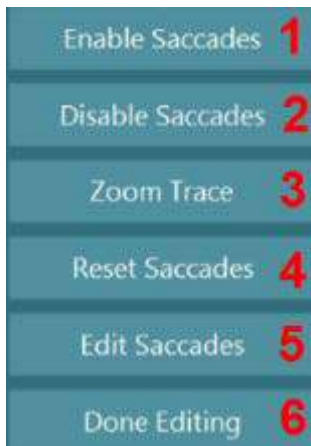


Figure 6.5.2 Saccade editing tools

1. Click or touch the **Enable Saccades** button. The selection box that the user creates on the waveform will enable any saccades that were disabled the analysis.
2. Click or touch the **Disable Saccades** button. The selection box that the user creates on the waveform will disable any saccades and remove them from the saccade analysis.
3. Click or touch the **Zoom Trace** button. Click or touch on a spot on the waveform to magnify that area by 2X (in time and amplitude). Select another spot or select the **Zoom Trace** button again to exit magnification.
4. The **Reset Saccades** button discards the user's edits and returns the waveform to the original software analysis.
5. The **Edit Saccades** button highlights the first visible saccade in the waveform and displays the individual saccade results in the editing toolbar (latency, velocity, and accuracy). Use the previous saccade and next saccade buttons or the left and right arrows on the keyboard to move through the saccades. Use the disable / enable saccade button to toggle the saccade from the analysis. To switch between the left and right eye saccades (if the saccades are not split in separate graphs), select one of the three analysis results in the editing toolbar. Select the **Edit Saccades** button again to exit editing.

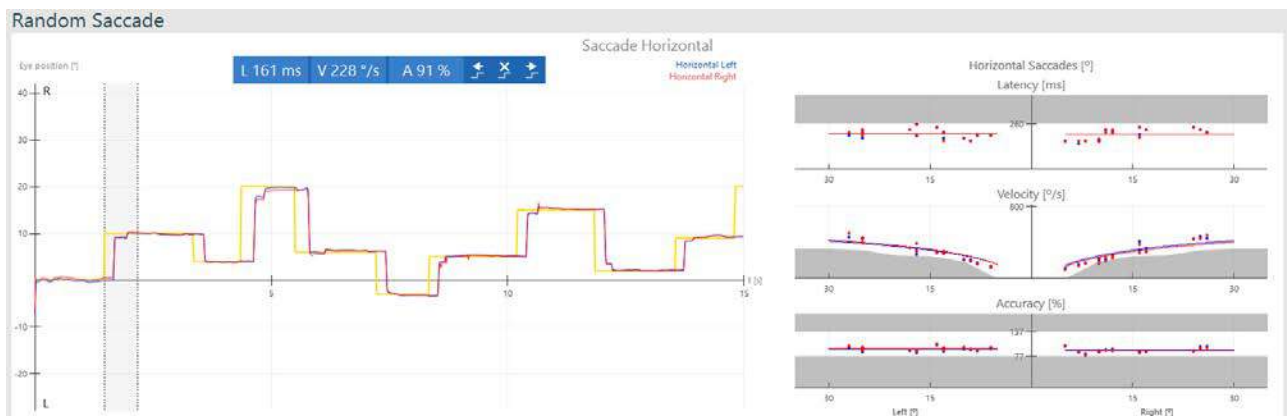


Figure 6.5.3 Saccade Editing

6. Select the **Done Editing** button to exit the editing tools and keep the edits to the saccade analysis.

6.6 Editing smooth pursuit test results

Editing tools are available for viewing and editing the smooth pursuit tests. These tools are accessed after the data collection is complete by selecting the **Edit Tools** button. These tools are also available from the Smooth Pursuit summary view. If accessed from the Smooth Pursuit summary, select the tool then select the test to edit.



Figure 6.6.1 Edit Tools for Smooth Pursuit tests



Figure 6.6.2 Smooth Pursuit editing tools

1. Click or touch the **Enable Half-cycles** button. The selection box that the user creates on the waveform will enable each half cycle that was disabled in the analysis.
2. Click or touch the **Disable Half-cycles** button. The selection box that the user creates on the waveform will disable each half cycle and remove it from the analysis.
3. Click or touch the **Zoom Trace** button. Click or touch on a spot on the waveform to magnify that area by 2X (in time and amplitude). Select another spot or select the **Zoom Trace** button again to exit magnification.
4. The **Reset Half-cycles** button discards the user's edits and returns the waveform to the original software analysis.
5. The **Edit Half-cycles** button highlights the first visible half cycle in the waveform and displays the individual half cycle gain results in the editing toolbar. Use the previous half cycle and next half cycle buttons or the left and right arrows on the keyboard to move through the pursuit cycles. Use the disable / enable half cycle button to toggle the half cycle from the analysis. To switch between the left and right eye waveforms (if the pursuit waveforms are not split in separate graphs), select the gain value in the editing toolbar. Select the **Edit Half-cycles** button again to exit editing.

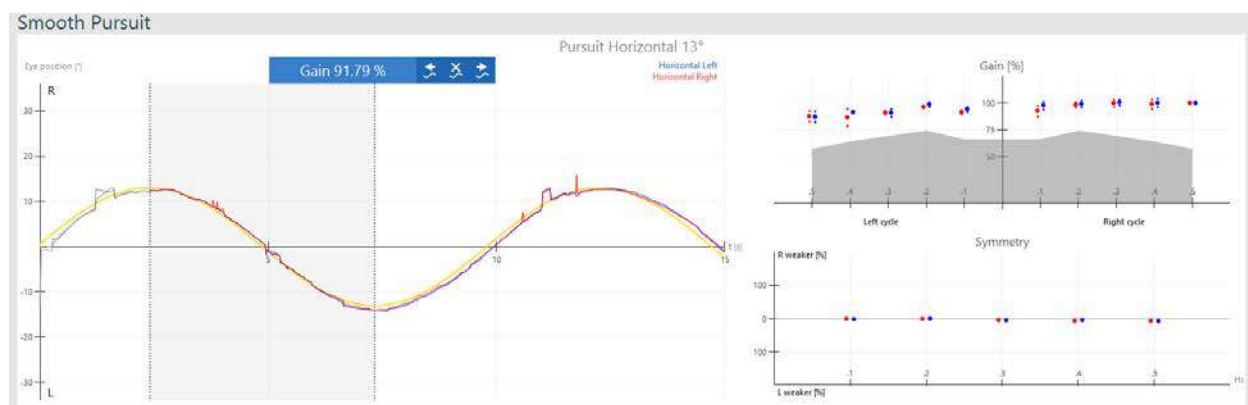


Figure 6.6.3 Smooth Pursuit editing

6. Select the **Done Editing** button to exit the editing tools and keep the edits to the pursuit analysis.

6.7 Editing rotary chair test results

6.7.1 Editing SHA Tests

This section pertains to all tests in which the rotary chair rotates in a sinusoidal harmonic acceleration pattern (SHA, VOR Suppression, and Visual VOR). The following edit tools can be accessed by tapping the Edit Tools button in the left side menu available within a specific test review screen, or from the summary test results screen.



Figure 6.7.1 SHA tests editing tools

1. The **Enable Section** tool allows the user to include a section of the response in the analysis. Once the **Enable Section** button has been activated, click and drag over the section of the eye velocity trace that should be included in the analysis of the response.
2. The **Disable Section** tool allows the user to exclude a section of the response from the analysis. With the **Disable Section** activated, click and drag over the section of the eye velocity trace that should be excluded from the analysis (i.e. artifact). A dashed line box will appear around the section being disabled. The disabled section will turn grey to indicate that it is no longer included in the analysis (Figure 6.7.2). The section can again be re-enabled by using the enable section tool.
3. The **Reset Graph** button discards all user edits and returns the waveform to the original software analysis.
4. Select the **Done Editing** button to exit the editing tools and keep the edits to the analysis.

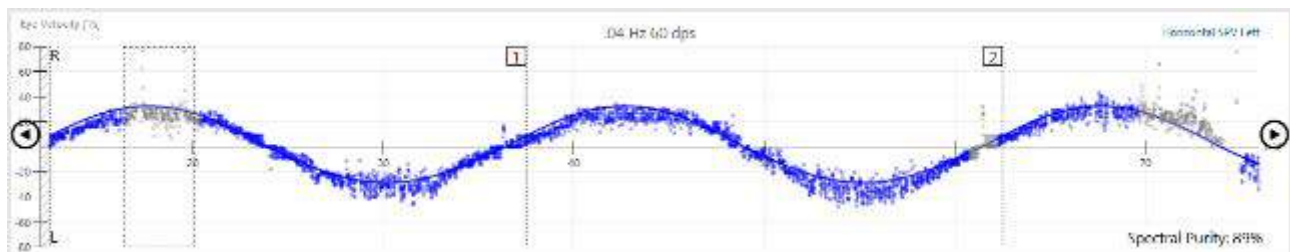


Figure 6.7.2 Disable section edit tool in SHA tests

6.7.2 Editing Step rotation tests

The edit tools available for Step Rotation tests are the same tools available for all nystagmus tests. Please refer to the section pertaining to edit tools for nystagmus tests. The Step Rotation edit tools can be accessed by tapping the Edit Tools button in the left side menu available within a specific test review screen, or from the summary test results screen.

6.8 Other functions available in side menu

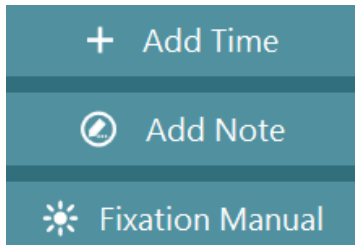


Figure 6.8.1 Additional functions available during testing

Add Time: Adds 30 seconds to the test recording.

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 12.2 Hardware) (controlled by user, not automatic). Also activated using the RF Remote.

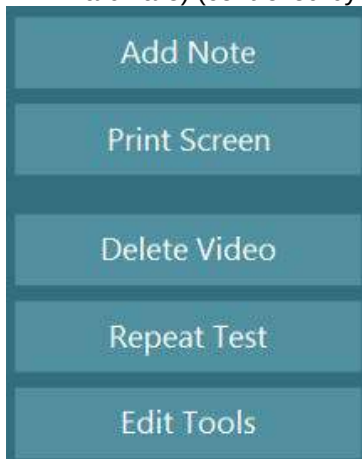


Figure 6.8.2 Additional functions available after testing is complete

After the test has finished the following options will be available (Figure 6.8.2).

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).

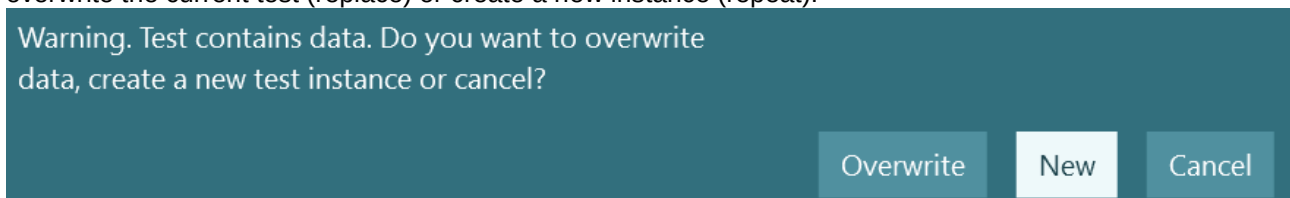


Figure 6.8.3 Repeat Test dialog

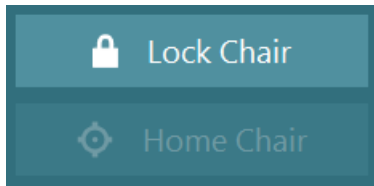


Figure 6.8.4 Rotational Chair functions

When a reclining rotary chair is configured with VisualEyes™ 515/525 there may be additional side menu functions available to the user (Figure 6.8.4).

Lock Chair:

Orion Reclining Chair

This function is designed to place the chair into an immobile state in order to ensure patient safety when seating and/or disembarking the patient from the reclining chair. It is also used to keep the chair immobile during the VNG test battery. The lock chair function is only made available prior to the test and cannot be activated during the testing procedure. This will automatically be switched off when performing a rotational chair test. To lock or unlock the chair at any other time, tap the **Lock Chair** button. The chair is locked when the button is yellow and unlocked when the button is light green. The chair can be unlocked as well using the electronic locking mechanism (ELM) switch found on the top left of the chair. While depressing the ELM switch, the chair can be rotated freely. Releasing the ELM switch will lock the chair in approximately in that position (may require minor rotation to allow the gear lock to fit properly).



Figure 6.8.5 Electronic Locking Mechanism (ELM) switch on Orion Reclining chair

Nydiag 200 Chair

This function is designed to place the chair into an immobile state in order to ensure patient safety when seating and/or disembarking the patient from the reclining chair. It is also used to keep the chair immobile during the VNG test battery. The lock chair function is only made available prior to the test and cannot be activated during the testing procedure. This will automatically be switched off when performing a rotational chair test. To lock or unlock the chair at any other time, tap the **Lock Chair** button. The chair is locked when the button is yellow and unlocked when the button is light green.

System 2000 Reclining Chair

The System 2000 Reclining chair does not have an electronic braking system. A manual foot brake is found on the side of the chair drum. The operator should apply the brake to keep the chair in place for patient entry and VNG testing. When reclining the chair for Dix Hallpike, Positional, and Caloric tests, the foot brake should be released in order to rotate the chair if needed due to space constraints. The foot brake should then be reapplied when the chair is reclined to the appropriate position to keep the chair from rotating during the test. When the rotational chair tests are performed, verify the foot brake is released.



Figure 6.8.6 Foot brake released



Figure 6.8.7 Foot brake applied

Home Chair: Orion Reclining Chair and Nydiag 200 Chair

The chair will have a default position to which it will move prior to testing. This position is called the home position. Ideally the chair should be set in front of the television or projection screen so the home position is lined up with the center of the screen. If the chair is installed with the home position not centered with the screen, the Zero Position can be adjusted to the new location. This value is found in System Default Settings (see Chapter 12.8 Reclining chair). The **Home Chair** button will move to this override location.

6.9 Fixation suppression

There may be times in certain nystagmus tests (i.e. spontaneous and positional) where a fixation light is presented to the patient to differentiate peripheral from central abnormalities.

The fixation suppression index (FI) quantifies the ability of a patient to deliberately suppress nystagmus by fixating on a given target. It is determined by switching on the fixation light within the goggles. The value quantified will be displayed as a percentage in the bar graph in both horizontal and vertical channels.

A yellow bar appears in the trace to acknowledge the presence of the fixation light (Figure 6.9.1). The length of the bar determines the length of time the fixation light was active.

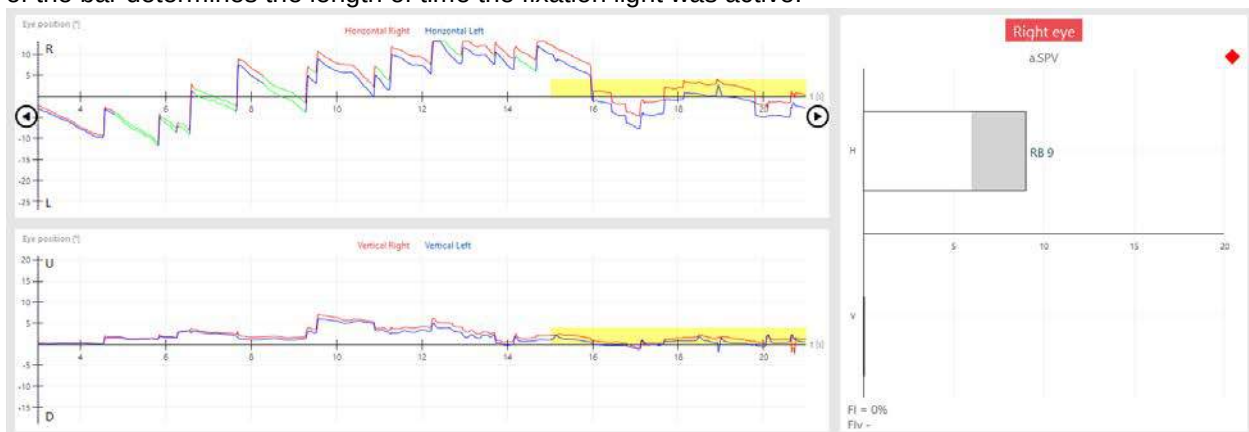


Figure 6.9.1 Yellow bar shows presence of fixation light in eye recording trace

The fixation light can be turned on in one of three different ways:

- Manually: Controlled by examiner using the RF Remote or **Fixation Manual** button
- Timed: Time predefined in the test settings. If the examiner turns on the fixation light manually before the time set in the test settings, the software will change to manual mode
- Automatic: In the caloric test, the fixation light is turned on automatically post detection of peak response

The fixation light can also be set to be displayed in either left or right eye (see 12.2 Hardware).

6.10 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 Protocol Management

7.1 Protocols

Protocols are able to be customized to the desired settings of the end user. They are composed of a list of tests and designated to be performed in a specific order at the preference of clinician or clinic. Protocols can be created for a specific clinician's testing style, screening versus clinical test lists, or to create a default protocol template for a clinic. There is no practical limit to the number of protocols that can be created.

The protocols are accessed from the Protocol Manager button under the Configuration menu on the main screen.

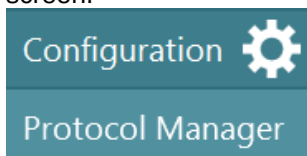


Figure 7.1.1 Configuration drop down menu with Protocol Manager displayed

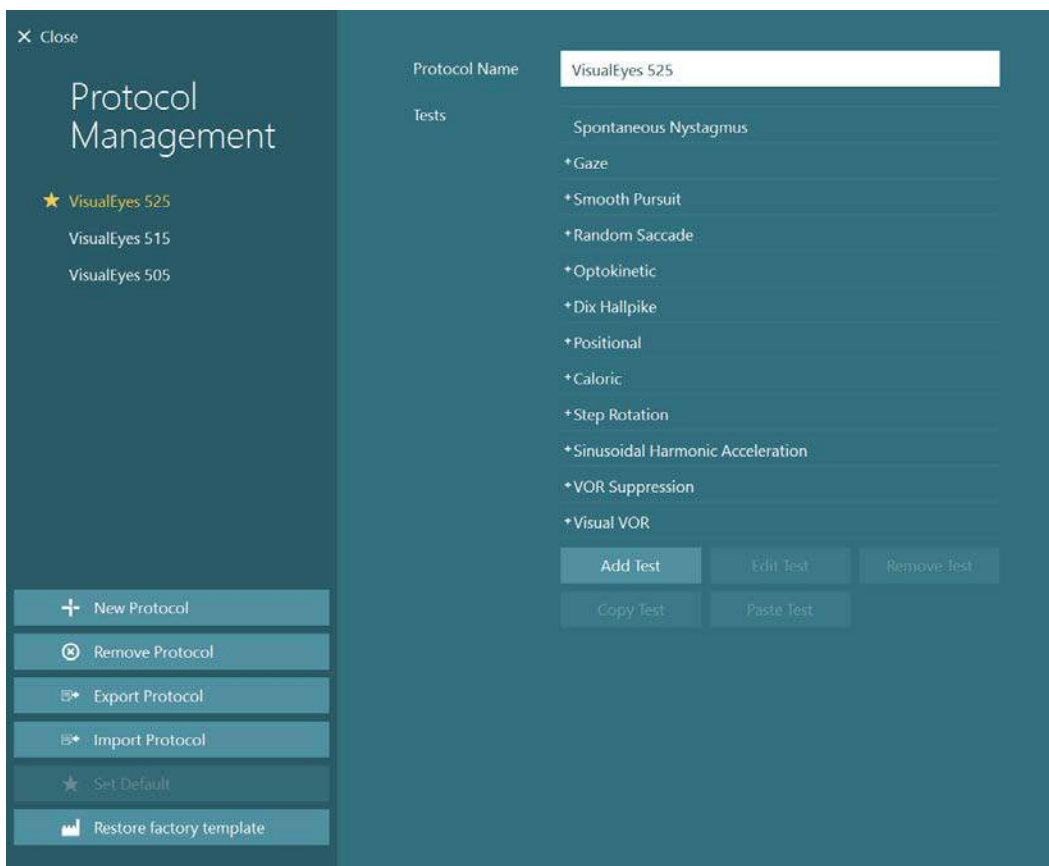
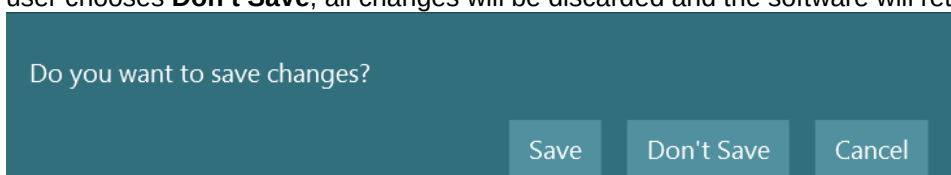


Figure 7.1.2 Protocol Manager screen

Upon exiting Protocol Management, the user will be asked to confirm to save changes to the protocols. If the user chooses **Don't Save**, all changes will be discarded and the software will return to the main screen.



7.2 Creating a new protocol

The left side panel displays the existing protocols. The **New Protocol** button is used to create a new blank protocol.



Figure 7.2.1 New Protocol button

Enter a name for the new protocol. By default this will be called New Protocol 1.

Figure 7.2.2 Enter Protocol Name

To add tests to the protocol, press the **Add Test** button and select one of the tests. Tests that don't match one of the default test types (e.g. Fistula test, Head shake test, etc.) can usually be entered as a basic Spontaneous Nystagmus test.

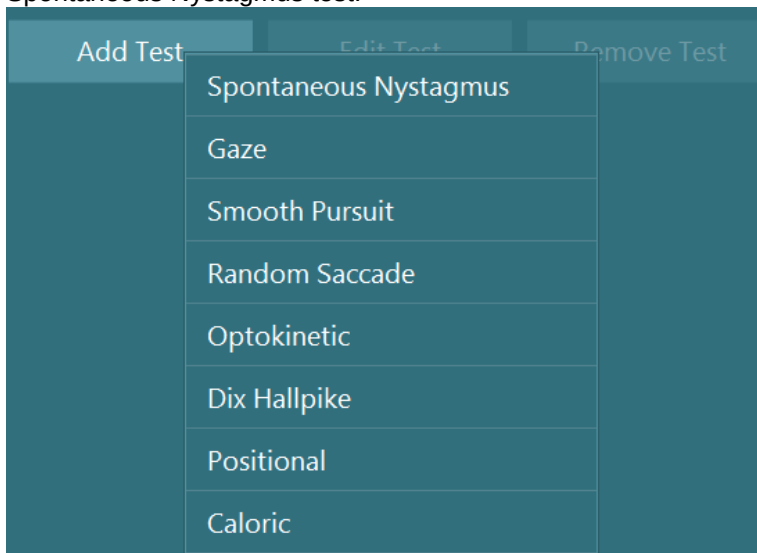


Figure 7.2.3 Add Test button

If two or more of the same test type are desired, click on the test of interest. The test title will appear with an additional numeric ending to indicate its position (i.e. Spontaneous Nystagmus2, Spontaneous Nystagmus3 etc...). These test titles can be renamed for easier identification or customization.

When added to the protocol, these tests will appear in the bottom of the protocol test sequence. The tests within the protocol can be reordered by clicking the specific test and dragging it up or down the list to the desired position using the mouse.

7.3 Setting default protocol

The Default protocol will be marked in the side menu with a star (Figure 7.1.6). When a new patient is entered into OtoAccess and the VisualEyes software is started, this default protocol will be selected automatically.

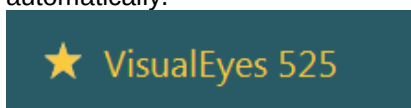


Figure 7.3.1 Default Protocol

Select the protocol of interest, then select the **Set Default** button (Figure 7.1.7) to confirm its designation as the Default protocol. A star shall appear next to the Protocol name to symbolize the change.



Figure 7.3.2 Set Default Protocol button

7.4 Remove protocol

To permanently remove a protocol and all tests in the selected protocol, select the Remove Protocol button. The software will ask to confirm the protocol removal.

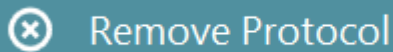


Figure 7.4.1 Remove Protocol button

7.5 Exporting protocols

Protocols can be exported for later use. Highlight the chosen protocol and select the **Export Protocol** button from the left menu panel.



Figure 7.5.1 Export protocol button

An export dialog with a destination folder location will appear (Figure 7.1.10). Select the desired destination folder for the exported protocol and select the **Export** button. This will save the protocol to the selected location for later use (e.g. to import into another VisualEyes™ 515/525 system). Select **Close** to return to the Protocol Management screen.

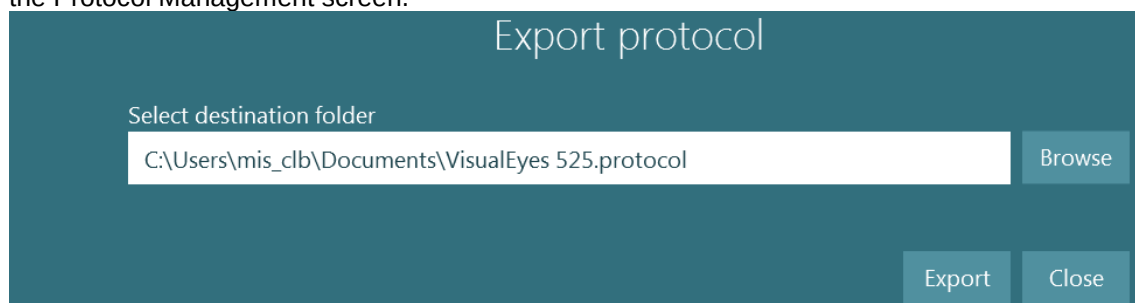


Figure 7.5.2 Export Protocol dialog

7.6 Importing protocols

Previously exported protocols can be imported into Protocol Manager using the **Import Protocol** button.



Figure 7.6.1 Import Protocol button

An import dialog with a source folder location will appear (Figure 7.1.10). Select the folder with the protocol file and select the **Import** button. This will save the protocol to the selected location for later use (e.g. to import into another VisualEyes™ 515/525 system). Once imported, the protocol can be edited or set as default like other protocols. Select **Close** to return to the Protocol Management screen.



Figure 7.6.2 Import Protocol dialog

7.7 Restore factory template

The VisualEyes software has a default test template for each test type licensed in the system. The settings for the default test template can be overridden using the **Set as default** button in each page of the test and subtest settings pages (e.g. override the default setting and set all tests based on Spontaneous Nystagmus should have the Split Eyes option set ON). To restore the default test template back to the system default settings select the Restore factory template button. Any protocols currently created will not be affected, but any new protocols and tests will be created using the default test template settings.



Figure 7.7.1 Restore factory template button

7.8 Selection of protocol

Select the protocol for testing by accessing the drop down menu below the **BEGIN TESTING** button. The default protocol will be selected initially. The drop down menu will list the available protocols. After selecting the desired protocol, click or touch the BEGIN TESTING button to begin testing with the first test of the selected protocol.

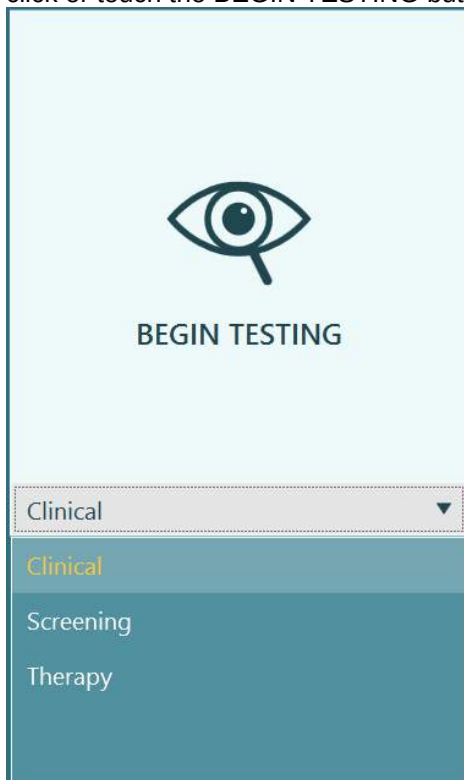


Figure 7.8.1 Begin Testing button with protocol selection

8 Test Properties

8.1 Configuring the tests

All tests within the VisualEyes™ VNG software suite can be configured to the user's preference. The changes need to be performed prior to conducting the test (cannot be changed post-test).

The specific test can be adjusted in 2 ways:

1. From the main screen select **Protocol Manager** section (under configuration).

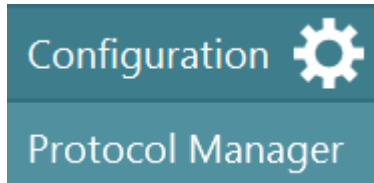


Figure 8.1.1 Configuration drop down menu with Protocol Manager displayed

Select the test in Protocol Management and choose **Edit Test**. Settings changed under the protocol manager will be made permanent.

2. In the Test screen, by clicking the configuration button:



Figure 8.1.2 Configuration button from testing

Settings changed under the configuration button are temporary and only apply to the current patient.

Temporary test settings will also have fewer options to alter compared to those under the Protocol management menu.

Each test will have some unique features to it that other tests may not. However, there are many features that will be similar and may be adjusted based on user preference.

Once the user is satisfied with the changes made to the test parameters, the settings may be incorporated into the protocol by selecting **Set as default**. These parameters will now be applied to that test within the specific protocol. A prompt will ask for confirmation to inherit the settings:

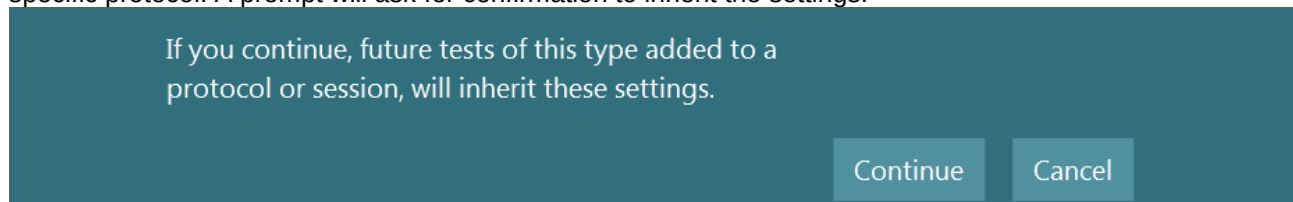


Figure 8.1.3 Saving test parameters to the protocol's default settings

By selecting **Reset to default** all settings for the page of settings with that test will return to the factory default settings.



Figure 8.1.4 Reset to default button

8.2 Configuring oculomotor tests

8.2.1 Configuring the gaze test

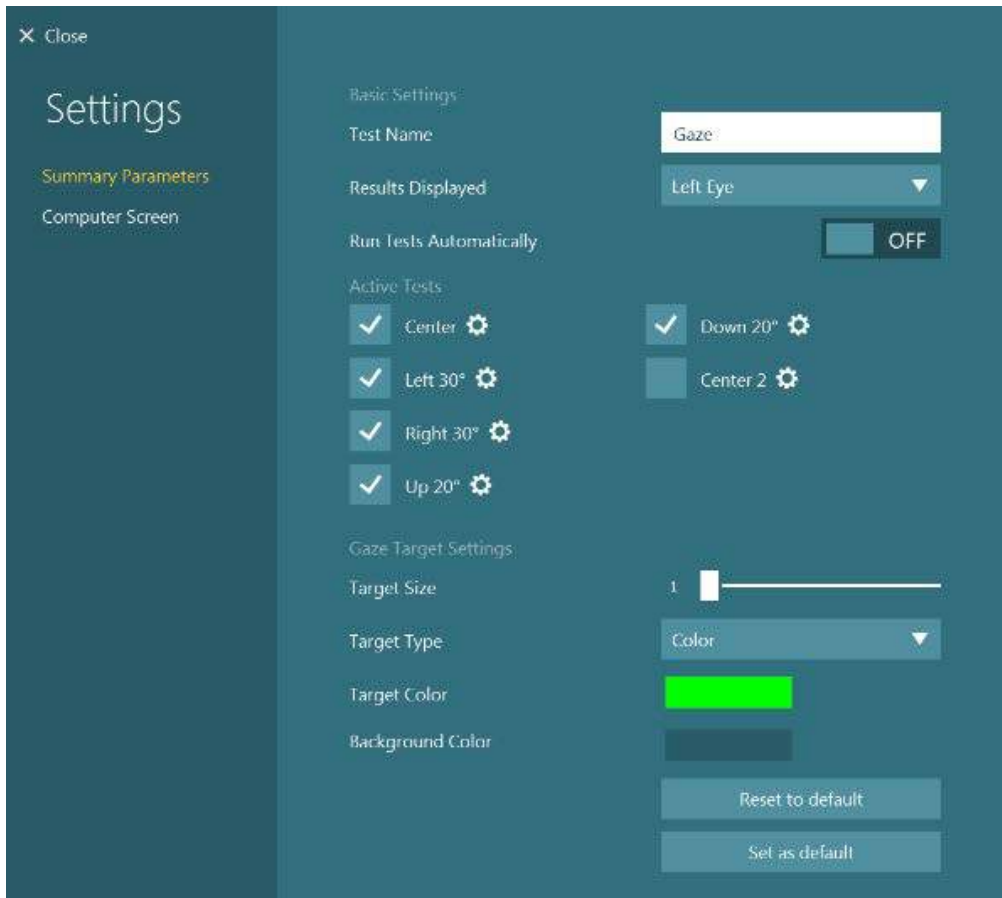


Figure 8.2.1 Gaze summary settings

Test Name: Name of the test

Results Displayed: Selects which eye is shown by default. Mixed Eyes will allow the user to choose the best eye for each subtest. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.

Run Tests Automatically: If enabled, when the subtest completes, the next subtest will be loaded and started automatically. This makes the Gaze test function similarly to the Calibration test.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. By default the active tests would be Center, Left, Right, Up, and Down. Center 2 is optional for a follow-up center gaze.

Gaze Target Settings:

Target Size: Adjusts size of target in degree increments. Note if the target size is increased, the maximum angle will decrease.

Target Type: Selects the stimulus for all Gaze subtests (circle of solid color, flower, potato head, or smiley face).

Target Color: If the target type is set to color, this option will change the target color.

Background color: Select different colors for the background.

The screenshot shows a 'Settings' window with a dark teal background. On the left is a sidebar with a 'Close' button at the top, followed by the 'Settings' title. Below the title are four menu items: 'Test Parameters' (highlighted in yellow), 'Computer Screen', 'Secondary Screen', and 'Nystagmus Parameters'. The main area on the right is titled 'Basic Settings' and contains the following controls: 'Test Name' with a text input field containing 'Center'; 'Duration' with a text input field containing '12'; 'Fixation light' with a dropdown menu showing 'Manual'; 'Video Auto-Save Settings' section containing 'Save Eye Recording' with a toggle switch set to 'OFF'; 'Gaze Settings' section containing 'Target Direction' with a dropdown menu showing 'Center' and 'Extend end of Recording' with a toggle switch set to 'OFF'. At the bottom of the main area are two buttons: 'Reset to default' and 'Set as default'.

Figure 8.2.2 Gaze subtest settings

Test Name: Name of subtest

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).

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.

Target Direction: Defines direction of target movement.

Extend end of Recording: If enabled the test will return the target back to center for two seconds. Not recommended if the tests are run automatically.

8.2.2 Configuration of saccade Test

Close

Temporary Settings

Summary Parameters
Computer Screen

Basic Settings

Test Name: Random Saccade

Results Displayed: Both Eyes

Active Tests

☒ Horizontal

☐ Vertical

☐ Combined

Saccade Target Settings

Target Size: 1

Target Type: Color

Target Color: [Bright Green]

Background Color: [Dark Grey]

Reset to default

Figure 8.2.3 Saccade summary settings

Test Name: Name of the test

Results Displayed: Selects which eye is shown by default. Both Eyes will show both eyes overlapping to allow easy viewing of disconjugate eye movements. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. Horizontal is selected by default. Vertical and Combined tests are optional tests. In the Combined subtest the target will jump horizontally or vertically randomly for each jump.

Saccade Target Settings:

Target Size: Adjusts size of target in degree increments. Note if the target size is increased, the maximum angle will decrease.

Target Type: Selects the stimulus for all Gaze subtests (circle of solid color, flower, potato head, or smiley face).

Target Color: If the target type is set to color, this option will change the target color.

Background color: Select different colors for the background.

Settings

Test Parameters

Computer Screen

Secondary Screen

Basic Settings

Test Name: Horizontal

Duration: 46 (Automatically calculated from the test specific settings below.)

Fixation light: Disabled

Video Auto-Save Settings

Save Eye Recording: OFF

Saccade Settings

Number of Jumps: 30

Minimum target movement: 5°

Maximum target movement: 30°

Compensate for drift: ON

Reset to default

Set as default

Figure 8.2.4 Saccade subtest settings

Test Name: Name of subtest

Duration: Length of time to perform the test based on the number of saccades

Fixation light: Determines when the fixation light in the goggles is displayed. Manual 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. Disabled (default) will block the fixation light from turning on in the test.

Save Eye Recording: Choice to save eye video recordings.

Number of Jumps: Defines how many saccade jumps the patient will follow.

Maximum target movement: Define maximum degrees target can move relative to previous target position.

Minimum target movement: Define minimum degrees target can move relative to previous target position.

Compensate for drift: If enabled, the software will adjust the patient's response to better align with the target.

Extend end of Recording: If enabled the test will return the target back to center for two seconds. Not recommended if the tests are run automatically.

8.2.3 Configuration of smooth pursuit tests

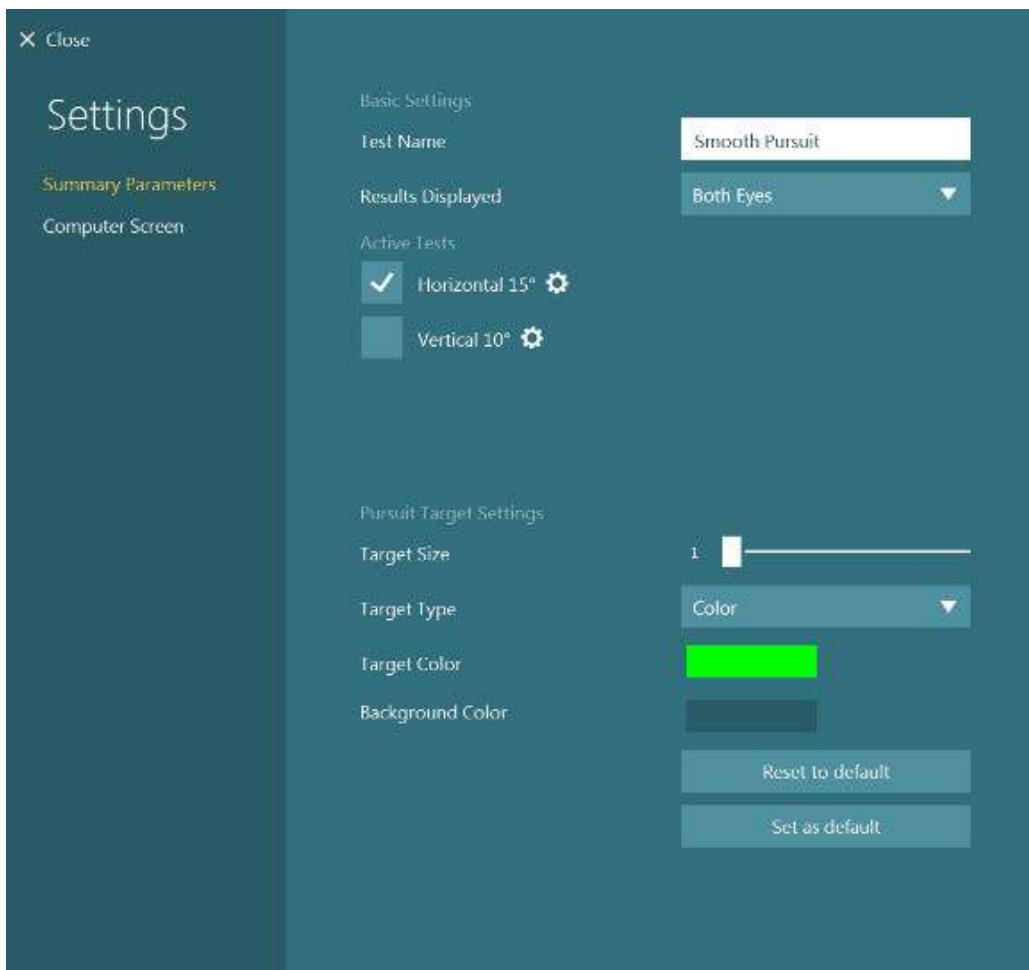


Figure 8.2.5 Smooth Pursuit summary settings

Test Name: Name of the test

Results Displayed: Selects which eye is shown by default. Both Eyes will show both eyes overlapping to allow easy viewing of disconjugate eye movements. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. Horizontal 15° is selected by default, and the clinician can choose to perform the Vertical 10° if desired.

Pursuit Target Settings:

Target Size: Adjusts size of target in degree increments. Note if the target size is increased, the maximum angle will decrease.

Target Type: Selects the stimulus for all Gaze subtests (circle of solid color, flower, potato head, or smiley face).

Target Color: If the target type is set to color, this option will change the target color.

Background color: Select different colors for the background.

Settings

Test Parameters

Computer Screen

Secondary Screen

Basic Settings

Test Name: Horizontal 1

Duration: 49 2

Fixation light: Disabled

Video Auto-Save Settings

Save Eye Recording: OFF 3

Pursuit Settings

Start Frequency [Hz]: 0.1 4

End Frequency [Hz]: 0.5 5

Cycles Per Frequency: 2 6

Target Amplitude: 15° 7

Compensate for drift: ON 8

Reset to default

Set as default

Figure 8.2.6 Smooth Pursuit subtest settings

Test Name: Name of subtest

Duration: Length of time to perform the test based on the number of pursuit cycles and frequencies tested

Fixation light: Determines when the fixation light in the goggles is displayed. Manual 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. Disabled (default) will block the fixation light from turning on in the test.

Save Eye Recording: Choice to save eye video recordings.

Start Frequency [Hz]: Initial frequency of the smooth pursuit test

End Frequency [Hz]: End frequency of the smooth pursuit test

Cycles Per Frequency: Determines how many cycles will be required for each frequency step to be performed

Target Amplitude: Sets the distance the target can move (in degrees)

Compensate for drift: If enabled, the software will adjust the patient's response to better align with the target.

8.2.4 Configuring the OPK tests

Figure 8.2.7 Optokinetic summary settings

Test Name: Name of the test

Results Displayed: Selects which eye is shown by default. Both Eyes will show both eyes overlapping to allow easy viewing of disconjugate eye movements. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. By default the active tests would be Left 20 dps, Right 20 dps, Left 40 dps, and Right 40 dps. Left 30 dps and Right 30 dps are optional.

Optokinetic Pattern Settings:

Optokinetic Pattern: Creates a tessellation pattern or stretches a background image across the stimulus screen. Tessellation patterns include checkerboard, stripes, and spheres. Stretched image patterns include firetruck, pilot and airplane, landscape, toy train, yellow airplane, and trains and tracks.

Foreground Color: If the Optokinetic pattern is a tessellation pattern, this selection will change the color of the primary shape.

Alternate Color: If the Optokinetic pattern is set to Spheres, this selection will change the color of the even rows of spheres.

Background color: If the Optokinetic pattern is a tessellation pattern, this selection controls the background color or fill color depending on the tessellation pattern.

Pattern Size: Adjusts size of shape used in the pattern tessellation. As the target size is increased, the number of shapes used in the pattern will decrease. Only available with Optokinetic Patterns of Checkerboard, Stripes, and Spheres.

The screenshot shows the 'Settings' window for the VisualEyes 515/525. The left sidebar contains a 'Close' button and a list of settings categories: 'Test Parameters' (highlighted in yellow), 'Computer Screen', 'Secondary Screen', and 'Nystagmus Parameters'. The main area is titled 'Basic Settings' and contains the following controls:

- Test Name:** A text field containing 'Left 20 dps'.
- Duration:** A text field containing '15'.
- Fixation light:** A dropdown menu set to 'Disabled'.
- Video Auto-Save Settings:** A section header.
- Save Eye Recording:** A toggle switch set to 'OFF'.
- Optokinetic Settings:** A section header.
- Velocity:** A slider control with a value of '20°'.
- Direction:** A dropdown menu set to 'Left'.
- Buttons:** 'Reset to default' and 'Set as default' buttons at the bottom.

Figure 8.2.8 Optokinetic subtest settings

Test Name: Name of subtest

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).

Fixation light: Determines when the fixation light in the goggles is displayed. Manual 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. Disabled (default) will block the fixation light from turning on in the test.

Save Eye Recording: Choice to save eye video recordings.

Velocity: Defines the speed the target pattern is displayed on the screen. Confirm that the Velocity value is used by another Optokinetic subtest with the Direction set to the opposite direction to ensure the Optokinetic Symmetry graph can be populated.

Direction: Defines direction of target movement.

8.3 Configuring the nystagmus tests

8.3.1 Configuring the spontaneous nystagmus test

Figure 8.3.1 Spontaneous Nystagmus test settings

Test Name: Name of test

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).

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.

8.3.2 Configuring the Dix-Hallpike tests

Figure 8.3.2 Dix Hallpike summary settings

Test Name: Name of the test

Results Displayed: Selects which eye is shown by default. Mixed Eyes will allow the user to choose the best eye for each subtest. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. The active tests are Left and Right.

Figure 8.3.3 Dix Hallpike subtest settings

Test Name: Name of test

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).

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.

Dix Hallpike Settings

Audible Tone Enabled: If enabled, the software will provide an audible beep after the Audible Tone Time has elapsed to signify to the operator to raise the patient to a sitting position.

Audible Tone Time: After the specified amount of time has passed, the software will draw a line on the waveform trace to signify to the operator to raise the patient to a sitting position.

8.3.3 Configuring the positional tests

Figure 8.3.4 Positional Summary settings

Test Name: Name of the test

Results Displayed: Selects which eye is shown by default. Mixed Eyes will allow the user to choose the best eye for each subtest. Left Eye will set each subtest to display the left eye. Right Eye will set each subtest to display the right eye.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. By default the active tests would be Supine, Head Right, Head Left, Body Right, and Body Left. Bow and Lean are optional body positions.

The screenshot shows the 'Settings' window with a sidebar on the left containing 'Close', 'Settings', 'Test Parameters' (highlighted), 'Computer Screen', 'Secondary Screen', and 'Nystagmus Parameters'. The main area is titled 'Basic Settings' and includes the following controls:

- Test Name:** A text input field containing 'Supine'.
- Duration:** A text input field containing '30'.
- Fixation light:** A dropdown menu set to 'Manual'.
- Video Auto-Save Settings:** A section containing a 'Save Eye Recording' toggle switch set to 'ON'.
- Buttons:** 'Reset to default' and 'Set as default' buttons at the bottom right.

Figure 8.3.5 Positional subtest settings

Test Name: Name of test

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).

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.

8.3.4 Configuring the caloric test

The screenshot shows the 'Settings' window with a sidebar on the left containing 'Close', 'Settings', 'Summary Parameters' (highlighted), 'Irrigator', and 'Computer Screen'. The main area is titled 'Basic Settings' and includes the following controls:

- Test Name:** A text input field containing 'Caloric'.
- Results Displayed:** A dropdown menu set to 'Left Eye'.
- Fixation Light Control:** A dropdown menu set to 'Automatic'.
- Show Nystagmus Count:** A toggle switch set to 'OFF'.
- Active Tests:** A section with two columns of checkboxes and gear icons:
 - Left column (all checked): Right Warm, Left Warm, Left Cool, Right Cool.
 - Right column (all unchecked): Spontaneous Nystagmus, Right Ice, Left Ice.
- Test Arrangement:** A section with two rows of dropdown menus:
 - Row 1: Right Cool, Left Warm.
 - Row 2: Right Warm, Left Cool.

Figure 8.3.6 Caloric summary settings

Test Name: Name of 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.

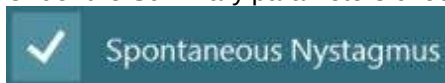
Fixation Light Control: Determines when the fixation light in the goggles is displayed. Automatic (default) will have the fixation light turn on after the current average slow phase velocity has dropped 10% of the magnitude of the maximum average slow phase velocity. Manual will leave the operator to determine when the fixation light should be displayed. Timed will have the fixation light come on automatically at the designated time.

Show Nystagmus Count: If enabled, the software will display the number of detected nystagmus beats in the peak response window and display the beat count in the pod view above the fixation index value..

Save Eye Recording: Choice to save eye video recordings.

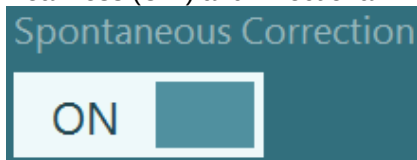
Before the caloric irrigation test is performed, a spontaneous nystagmus (SPN) test can be recorded. This is recommended for patients that have shown nystagmus in conditions without stimulation. The average slow phase velocity determined during the caloric SPN test is used in the calculation of directional preponderance.

Under the Summary parameters choose 'Spontaneous Nystagmus'



Once a sub test is complete, the option to choose 'Spontaneous Correction'.

The calculations consider the presence of underlying spontaneous nystagmus in the analysis of unilateral weakness (UW) and Directional Preponderance (DP).



Test Arrangement: The order of the caloric subtests and how they are displayed on the screen can be changed by setting the test order. Analysis results will also display the test results in the test arrangement if possible.

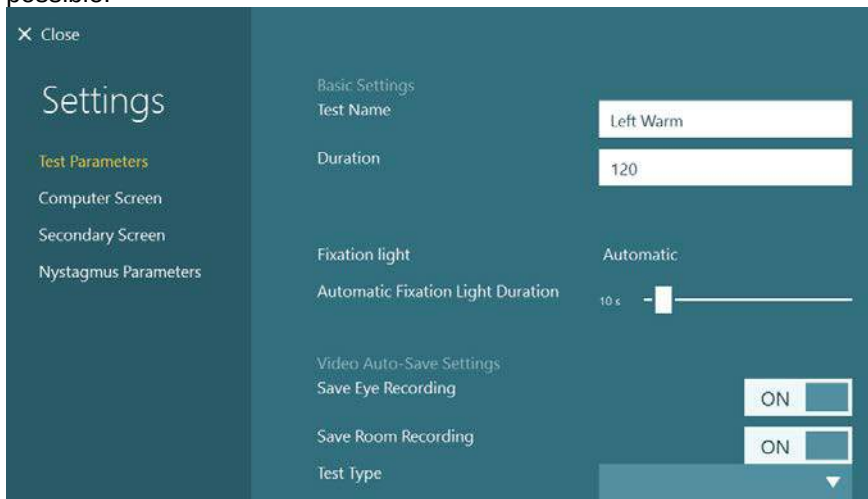


Figure 8.3.7 Caloric subtest settings

Test Name: Name of test

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds).

Fixation light: Determines when the fixation light in the goggles is displayed. This value is set by the Caloric summary settings.

Automatic Fixation Light Duration: If the subtest is set to use Automatic Fixation Light, the length of time the light is displayed to the patient can be set using the slider.

Save Eye Recording: Choice to save eye video recordings.

Test Type: After the test has been performed, this setting is available to change the type of caloric test in the event the operator had irrigated the wrong ear during testing.

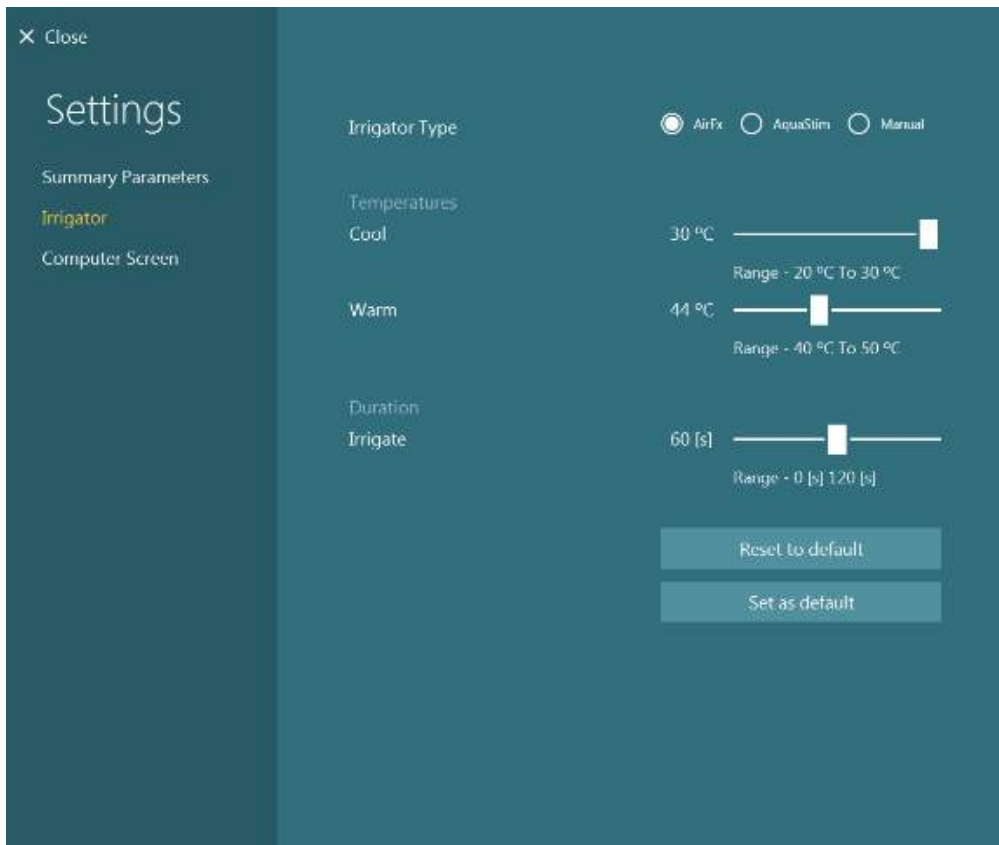


Figure 8.3.8 Caloric Summary Irrigator settings

1. VisualEyes™ system is compatible with Interacoustics and Micromedical water (Aqua Stim) and air (AirFx) Caloric irrigators. These irrigators interact with the software allowing for automatic temperature adjustment and activation of the test via the irrigator handle push button. Selecting the Manual option allows using any third-party caloric irrigator, however the software will not directly communicate with the irrigator.
2. Enter the temperature of the cold and warm irrigations (Figure 8.3.8). If set with the Air Fx or Aqua Stim, the irrigator will operate with these settings. If using a third-party irrigator, these values only provide a note to the desired temperature and shown in the caloric result graphs.
3. The duration to irrigate can be set to stop the flow of the air or water at the time desired. for time of irrigation. This is useful when there is a compatible irrigator. Selecting a time will allow the irrigator to perform the irrigation for the set time, automatically turn on and off.

8.4 Configuring rotary chair tests

8.4.1 Configuring sinusoidal harmonic acceleration test

The screenshot shows the 'Settings' window for the Sinusoidal Harmonic Acceleration test. The left sidebar contains 'Close', 'Settings', 'Summary Parameters', and 'Computer Screen'. The main panel is titled 'Basic Settings' and includes the following controls:

- Test Name:** A text field containing 'Sinusoidal Harmonic Acceleration'.
- Results Displayed:** A dropdown menu set to 'Left Eye'.
- Run Tests Automatically:** A toggle switch set to 'OFF'.
- SHA velocity profile:** Radio buttons for 'Discrete' (selected) and 'Variable'.
- Active Tests:** A list of frequencies with checkboxes and gear icons:

Frequency	Active	Settings
.01 Hz	✓	⚙
.02 Hz	✓	⚙
.04 Hz	✓	⚙
.08 Hz	✓	⚙
.16 Hz	✓	⚙
.32 Hz	✓	⚙
.64 Hz		⚙
- Chair Settings:** A toggle switch for 'Move To Zero When Test Is Complete' set to 'OFF'.

At the bottom right, there are two buttons: 'Reset to default' and 'Set as default'.

Figure 8.4.1 Sinusoidal Harmonic Acceleration summary settings

Test Name: Name of 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.

Run Tests Automatically: If enabled, when the subtest completes, the next subtest will be loaded and started automatically.

SHA velocity profile: This option defines whether the SHA subtests use a discrete standard velocity of 60 dps or use a variable velocity which is higher at lower frequencies (80 dps at 0.01 Hz and drops 10 dps for each increase in frequency to 20 dps at 0.64 Hz.) The default setting is Variable.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. The Nydiag 200 chair can test up to 0.32 Hz, and the Orion Reclining chair and System 2000 Reclining chair can test up to 0.64 Hz.

Move To Zero When Test Is Complete: If enabled, the chair (Nydiag 200 and Orion Reclining chair models only) will return to the zero position as set in System Default Settings.



Figure 8.4.2 SHA Summary Computer Screen settings

Summary View:

Detailed, individual cycles: Detailed view will draw each cycle individually and fit a line to each cycle.

Concise combined cycles: Concise will show every cycle overlapped and a single fitted line is drawn through the concise view.

Keep aspect ratio: This allows the nystagmus to be displayed in a non-compressed form, allowing for easy recognition of the slow phase velocities of nystagmus. Disabling this feature will cause the nystagmus to appear more compressed.

Display Interval: Set the desired length of time (in seconds) to display data in the test window. This feature only becomes available when “Keep aspect ratio” is disabled.

Invert chair signal: Enabling this feature sets the eye trace to overlap the stimulus trace, providing a different view for comparing results. By default the setting is disabled.

Figure 8.4.3 SHA subtest settings

Test Name: Name of subtest

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds). This value is calculated based on the Frequency, Peak Velocity, and Number of Cycles.

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.

Target Direction: Defines direction of target movement.

Extend end of Recording: If enabled the test will return the target back to center for two seconds. Not recommended if the tests are run automatically.

Sinusoidal Harmonic Acceleration Settings:

Frequency: Define the frequency (Hz) of Stimulus (Chair motion side to side). The frequencies available include 0.01 Hz to 0.32 Hz with increments of 0.01 Hz.

Peak Velocity: Define the peak velocity (in dps) the chair will rotate. Range of velocities is 1 to 200 degrees per second.

Peak Acceleration: The maximum rate at which the chair can accelerate (in m/s^2). This is automatically calculated based on the sinusoidal harmonic acceleration settings.

Number of Cycles: The total number of cycles to be performed for this frequency of chair movement. The initial half cycle is rejected automatically.

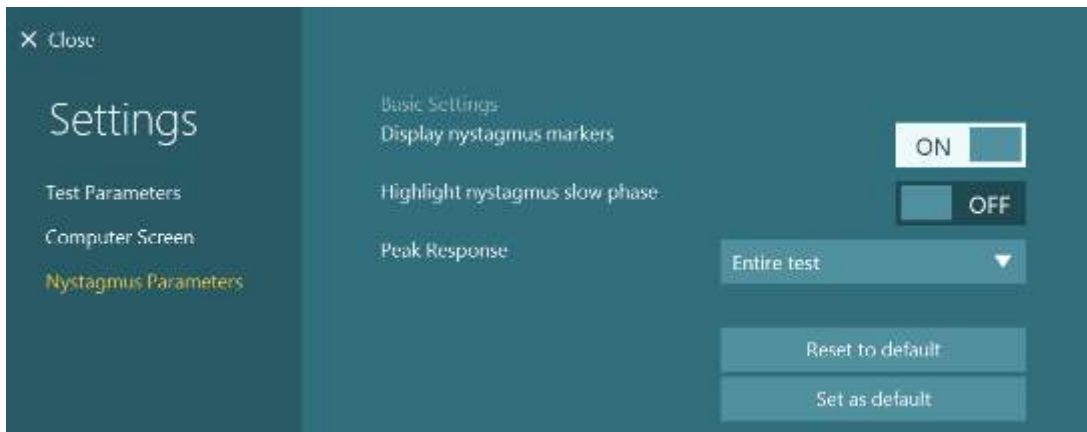


Figure 8.4.4 SHA subtest Nystagmus Parameters

Display nystagmus markers: Enabling this feature will display a marker i.e. triangle above the nystagmus fast phase slope to assist identification of a nystagmus beat. The triangle may face upwards (referring to right/up beating nystagmus) and downwards referring to left/ down beat nystagmus.

Highlight nystagmus slow phase: By default, the slow phases are the same color as the rest of the trace. However should the user want to differentiate the slow phases amongst the trace data, enabling this feature will mark the slow phases in green.

Peak Response: Selecting the drop down menu presents several options to define the length of time for the analysis of the peak response. By default, the entire test will be included in the peak response for accuracy purposes.

8.4.2 Configuring step rotation test

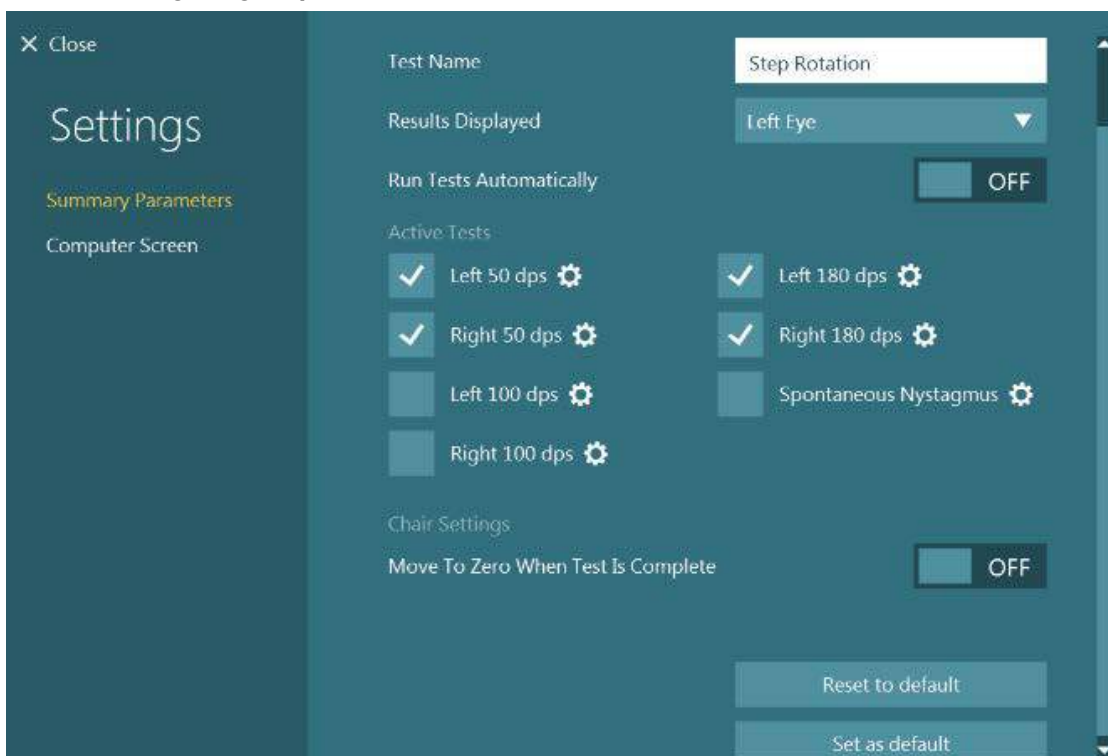


Figure 8.4.5 Step Rotation summary settings

Test Name: Name of 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.

Run Tests Automatically: If enabled, when the subtest completes, the next subtest will be loaded and started automatically.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. By default the Step Rotation test will test the patient in both directions at 50 and 180 dps. Optionally the test can also spin the patient at 100 dps.

Move To Zero When Test Is Complete: If enabled, the chair (Nydiag 200 and Orion Reclining chair models only) will return to the zero position as set in System Default Settings.

The screenshot shows a 'Temporary Settings' dialog box with a sidebar on the left containing 'Test Parameters', 'Computer Screen', 'Secondary Screen', and 'Nystagmus Parameters'. The main area is divided into 'Basic Settings' and 'Step Rotation Settings'. Under 'Basic Settings', there are fields for 'Test Name' (set to 'Left'), 'Duration' (set to '121', with a note 'Automatically calculated from the test specific settings below'), 'Fixation light' (set to 'Manual' via a dropdown), and 'Video Auto-Save Settings' with a 'Save Eye Recording' toggle set to 'ON'. Under 'Step Rotation Settings', there are dropdowns for 'Rotation Direction' (set to 'Left') and sliders for 'Velocity' (50°/s), 'Acceleration' (100°/s²), 'Stable Time' (60s), 'Deceleration' (100°/s²), and 'Stop Time' (60s). A 'Reset to default' button is at the bottom.

Figure 8.4.6 Step Rotation subtest settings

Test Name: Name of subtest

Duration: Length of time (in seconds) the test shall run. This is automatically calculated from the test specific settings. The length of time is dependent on the step rotation setting, i.e. velocity, acceleration, deceleration time.

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.

Step Rotation Settings

Rotation direction: Defines the direction the chair will be rotating, Left (counterclockwise) or Right (clockwise).

Velocity: The peak velocity of chair movement

Acceleration: The rate at which the chair accelerates to reach the Velocity value.

Stable Time: Length of time the chair will be rotating at the Velocity value past the time required to reach the Velocity value using the Acceleration rate.

Deceleration: Defines the rate the chair decelerates (in deg/sec²).

Stop Time: Length of time (in seconds) the test will continue recording after the chair has stopped.

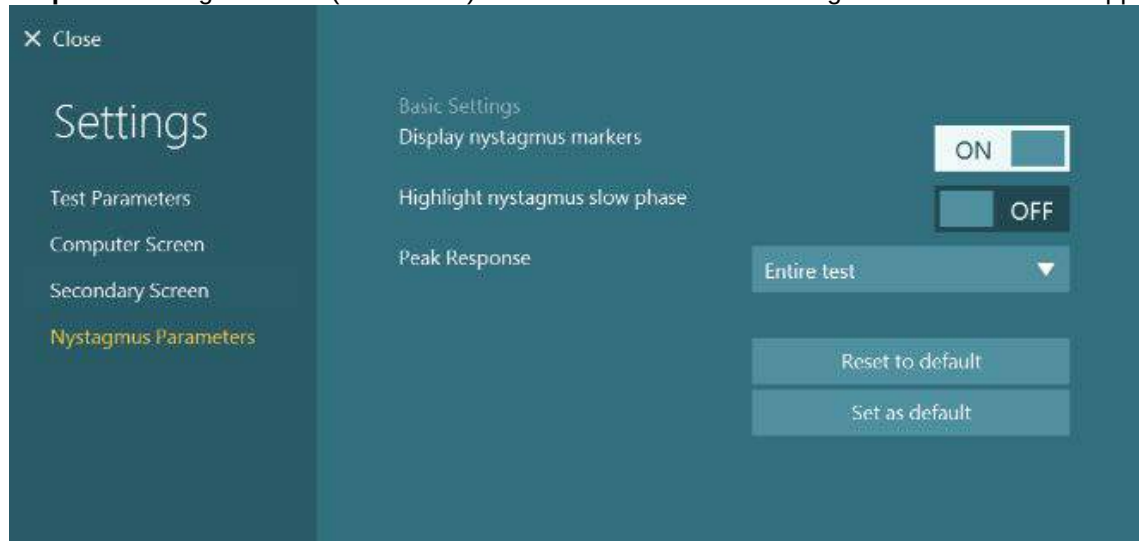


Figure 8.4.7 Step Rotation subtest Nystagmus Parameters

Display nystagmus markers: Enabling this feature will display a marker i.e. triangle above the nystagmus fast phase slope to assist identification of a nystagmus beat. The triangle may face upwards (referring to right/up beating nystagmus) and downwards referring to left/ down beat nystagmus. Nystagmus markers will be enabled by default.

Highlight nystagmus slow phase: By default, the slow phases are the same color as the rest of the trace. However should the user want to differentiate the slow phases amongst the trace data, enabling this feature will mark the slow phases in green.

Peak response: Selecting the drop down menu presents several options to define the length of time for the analysis of the peak response. By default, the entire test will be included in the peak response for accuracy purposes.

8.4.3 Configuring VOR suppression test

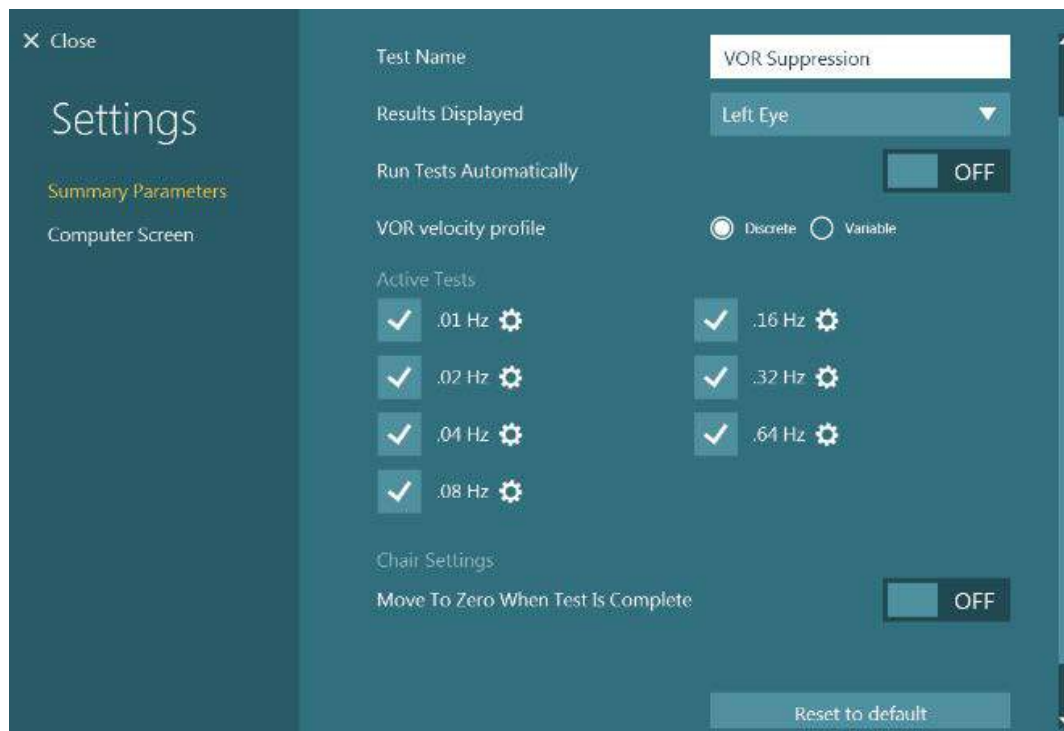


Figure 8.4.8 VOR Suppression summary settings

Test Name: Name of 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.

Run Tests Automatically: If enabled, when the subtest completes, the next subtest will be loaded and started automatically.

SHA velocity profile: This option defines whether the VOR Suppression subtests use a discrete standard velocity of 60 dps or use a variable velocity which is higher at lower frequencies (80 dps at 0.01 Hz and drops 10 dps for each increase in frequency to 20 dps at 0.64 Hz.) The default setting is Variable. This value should be the same as the VOR tests that the VOR Suppression test will compare against.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. The Nydiag 200 chair can test up to 0.32 Hz, and the Orion Reclining chair and System 2000 Reclining chair can test up to 0.64 Hz.

Move To Zero When Test Is Complete: If enabled, the chair (Nydiag 200 and Orion Reclining chair models only) will return to the zero position as set in System Default Settings.



Figure 8.4.9 VOR Suppression summary Computer Screen settings

Summary View:

Detailed, individual cycles: Detailed view will draw each cycle individually and fit a line to each cycle

Concise combined cycles: Concise will show every cycle overlapped and a single fitted line is drawn through the concise view.

Keep aspect ratio: This allows the nystagmus to be displayed in a non-compressed form, allowing for easy recognition of the slow phase velocities of nystagmus. Disabling this feature will cause the nystagmus to appear more compressed.

Display Interval: Set the desired length of time (in seconds) to display data in the test window. This feature only becomes available when "Keep aspect ratio" is disabled.

Invert chair signal: Enabling this feature sets the eye trace to overlap the stimulus trace, providing a different view for comparing results. By default the setting is disabled.

Figure 8.4.10 VOR Suppression subtest settings

Test Name: Name of subtest

Duration: Define how long the eye movement is to be recorded and analyzed (in seconds). This value is calculated based on the Frequency, Peak Velocity, and Number of Cycles.

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.

Target Direction: Defines direction of target movement.

Extend end of Recording: If enabled the test will return the target back to center for two seconds. Not recommended if the tests are run automatically.

Sinusoidal Harmonic Acceleration Settings:

Frequency: Define the frequency (Hz) of Stimulus (Chair motion side to side). The frequencies available include 0.01 Hz to 0.32 Hz with increments of 0.01 Hz.

Peak Velocity: Define the peak velocity (in dps) the chair will rotate. Range of velocities is 1 to 200 degrees per second.

Peak Acceleration: The maximum rate at which the chair can accelerate (in m/s^2). This is automatically calculated based on the sinusoidal harmonic acceleration settings.

Number of Cycles: The total number of cycles to be performed for this frequency of chair movement. The initial half cycle is rejected automatically.

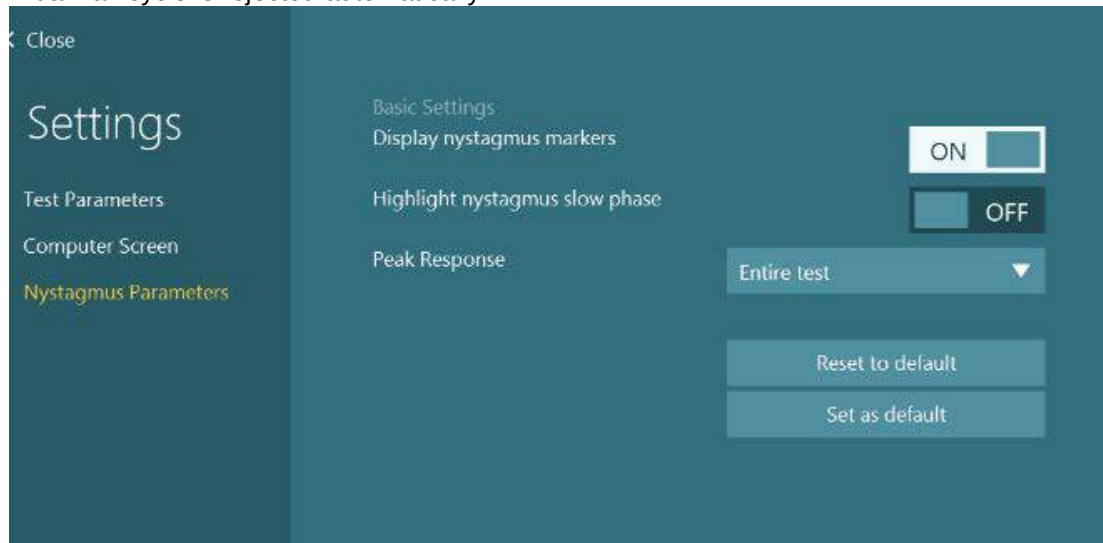


Figure 8.4.11 VOR Suppression subtest Nystagmus Parameters

Display nystagmus markers: Enabling this feature will display a marker i.e. triangle above the nystagmus fast phase slope to assist identification of a nystagmus beat. The triangle may face upwards (referring to right/up beating nystagmus) and downwards referring to left/ down beat nystagmus.

Highlight nystagmus slow phase: By default, the slow phases are the same color as the rest of the trace. However should the user want to differentiate the slow phases amongst the trace data, enabling this feature will mark the slow phases in green.

Peak Response: Selecting the drop down menu presents several options to define the length of time for the analysis of the peak response. By default, the entire test will be included in the peak response for accuracy purposes.

8.4.4 Configuring visual VOR test

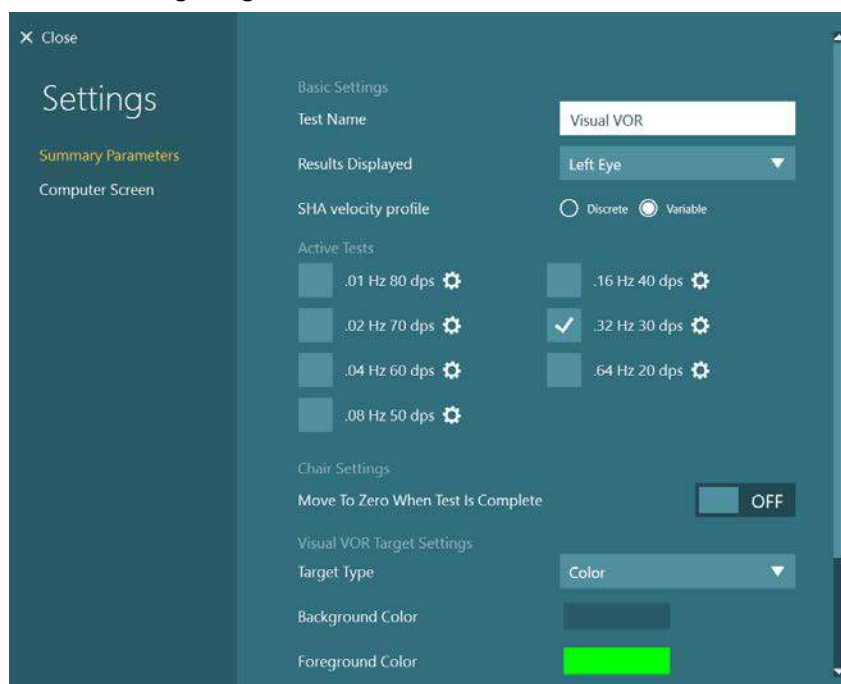


Figure 8.4.12 Visual VOR summary settings

Test Name: Name of 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.

SHA velocity profile: This option defines whether the SHA subtests use a discrete standard velocity of 60 dps or use a variable velocity which is higher at lower frequencies (80 dps at 0.01 Hz and drops 10 dps for each increase in frequency to 20 dps at 0.64 Hz.) The default setting is Variable. This value should be the same as the VOR tests and VOR Suppression tests.

Active Tests: The subtests selected will appear in the testing screen. The configuration gear button beside each test will open the subtest settings. The Nydiag 200 chair can test up to 0.32 Hz, and the Orion Reclining chair and System 2000 Reclining chair can test up to 0.64 Hz. By default only the 0.32 Hz test is selected.

Move To Zero When Test Is Complete: If enabled, the chair (Nydiag 200 and Orion Reclining chair models only) will return to the zero position as set in System Default Settings.

Visual VOR Target Settings:

Target Type: Creates a tessellation pattern or stretches a background image across the stimulus screen. Tessellation patterns include checkerboard, stripes, and spheres. Stretched image patterns include firetruck, pilot and airplane, landscape, toy train, yellow airplane, and trains and tracks.

Foreground Color: If the Target Type is a tessellation pattern, this selection will change the color of the primary shape.

Alternate Color: If the Target Type is set to Spheres, this selection will change the color of the even rows of spheres.

Background color: If the Target Type is a tessellation pattern, this selection controls the background color or fill color depending on the tessellation pattern.

Pattern Size: Adjusts size of shape used in the pattern tessellation. As the target size is increased, the number of shapes used in the pattern will decrease. Only available with Target Type of Checkerboard, Stripes, and Spheres.

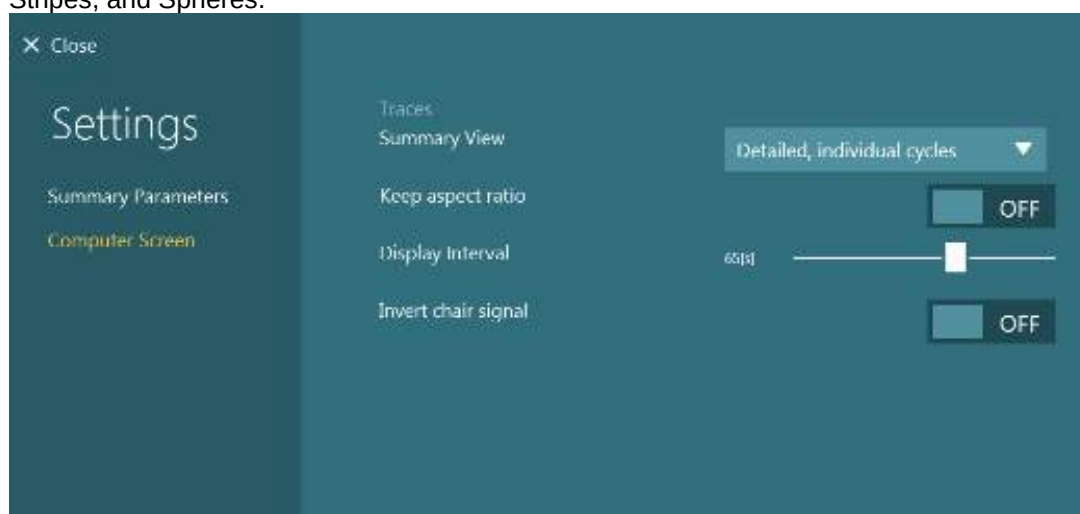


Figure 8.4.13 Visual VOR summary Computer Screen settings

Summary View:

Detailed, individual cycles: Detailed view will draw each cycle individually and fit a line to each cycle

Concise combined cycles: Concise will show every cycle overlapped and a single fitted line is drawn through the concise view.

Keep aspect ratio: This allows the nystagmus to be displayed in a non-compressed form, allowing for easy recognition of the slow phase velocities of nystagmus. Disabling this feature will cause the nystagmus to appear more compressed.

Display Interval: Set the desired length of time (in seconds) to display data in the test window. This feature only becomes available when "Keep aspect ratio" is disabled.

Invert chair signal: Enabling this feature sets the eye trace to overlap the stimulus trace, providing a different view for comparing results. By default the setting is disabled.

9 Suggested threshold values

The VisualEyes™ VNG software suite has suggested threshold tables. The values in these tables are suggested threshold values as published from the text book of Gary Jacobson and Neil Shepard, Balance Function Assessment and Management 2nd edition unless otherwise referenced. It is recommended that the clinician collects a sample of data from the clinics, using the customized protocols and settings and document any differences to the findings in these tables. If the clinic decides to use custom test thresholds, the test thresholds can be updated to reflect the clinic settings.

9.1 Updating test thresholds

- Tap the **Configuration** option from main screen
- Select **System Default Settings**
- Choose **Threshold Data** from the list in the side panel menu
- A disclaimer will appear (Figure 9.1.1), prior to allowing access to the suggested threshold values. Click **Ok** to accept the disclaimer and move onto the threshold data tables.

DISCLAIMER. This function of the software is intended for research purposes only, and is provided "as is" without warranty of any kind, express or implied. You assume all responsibility for data entered in the software, and any diagnosis made on the basis of this data. Under no circumstances and under no legal theory shall Interacoustics be liable to you or to any other person for any indirect, special, incidental, or consequential damages of any character including, all damages or losses.

OK

Figure 9.1.1 Disclaimer for suggested threshold values

Changes can be made to the threshold data by entering the new value(s) into the appropriate fields. An **Undo** button is available to restore all values back to the values prior editing. To reload the default suggested threshold data, click the **Reset to default** button. To save the new laboratory specific threshold data for use with all patients (new or previously tested), click the **Save** button.

9.2 Nystagmus tests

The average slow phase velocity (a.SP.V) bar graph displays the a.SP.V of 3 or more beats found within the peak response time period defined in the test properties. The Max Slowphase Velocity value of 6 degrees per second is treated as within threshold limits and will be displayed as a white bar. Values exceeding this threshold will have the threshold value portion in white and the remaining displayed in gray.

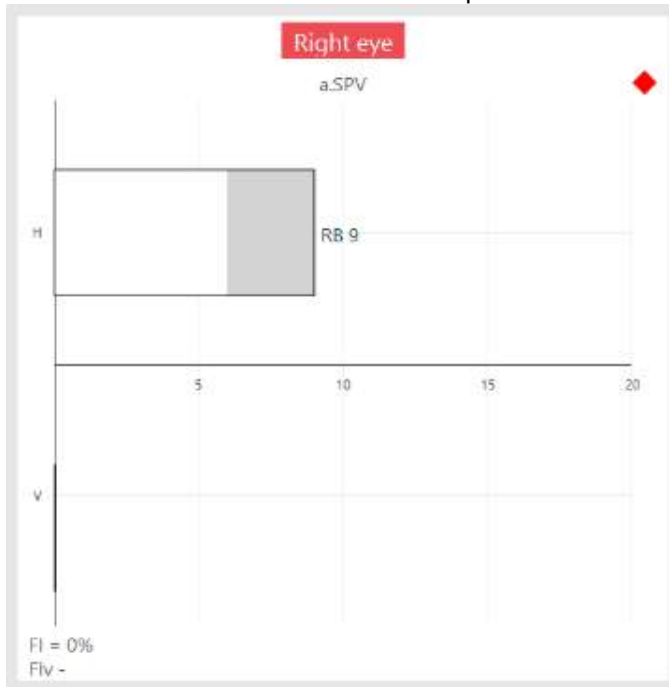


Figure 9.2.1 Average Slow Phase Velocity bar graph with 6 dps threshold

Nystagmus threshold levels												
Max Slowphase Velocity	6	6	6	6	6	6	6	6	6	6	6	6

Figure 9.2.2 Nystagmus threshold levels

9.3 Caloric tests

Unilateral Weakness and Directional Preponderance are calculated using Jongkees formula. Unilateral weakness is 25%. Directional Preponderance is 30%. Monothermal Warm Screening Test weakness is defined as 30%. When cool tests are performed, the software will use the Unilateral weakness value. Bilateral Weakness is defined if the total slow phase velocity is less than 11 degrees per second. The Fixation Index threshold is considered 50%. Patients with a Fixation Index less than 50% is said to have a failure to suppress nystagmus with fixation.

Caloric threshold levels												
Age groups	5 - 6	7 - 8	9 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 <
Directional preponderance	30	30	30	30	30	30	30	30	30	30	30	30
Unilateral weakness	25	25	25	25	25	25	25	25	25	25	25	25
MWST	30	30	30	30	30	30	30	30	30	30	30	30
Bilateral Weakness	11	11	11	11	11	11	11	11	11	11	11	11
Fixation Index	50	50	50	50	50	50	50	50	50	50	50	50

Figure 9.3.1 Caloric threshold levels

9.4 Optokinetic tests

The Optokinetic test measures nystagmus and displays gain and symmetry. The analysis of the optokinetic test calculates the average velocity of the movement during the peak response window (a.SPV) and compares this velocity with the projection pattern velocity. The relation of velocity values is called gain (G).

$$G = a.SPV / \text{Stimulus Velocity}$$

Data acquired in the first three seconds of a measurement is not included in the analysis. The difference between the 2 ears is the symmetry value.

OPK Minimum Gain	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
OPK Maximum Asymmetry	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Figure 9.4.1 Optokinetic threshold values

9.5 Smooth pursuit tests

Gain is measured for each frequency. For each frequency between 0.1 Hz and 0.5 Hz, the average gain value for all cycles for the selected frequency is compared to the minimum gain value in the table of thresholds. If the average gain value is less than the minimum gain value specified in the table then the test will be labeled as outside threshold. Smooth Pursuit threshold data does vary based on the patient's age.

Age groups	5 - 6	7 - 8	9 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 <
Smooth Pursuit Min Gain 0.1 Hz	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.53	0.40	0.40	0.40
Smooth Pursuit Min Gain 0.2 Hz	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.70	0.68	0.68	0.68
Smooth Pursuit Min Gain 0.3 Hz	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.61	0.61	0.61	0.61
Smooth Pursuit Min Gain 0.4 Hz	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.49	0.51	0.51	0.51
Smooth Pursuit Min Gain 0.5 Hz	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.36	0.41	0.41	0.41

Figure 9.5.1 Pursuit threshold values

9.6 Saccade tests

Saccade tests measure three values: velocity, latency, and accuracy. Saccade thresholds do vary with patient age. To create the velocity graph, minimum velocities at velocities between 5 degrees and 30 degrees are used to create a velocity profile.

Age groups	5 - 6	7 - 8	9 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 <
Saccade Max Accuracy	137	137	137	137	137	137	137	137	134	121	121	121
Saccade Max Latency	260	260	260	260	260	260	260	260	260	270	270	270
Saccade Min Accuracy	77	77	77	77	77	77	77	77	80	85	85	85
Saccade Min Velocity 5°	0	0	0	0	0	0	0	0	0	0	0	0
Saccade Min Velocity 10°	191	191	191	191	191	191	191	191	191	191	191	191
Saccade Min Velocity 15°	249	249	249	249	249	249	249	249	249	249	249	249
Saccade Min Velocity 20°	257	257	257	257	257	257	257	257	257	257	257	257
Saccade Min Velocity 25°	315	315	315	315	315	315	315	315	315	315	315	315
Saccade Min Velocity 30°	329	329	329	329	329	329	329	329	329	329	329	329

Figure 9.6.1 Saccade threshold values

9.7 Sinusoidal harmonic acceleration tests

For SHA tests, threshold values for gain, phase, and symmetry are displayed. There are values for both discrete velocity tests (based on 60 deg/sec for all frequencies) and variable velocity (increased velocity with decreased frequency). See the following references below for threshold values.

Reference:

SHA Variable or Discrete Velocity threshold values referenced from Henry, D.F. publication: Closed-Loop, Sinusoidal Harmonic Acceleration, and Active Head Rotation Tests Norms and Reliability. Otolaryngol Head and Neck Surg. 155(3); 65: 531-43.

SHA threshold levels 												
SHA velocity profile ☐ Discrete ☒ Variable												
Frequency 0.01 Hz 												
Minimum Gain	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Maximum Gain	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Minimum Phase	32	32	32	32	32	32	32	32	32	32	32	32
Maximum Phase	59	59	59	59	59	59	59	59	59	59	59	59
Minimum Symmetry	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26
Maximum Symmetry	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Minimum VOR Gain Reduction												
Frequency 0.02 Hz 												
Minimum Gain	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Maximum Gain	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Minimum Phase	15	15	15	15	15	15	15	15	15	15	15	15
Maximum Phase	36	36	36	36	36	36	36	36	36	36	36	36
Minimum Symmetry	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22
Maximum Symmetry	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Minimum VOR Gain Reduction												
Frequency 0.04 Hz 												
Minimum Gain	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Maximum Gain	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Minimum Phase	6	6	6	6	6	6	6	6	6	6	6	6
Maximum Phase	24	24	24	24	24	24	24	24	24	24	24	24
Minimum Symmetry	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25
Maximum Symmetry	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Minimum VOR Gain Reduction	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89

Frequency 0.08 Hz ⊗												
Minimum Gain	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Maximum Gain	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Minimum Phase	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Maximum Phase	17	17	17	17	17	17	17	17	17	17	17	17
Minimum Symmetry	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18
Maximum Symmetry	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Minimum VOR Gain Reduction	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Frequency 0.16 Hz ⊗												
Minimum Gain	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Maximum Gain	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Minimum Phase	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Maximum Phase	9	9	9	9	9	9	9	9	9	9	9	9
Minimum Symmetry	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20
Maximum Symmetry	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Minimum VOR Gain Reduction	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Frequency 0.32 Hz ⊗												
Minimum Gain	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Maximum Gain	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Minimum Phase	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Maximum Phase	8	8	8	8	8	8	8	8	8	8	8	8
Minimum Symmetry												
Maximum Symmetry												
Minimum VOR Gain Reduction	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82

Figure 9.7.1 SHA threshold values

9.8 Step rotation tests

Step Rotation tests display threshold values for gain, time constants, and time constant asymmetry.

Reference:

Step Velocity threshold values referenced from the Leen Maes et al. Publication: Normative Data and Test-Retest Reliability of the Sinusoidal Harmonic Acceleration test, Pseudorandom Rotation Test and Step Velocity Test. *Journal of Vestibular Research* 14 (2004) 153–204.

Step Rotation threshold levels ⊕												
Velocity 50°/s ⊗												
Minimum Gain	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Maximum Gain	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Minimum Time Constant	5	5	5	5	5	5	5	5	5	5	5	5
Maximum Time Constant	22	22	22	22	22	22	22	22	22	22	22	22
Maximum Asymmetry	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Velocity 100°/s ⊗												
Minimum Gain	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Maximum Gain	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Minimum Time Constant	5	5	5	5	5	5	5	5	5	5	5	5
Maximum Time Constant	21	21	21	21	21	21	21	21	21	21	21	21
Maximum Asymmetry	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Velocity 180°/s ⊗												
Minimum Gain	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Maximum Gain	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Minimum Time Constant	5	5	5	5	5	5	5	5	5	5	5	5
Maximum Time Constant	21	21	21	21	21	21	21	21	21	21	21	21
Maximum Asymmetry	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29

Figure 9.8.1 Step rotation threshold values

9.9 VOR suppression tests

VOR Suppression Tests display threshold values for minimum gain reduction (%) for both discrete and variable velocity for frequencies 0.04, 0.08, 0.16, and 0.32 Hz.

Frequency 0.04 Hz ⓘ												
Minimum Gain	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Maximum Gain	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Minimum Phase	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
Maximum Phase	21	21	21	21	21	21	21	21	21	21	21	21
Minimum Symmetry	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32
Maximum Symmetry	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Minimum VOR Gain Reduction	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Frequency 0.08 Hz ⓘ												
Minimum Gain	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Maximum Gain	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Minimum Phase	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17
Maximum Phase	16	16	16	16	16	16	16	16	16	16	16	16
Minimum Symmetry	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31
Maximum Symmetry	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Minimum VOR Gain Reduction	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Frequency 0.16 Hz ⓘ												
Minimum Gain	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Maximum Gain	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Minimum Phase	-36	-36	-36	-36	-36	-36	-36	-36	-36	-36	-36	-36
Maximum Phase	9	9	9	9	9	9	9	9	9	9	9	9
Minimum Symmetry	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33
Maximum Symmetry	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Minimum VOR Gain Reduction	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Frequency 0.32 Hz ⓘ												
Minimum Gain	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Maximum Gain	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Minimum Phase	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39	-39
Maximum Phase	2	2	2	2	2	2	2	2	2	2	2	2
Minimum Symmetry												
Maximum Symmetry												
Minimum VOR Gain Reduction	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82

Figure 9.9.1 VOR Suppression threshold values

10 Patient report

10.1 Write report editor

A written report can be created within the VisualEyes™ 515/525 software. This is a word processor that saves the created document in the patient review sessions for later viewing or printing. The write report editor can be accessed from the session review screen by selecting 'Write report' from the Session Review screen.

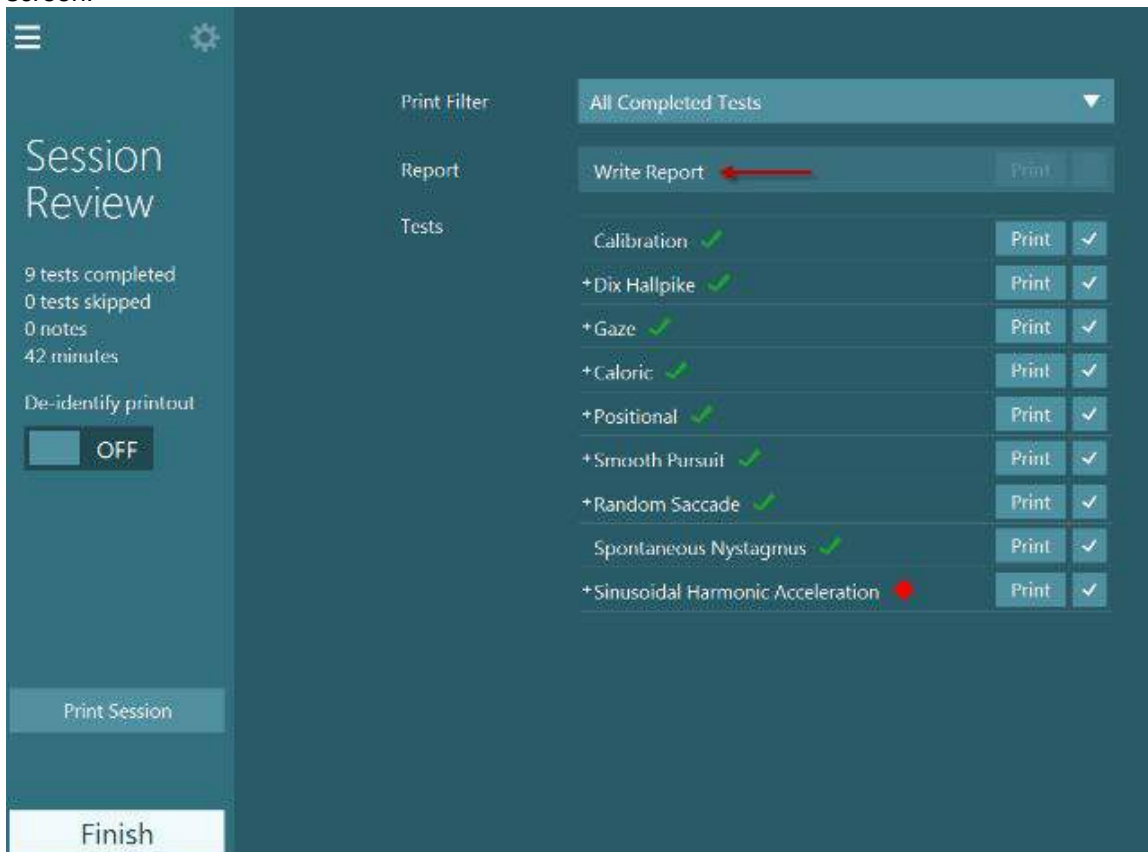


Figure 10.1.1 Write Report feature

10.2 Text styles

The report can be written as per a normal word processor. There are options within the left menu panel 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.

10.3 Templates

The templates section gives the operator an option to customize the patient report using patient information from the OtoAccess database, keywords, and findings templates. Creating a template allows the user to then access the predefined template from the Templates button 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 button to enter the Template Editor.



Figure 10.3.1 Manage templates from the templates menu

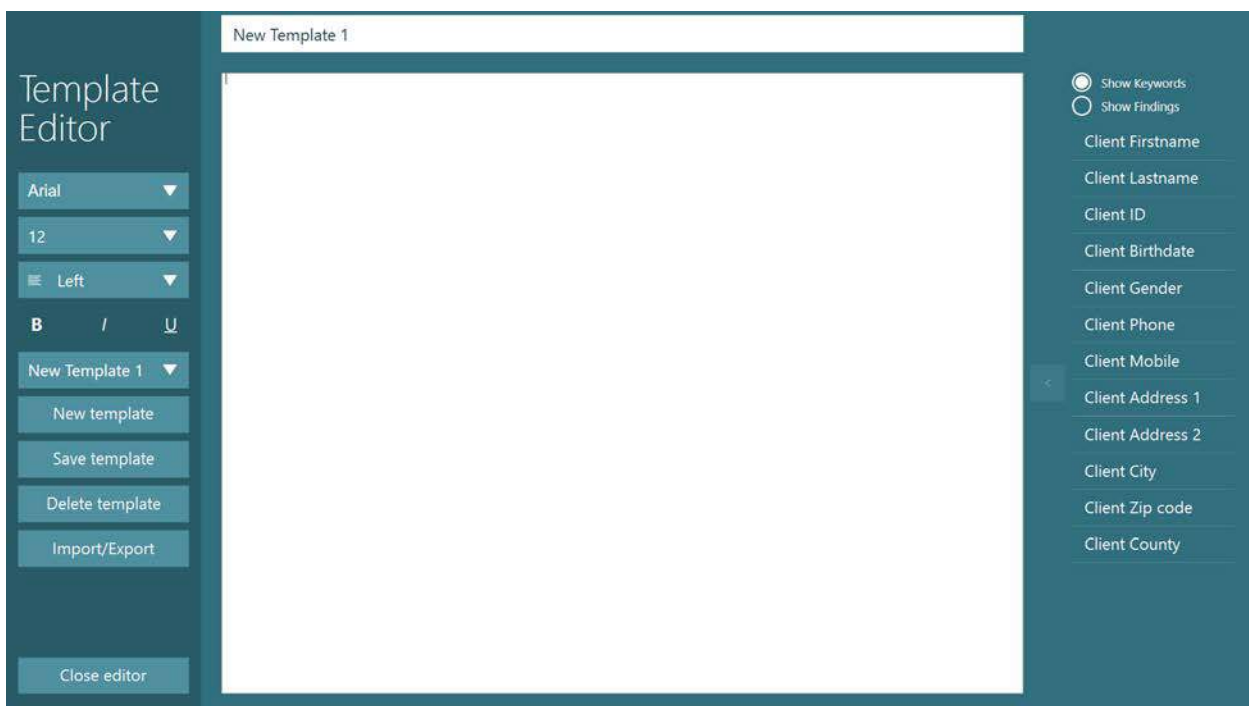


Figure 10.3.2 Template Editor screen

With a new installation of VisualEyes™ 515/525, there are two predefined templates included, Normal VNG and Normal VNG Detailed. To view these templates, select one of the templates from the pull-down box. Otherwise click on the New template button to create a report template.

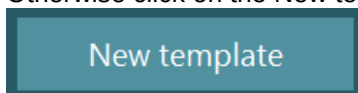


Figure 10.3.3 New template button

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 10.3.4 Add keyword or finding button

Once the template text has been written, tap the Save template button.

Figure 10.3.5 Template Editor displaying sample 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.

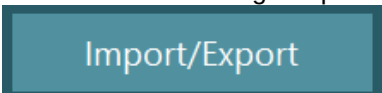


Figure 10.3.6 Import/Export templates button

Tap the Close editor button exit the Template Editor screen and return to the Report Editor screen.

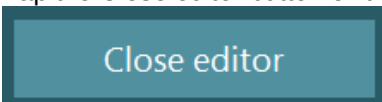


Figure 10.3.7 Close editor button

Within the Report Editor screen, use the Templates selection box and select the template that was created. VisualEyes™ 515/525 will ask to confirm replacing the report with selected report template.

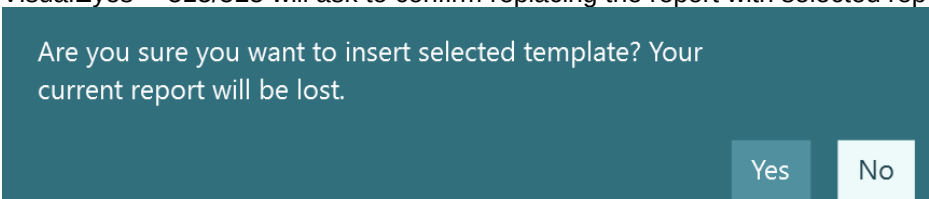


Figure 10.3.8 Confirm insert selected template message

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.

The screenshot shows the 'Report Editor' interface. On the left is a dark teal sidebar with the title 'Report Editor' and several controls: a font dropdown set to 'Arial', a size dropdown set to '12', a direction dropdown set to 'Left', bold (B), italic (/), and underline (U) buttons, and a 'Templates' dropdown. The main area has a teal header with the patient's name 'John Smith'. Below this, the report content is organized into sections: 'Patient:' with fields for Name (John Smith, Male), ID (100), and DOB (12/17/1977); 'Contact Information:' with address (10 Kemp Drive, Suite C, Chatham, 62629, Sangamon), Home Phone (217-483-4533), and Mobile Phone (217-555-0000); 'Reason for Referral:' with a prompt 'Enter reason here.'; 'Current Medications:' with a prompt 'List any current medications the patient is taking.'; and 'Other Important Information:' with a prompt 'List any specific items regarding patient testing or patient history here.'

Figure 10.3.9 Report Editor with example template

10.4 Findings

Findings are predefined templates that can be added into the written report within report editor. They are used to quickly add a comment regarding the patient's test result into the 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 desired finding from the Findings selection menu.



Figure 10.4.1 List of available predefined findings

To add a new finding to the list of findings, choose Manage Findings from the Findings menu. This will launch the Findings Editor screen.

Findings Editor

Calibri ▼

30 ▼

Left ▼

B / U

Abnormal Dix-Hall ▼

New finding

Save finding

Delete finding

Import/Export

Close editor

Abnormal Dix-Hallpike

The Dix-Hallpike maneuver for benign paroxysmal positioning vertigo (BPPV) was positive with the head hanging to the _____. This maneuver provoked a simultaneous burst of nystagmus and vertigo, both of which fatigued upon repetition of the maneuver.

Figure 10.4.2 Findings Editor screen

To create a new finding, tap New finding. A new finding called New Finding 1 will be displayed. Overwrite New Finding 1 in the upper white text box with the desired keyword for the finding. Next enter the text for the finding in the lower white text box. 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. The new finding will now appear within the dropdown menu when selecting the Findings button.

10.5 Save report

Once a report is complete, select the Close editor button to save the report with the patient's current session.

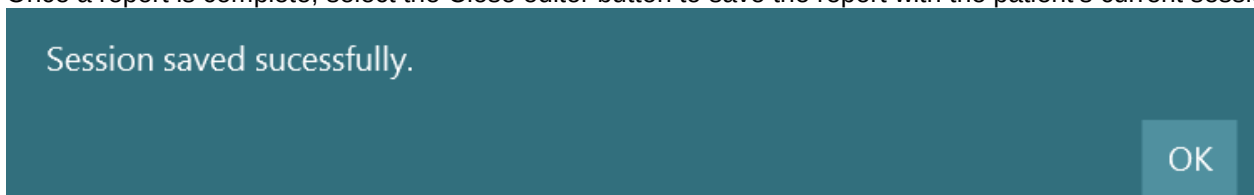


Figure 10.5.1 Session saved confirmation

11 Printing

11.1 Printing results

The VisualEyes™ system gives the option between printing 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.

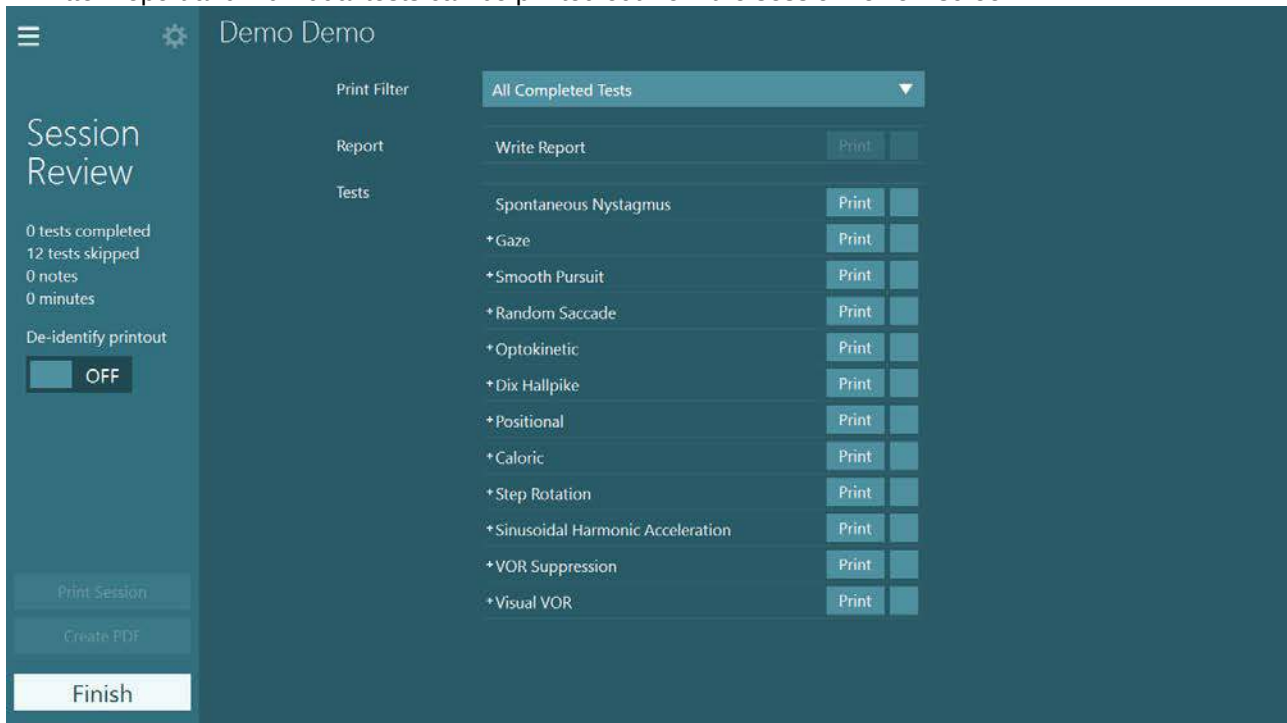


Figure 11.1.1 Session review and printing options

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 to be printed in the report. Tests can be selected individually with the check boxes. Clicking the **Print Session** button will print the report with the selected tests and the clinical report (if a written report has been completed).



Figure 11.1.2 Print button for the whole session

Once printing commences a status bar will appear to show the progress.

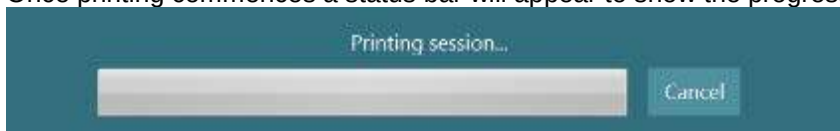


Figure 11.1.3 Icon to show printing progress

11.2 Printing patient demographics

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

11.3 De-identify printout

De-identify printout is available from the Session Review screen. Activating this feature will create the results without displaying vital information about the patient. This allows for patient data to be printed without disclosing any identifiers about the particular patient.

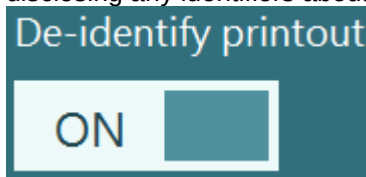


Figure 11.3.1 De-identify printout option

11.4 Printing calibration

Calibration waveforms can be printed for monocular and or binocular recordings and for both horizontal and vertical eye movement calibrations. These wave forms can provide proof of acceptable calibrations vs technical errors.

11.5 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 in the Session Review screen. The printed document will contain the notes for the test only.



Figure 11.5.1 Example of test printed from Session Review screen

11.6 Printing a session

To print all the tests performed within a test session:

- Open the Session Review
- In the left panel menu, select **Print Session**:
- The test data (graphs and a trace segment) for each test performed, along with the clinical report, will be printed

11.7 Printing traces

To print the entire trace for an individual test, open the desired test or subtest from the Session Review screen. A Print Screen button will show up in the left menu panel. Click or touch this button to print the entire trace and graphs for the specific test or subtest.

11.8 Condensed printing

By default, each test completed in VisualEyes™ will be printed on a separate page. However, in System Default Settings this feature can be deselected to reduce the number of pages printed. Refer to 12.9 Print PDF for further explanation.

11.9 Create PDF

By selecting Create PDF the file is saved in the defined data location. For further information see Section 12.9: Print PDF.

12 System default settings

12.1 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.

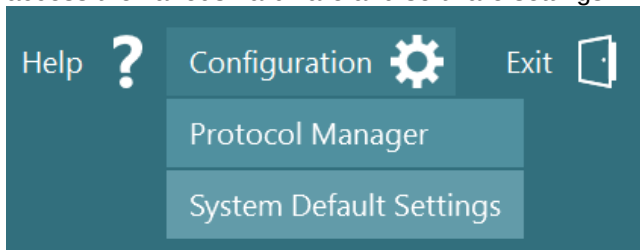


Figure 12.1.1 System Default Settings from Configuration menu

12.2 Hardware

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

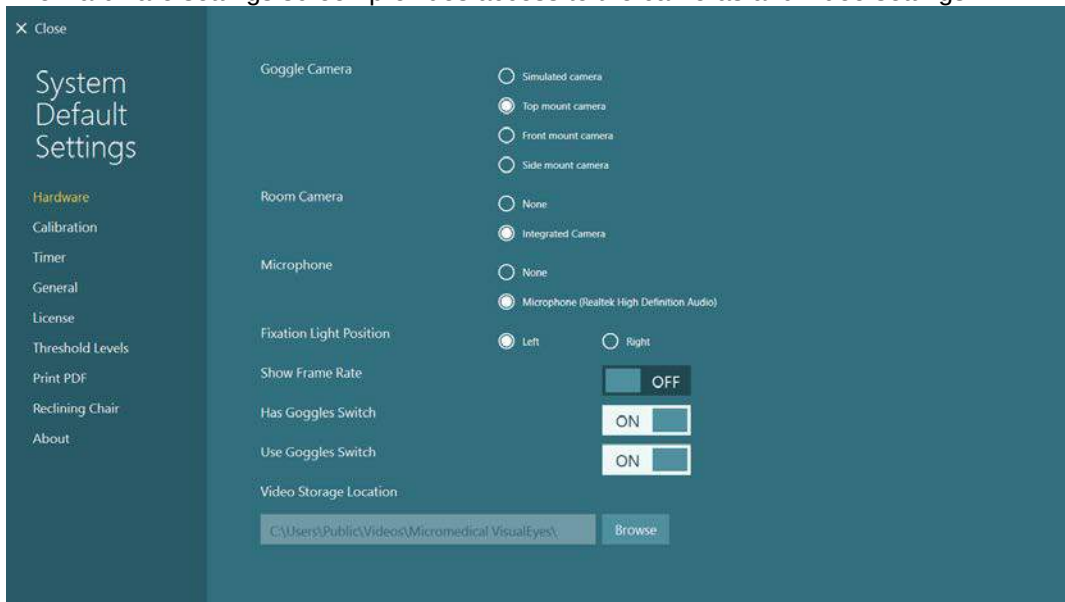


Figure 12.2.1 Hardware settings

The Goggle Camera selection determines which goggle camera is to be used for testing.

- Simulated camera – demonstration option showing only an image of the eyes
- Top mount camera– two cameras
- Front mount camera –single camera
- Side mount camera –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 (Micromedical Binocular) and defines the goggle 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 (Micromedical Binocular). 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.

12.3 Calibration

The Calibration settings for VisualEyes™ 81 systems require a TV or second monitor to be used in conjunction with the VisualEyes™ 81 system. Turning on Enable Monitor allows the calibration stimulus to appear on the TV or monitor, as well as for all oculomotor stimuli during those tests. In addition, the Enable Monitor option showcases the eye recordings and room recording on a second screen during non-oculomotor tests.



Figure 12.3.1 Calibration option to Enable Monitor

The horizontal and vertical angles to be used for calibration, as well as target size, target color, and background color can all be adjusted within Calibration settings.

12.4 Timer settings

The timer settings menu (Figure 12.4.1) presents options to customize the timer function.

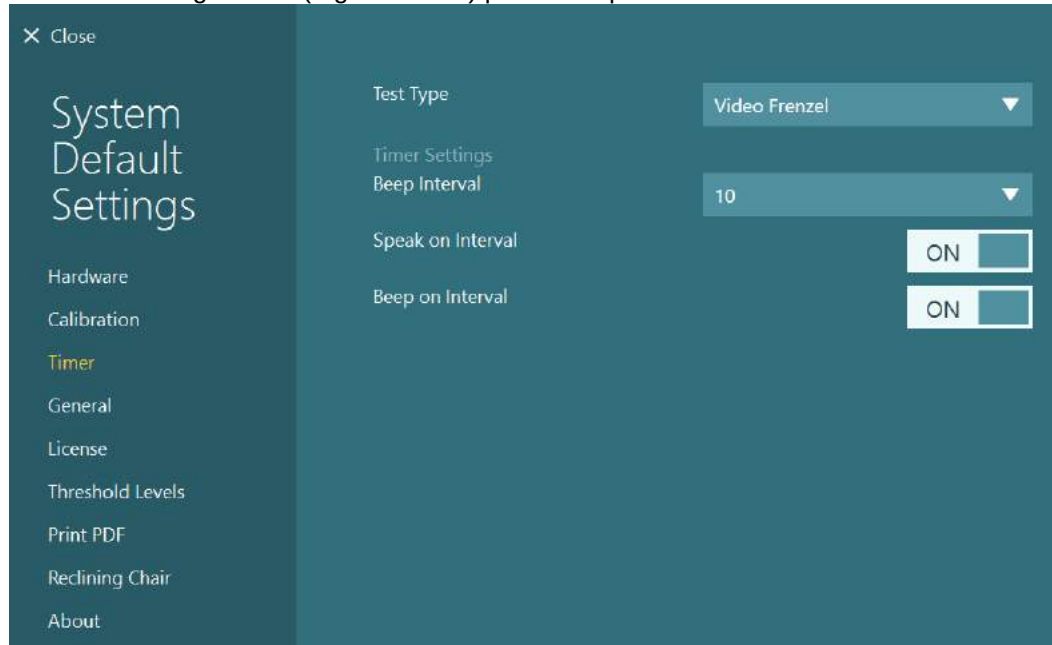


Figure 12.4.1 Timer settings

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.

12.5 General

The General Settings page contains additional program settings.

Display full test list allows the entire session tree with all tests and subtests to be displayed in expanded view. By default the test list is condensed to only show test headings and no subtests beneath the headings. Clicking or touching the plus sign next to the heading then allows for the expansion of all subtests. Enable the Display full test list option to display all permanently.

Highlight nystagmus slow phase option is not enabled by default. To highlight nystagmus slow phases in green, enable this option.

Caloric Color Scheme can be set to temperature (cool irrigations in blue and warm irrigations in red) or set to eye (left eye recordings in light blue for cool irrigations and dark blue for warm irrigations, right eye recordings in light red for cool and dark red for warm).

Language can also be selected within General Settings. Changing the program language will display the text in the selected language. The software supports English, German, Spanish, Chinese, Russian, Portuguese, Japanese, Korean, French, and Danish. The software will have to be restarted when the program language is changed.

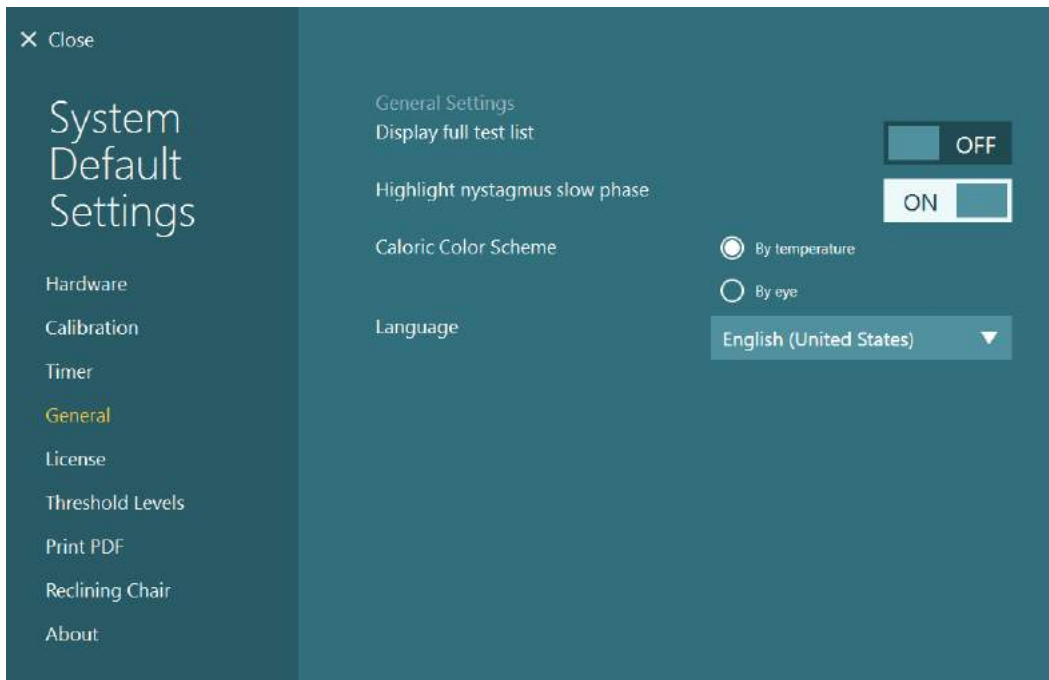


Figure 12.5.1 General settings

12.6 License

The License settings screen allows the user to enter the license keys for the eye cameras. Connect the cameras to the computer, then click or touch the Update button. A dialog will appear with the camera serial numbers that are detected. Enter the license key for the appropriate camera serial number. If a camera serial number should be ignored (e.g. EyeSeeCam camera serial number), click or touch the ignore button beside the license key box for that serial number. The ignore button will then change to yellow. To remove all license keys registered, click or touch the Clear button.

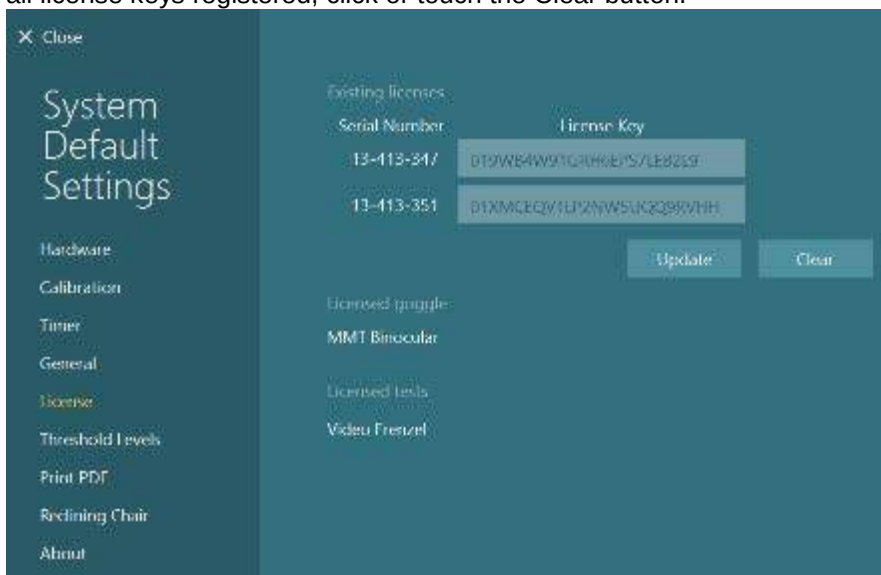


Figure 12.6.1 License settings



Figure 12.6.2 License dialog

12.7 Threshold levels

The Threshold Levels settings screen contains age-matched thresholds for various VNG and Rotary Chair tests. The threshold levels are explained in detail in Chapter 9 Suggested threshold values.

12.8 Reclining chair

The Reclining Chair settings screen provides access to selecting the reclining rotational chair type connected, calibration of the black reclining rotational chair, and the safety limits for the tests that can be performed for patients of different age groups.

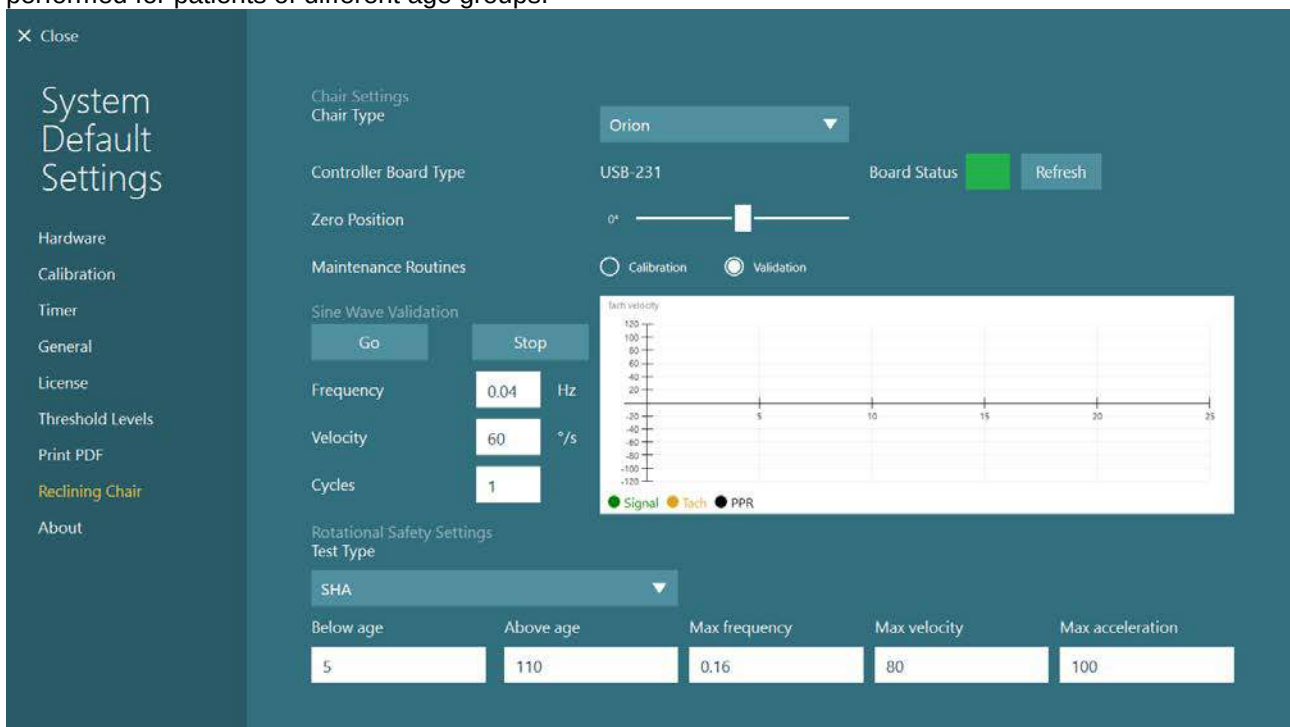


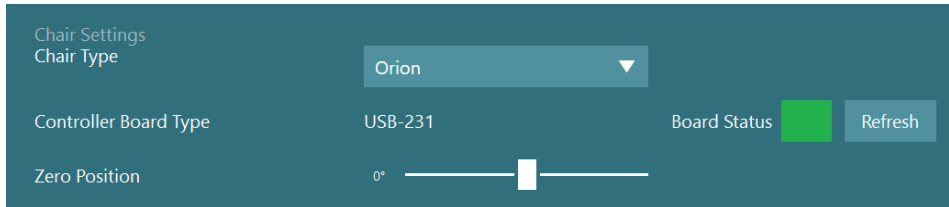
Figure 12.8.1 Reclining Chair settings (Orion chair selected)

12.8.1 Selecting the reclining rotational chair

The VisualEyes™ software supports the Nydiag 200, System 2000 Reclining, and Orion Reclining chairs. If the VisualEyes™ system has a reclining chair option, the Chair Type will need to be selected to match the chair. Nydiag 200 and Orion Reclining chairs can choose a new Zero Position location if the chair needs to be turned away from the zero position to allow the patient to exit the chair easily.

Orion Reclining chair

If the Orion reclining chair is selected, then the Controller Board Type will be using USB-231 board. The Board Status will be green if the chair communication is successful, and will be red if there is an error. The Zero Position is used to align the chair with the center of the TV or projection screen for ocularmotor testing. If the chair is not centered when using the Home Chair button in testing, adjust this slider to have the Home Chair button rotate the chair to this Zero Position instead.



Chair Settings
Chair Type: Orion

Controller Board Type: USB-231

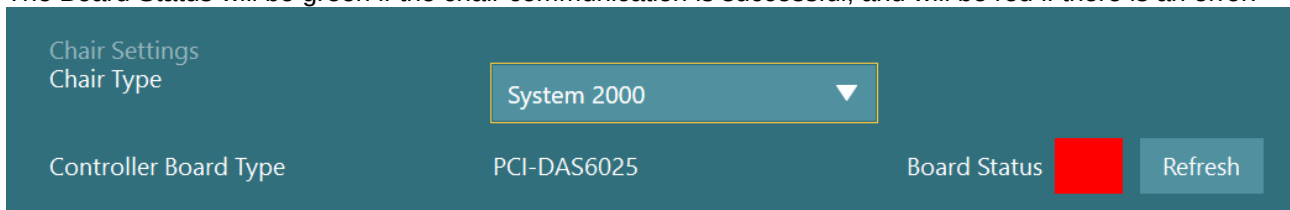
Board Status: ■ Refresh

Zero Position: 0°

Figure 12.8.2 Chair settings for Orion Reclining chair

System 2000 Reclining chair

If the System 2000 Reclining chair is selected, then the Controller Board Type will be using PCI-6025 board. The Board Status will be green if the chair communication is successful, and will be red if there is an error.



Chair Settings
Chair Type: System 2000

Controller Board Type: PCI-DAS6025

Board Status: ■ Refresh

Figure 12.8.3 Chair settings for System 2000 Reclining

Nydiag 200 chair

If the Nydiag 200 chair is selected, then the Gear Reduction value is displayed. This number acts as a gain value for the chair calculated from a separate calibration program. The Zero Position is used to align the chair with the center of the TV or projection screen for ocularmotor testing. If the chair is not centered when using the Home Chair button in testing, adjust this slider to have the Home Chair button rotate the chair to this Zero Position instead.



Chair Settings
Chair Type: Nydiag 200

Zero Position: 0°

Gear Reduction: 15.125

Figure 12.8.4 Chair settings for Nydiag 200 chair

12.8.2 Maintenance routines with System 2000 Reclining and Orion Reclining chair

The VisualEyes™ software calibrates the System 2000 Reclining chair and Orion Reclining chair to accurately spin the patient at the desired velocity and frequency. If the software has reported a calibration error during testing, or the reclining chair has not been calibrated yet, then select the Calibration option to view the calibration tests.

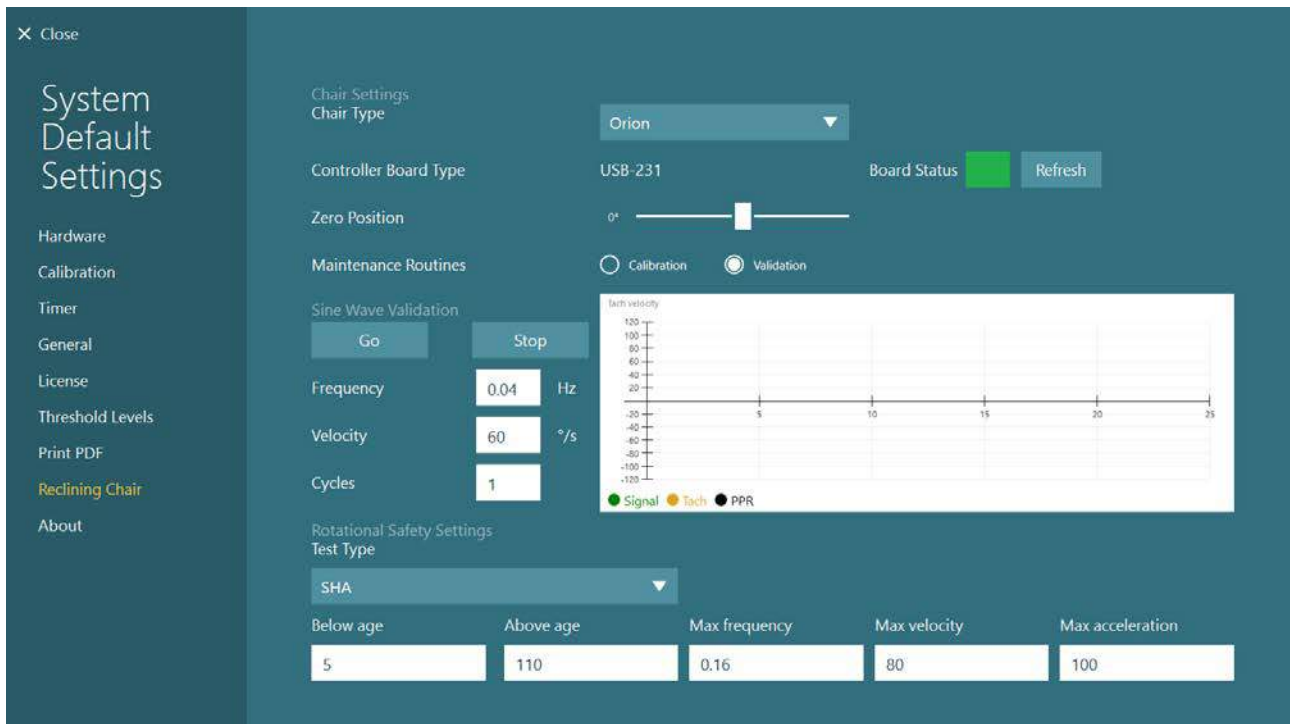


Figure 12.11 Reclining chair maintenance routines (Orion Reclining chair)

Drift calibration

Click or touch the Go button for the Drift Calibration to verify the chair does not drift (turn slowly) when enabled. The signal trace (green line) and the tachometer trace (yellow line) will be displayed in the graph. Adjust the Drift Offset value using the triangle buttons to adjust the chair offset to make the traces coincide. When they coincide, click or touch the Stop button to end the drift calibration test.

Velocity Tach calibration

Once the chair's drift has been corrected, click or touch the Go button for the Velocity Tach Calibration. The software will then spin the chair to optimize the Signal Voltage and Tach Voltage values to synchronize the traces. After two spins past the chair's zero position (seen by the deflections in the PPR trace), the software will stop the chair and update the signal and tach voltage values. Click or touch the Stop button to clear the traces from the graph or stop the test early.

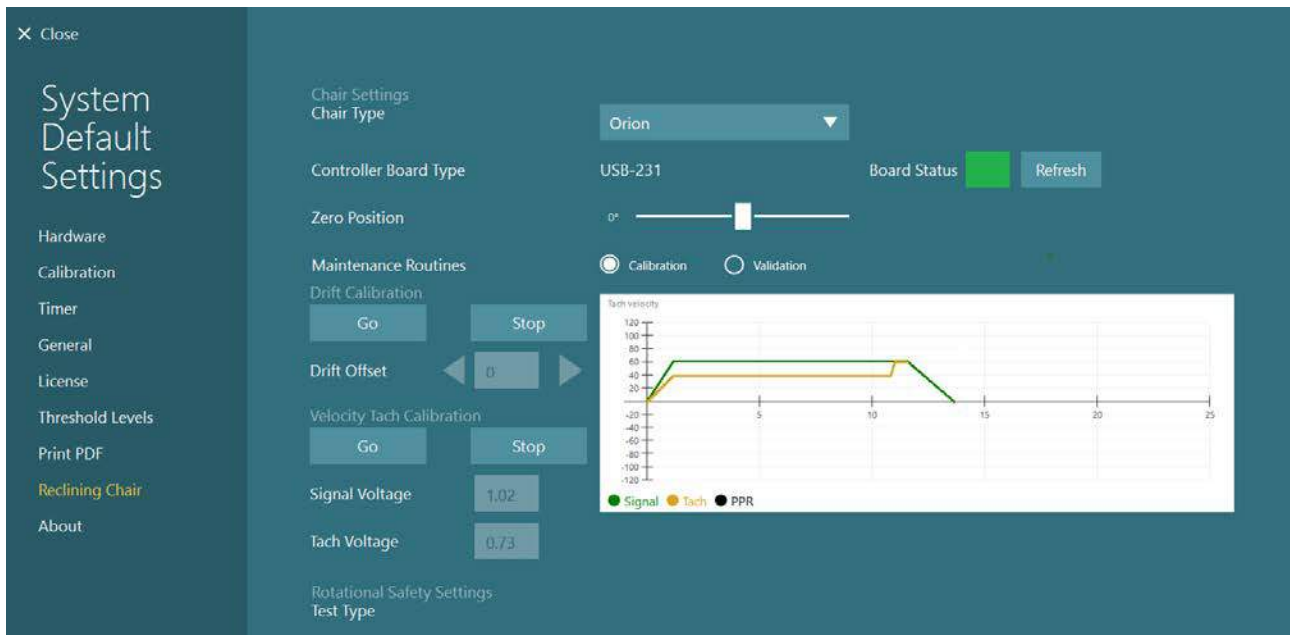


Figure 12.8.5 Velocity Tach calibration (Orion Reclining chair)

Sine wave validation

Once both calibration tests have been performed, select the Validation option for the maintenance routines to perform the Sine Wave Validation test. Click or touch the Go button to run a sinusoidal test for one cycle at 60 degrees per second at 0.04 Hz. These settings can be adjusted if necessary. The chair will rotate using the calibrated settings and should have the signal and tach traces appear superimposed. If the traces are not adequately aligned, perform the calibration tests again.

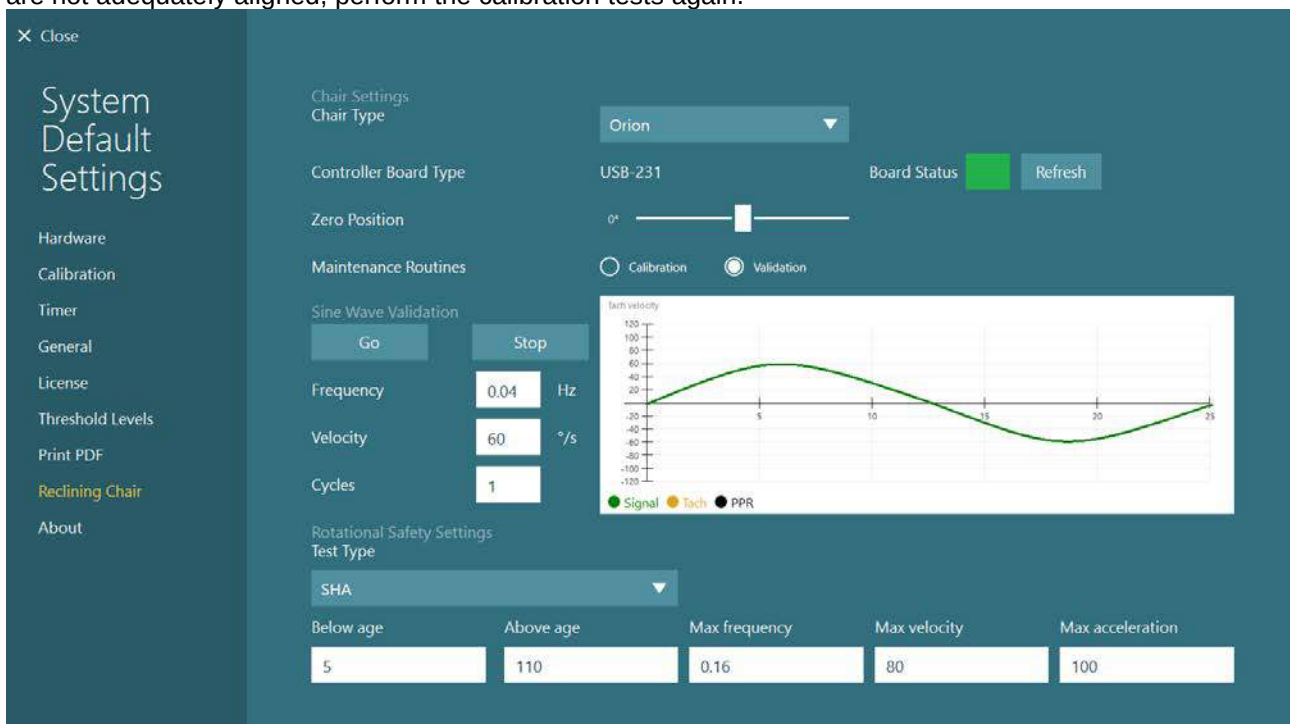


Figure 12.8.6 Sine Wave Validation (Orion Reclining chair)

12.8.3 Rotational safety settings

Young patients may be tested in the reclining rotational chair. For the patient's safety, the reclining rotational chair will not allow faster tests to be performed for young patients. The software is configured to prevent the test from running if the patient's age falls within the values (Figure 12.8.7). In step tests the Max frequency is set to 1 as the setting is not used in step tests.

Rotational Safety Settings				
Test Type				
SHA ▼				
Below age	Above age	Max frequency	Max velocity	Max acceleration
5	110	0.16	80	100
Step ▼				
Below age	Above age	Max frequency	Max velocity	Max acceleration
5	110	1	60	100
VOR Suppression ▼				
Below age	Above age	Max frequency	Max velocity	Max acceleration
5	110	0.16	80	100
Visual VOR ▼				
Below age	Above age	Max frequency	Max velocity	Max acceleration
5	110	0.16	80	100

Figure 12.8.7 Rotational safety settings for each chair test

Using these default values, a patient below the age of 1 cannot be tested in Step tests with a max velocity greater than 60 degrees per second. If the patient would be prepared to perform a step test with a velocity of 60 degrees per second, when the test would be started, the software would block the clinician from testing and give an error message (Figure 12.8.8).

Velocity is set to 100 which exceeds the recommended value for a patient below 5 years

OK

Figure 12.8.8 Warning message preventing the clinician from testing a young patient based on the test settings

12.9 Print PDF

The Print PDF settings screen provides access to automatic PDF document creation settings.

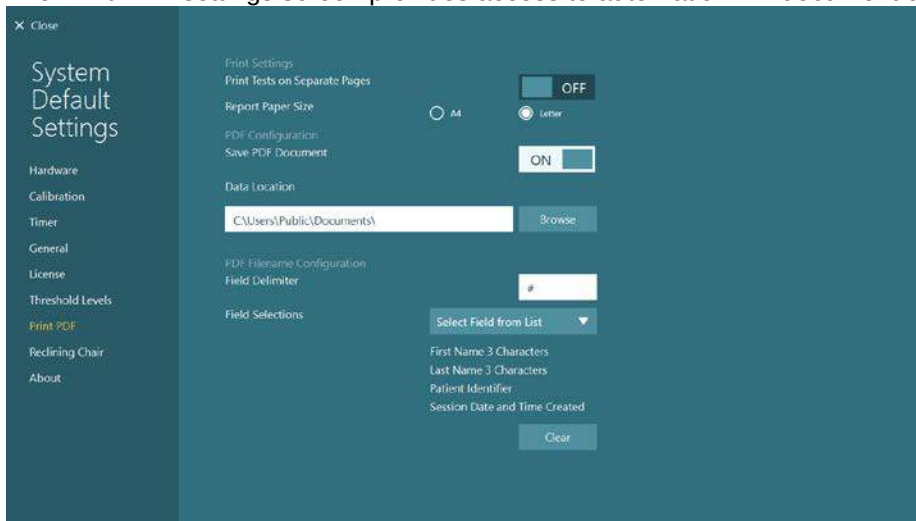


Figure 12.9.1 Print PDF settings

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™ 61 systems to reduce the extra space printed between tests, as only the notes are printed for video Frenzel tests.

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.

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:
 - o First Name 3 Characters
 - o Last Name 3 Characters
 - o Module (Micromedical VisualEyes™)
 - o Patient Identifier
 - o Report Date and Time Created
 - o Session Date and Time Created
 - o Session Identifier

12.10 About this software

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

13 Other functions

13.1 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 13.1.1 Help button

13.2 Exit button

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

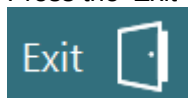


Figure 13.2.1 Exit button