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The Evolution of Fundus Automated Perimetry

Company Profile

CenterVue designs and manufactures highly automated medical devices for the diagnosis and management of ocular pathologies, including those that represent the leading causes of blindness.

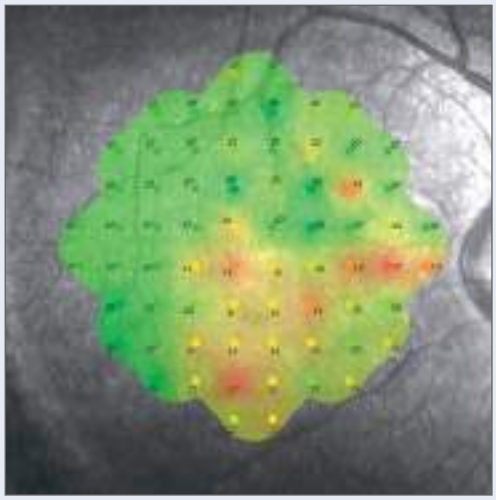
Our goal is to design Smartly Simple devices and to provide high-value services that enable Eye Care Specialists to better preserve patients' sight and quality of vision, in particular by detecting preventable diseases; and in so doing dramatically improve their quality of life.

CenterVue is headquartered in Padova, Italy, with the US branch in Fremont, California. CenterVue is present in over 70 countries with its distribution network.

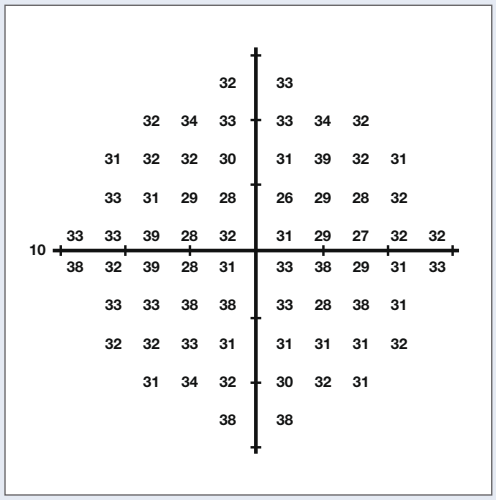
Fundus related perimetry

Fundus related perimetry is a technique that images the retina during visual field testing, enabling a correlation to be made between visual function and retinal structure.[1]

Advantages of Fundus Automated Perimetry[2] over Standard Automated Perimetry include reduced test – retest variability, increased sensitivity to early deficits, the possibility to measure sensitivity at specific retinal locations, higher accuracy in the description of scotomas and of course the simultaneous assessment of function (expressed by retinal sensitivity) and structure (images of the ONH and of the retina). Fundus Automated Perimetry also provides a simultaneous, quantitative assessment of fixation characteristics.



Example of 10-2 Fundus Automated Perimetry



Example of 10-2 SAP

Use of Fundus Automated Perimetry in the clinical management of glaucoma has been limited so far, as available systems were lacking compliance with the standards of automated perimetry.

COMPASS overcomes such limitations and brings visual field analysis to the next level!

In particular COMPASS, for the first time, extends field coverage to 30° + 30° and employs luminance parameters and a sensitivity scale as used in standard automated perimetry.

[1]Crossland et al., 2012 [2]Also referred as "microperimetry"

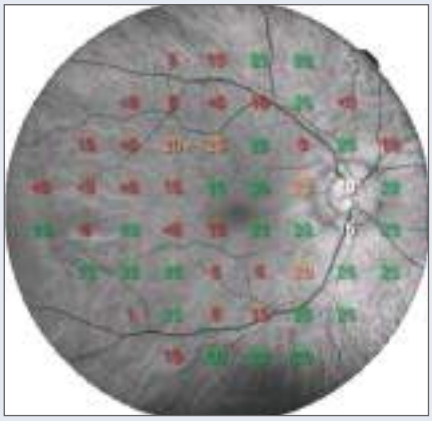
Introducing COMPASS

The first automated perimeter capable of performing standard 24-2 visual field testing and delivering true color confocal images.

COMPASS is a scanning ophthalmoscope combined with an automatic perimeter that provides confocal images of the retina, as well as measurements of retinal threshold sensitivity, under non-mydriatic conditions.

Compatibility with standard 24-2 visual field testing

As a perimeter, the system offers full compatibility with standard 24-2 visual field testing and contains an age-matched database of retinal sensitivity in normal subjects.

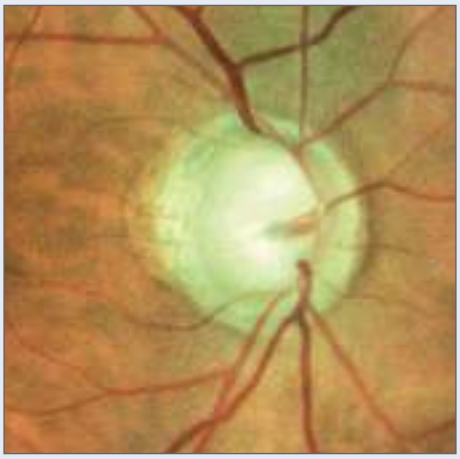


24-2 test performed with Compass

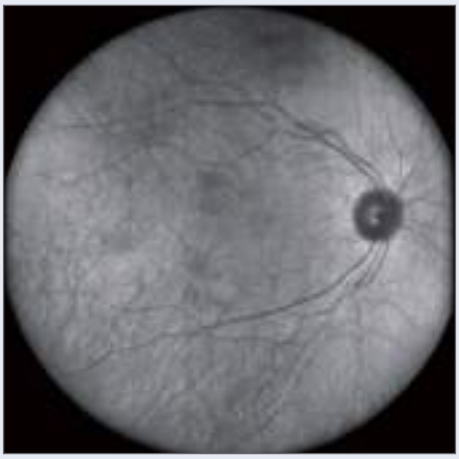
Superior quality of color and red-free images

As a retinal imager, COMPASS uses a confocal optical design, similarly to SLO systems, to capture color as well as red-free images of superior quality.

In addition, a high resolution live image of the retina obtained using infrared illumination is available throughout the test.



Color image: detail of the ONH



Infrared image

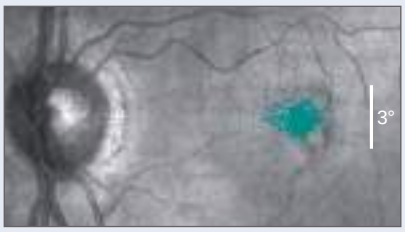
Red-free image: detail of the RNFL

Retinal Tracking

Retinal tracking is at the heart of Fundus Automated Perimetry.

Infrared images, acquired at the rate of 25 images per second, allow for continuous, automated, tracking of eye movements, with positional accuracy in the 10-20 microns range. Determination of eye movements yields to Fixation Analysis, where the location of the functional site of fixation and its stability are computed. Fixation analysis is unique to Fundus Automated Perimetry. Retinal tracking also yields to active compensation of fixation losses, with perimetric stimuli being automatically re-positioned prior to projection based on the current eye position. This mechanism is critical to reduce test-retest variability and ensure accurate correlation between function (i.e. retinal threshold values) and structure (retinal appearance).

Compensation of eye movements takes place before and during the projection of a certain stimulus. In absence of this mechanism, a normal 2-3 degrees shift in eye position occurring at the time of projection of a certain stimulus would easily produce an artifact in VF results, with a wrong sensitivity being reported at that specific location.

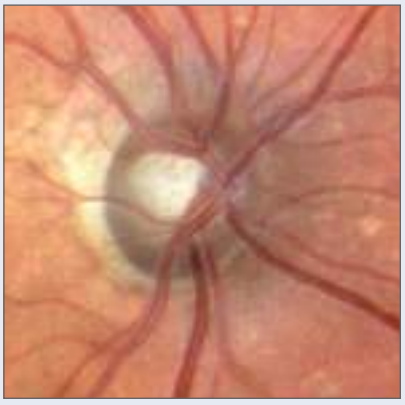


Plot of eye movements during VF testing

Color confocal imaging

SLO systems are superior to conventional fundus cameras in many ways, as they exploit a confocal imaging principle, which limits the effect of backscattered light from deeper layers and provides enhanced image quality in terms of contrast and resolution. Another major advantage of SLO systems is that they operate with much smaller pupils than non-confocal instruments. At the same time, though, SLO systems do not provide color images, as they typically employ monochromatic laser sources, resulting in black and white or pseudo-color images. Differently from existing SLO systems, Compass uses white light instead of monochromatic lasers, hence providing true color images and offering high fidelity to real retinal appearance. Compass images improve the diagnostic capabilities in the management of glaucoma as they offer:

- no need for pupil dilation
- excellent resolution and contrast
- high quality even in presence of media opacities, such as cataract
- optimized exposure of the ONH



Color image: detail of the ONH

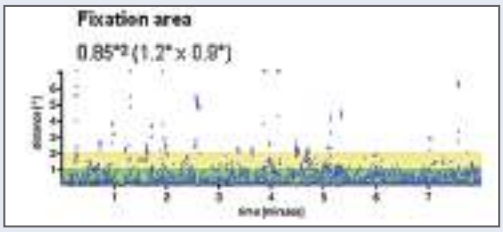
Non-confocal imaging: detail of the ONH

Fixation Analysis In Glaucoma

Studies have demonstrated abnormal fixation characteristics in patients diagnosed with early Primary Open Angle Glaucoma (POAG) and Advanced Glaucoma without other retinal diseases.

For example, fixation instability has been demonstrated in early and moderate POAG [1], while other studies have reported predominantly eccentric fixation in up to 15% of the studied population with advanced glaucoma [2]. Finally, it is known that fixation stability and its location correlate with visual acuity, in particular the more unstable and eccentric fixation is, the lower visual acuity [3].

Fixation analysis with Compass provides additional, quantitative, parameters for assessing visual function.



1. Shi Y, Liu M, Wang X, Zhang C, Huang P (2013) Fixation behavior in primary open angle glaucoma at early and moderate stage assessed by the MicroPerimeter MP-1. Journal of glaucoma 22 (2):169-173. 2. Kameda T, Tanabe T, Hangai M, Ojima T, Aikawa H, Yoshimura N (2009) Fixation behavior in advanced stage glaucoma assessed by the MicroPerimeter MP-1. Japanese journal of ophthalmology 53 (6):580-587. 3. Morales MU, Saker S, Mehta RL, Rubinstein M, Amoaku WM (2013) Preferred retinal locus profile during prolonged fixation attempts. Can J Ophthalmol 48 (5):368-374.

Benefits

- High-resolution confocal imaging of the ONH and of the central retina
- Combined structure and function analysis
- Significantly reduced test – retest variability
- Reliable follow-up
- Fully automated operation
- Comprehensive and clear printout
- Operator friendly
- More patient comfort: test can be suspended at any time without data loss

Features

- Pupillary tracking
- Fixation control using automated high-resolution, 25 Hz, retinal tracking
- Auto-focus
- Fully automated, visual field testing (24-2, 10-2, custom)
- Automatic follow-up
- Confocal, 60° imaging
- Color, red-free, infrared imaging
- Patient vocal guidance during VF testing
- Quantitative analysis of Fixation
- Wired/WiFi connectivity
- Touch-screen operated via tablet
- Non-mydriatic operation

COMPASS Printout

The comprehensive printout features traditional visual field maps combined with unique FAP structure & function analysis and real time retinal tracking performance.

Legend

1 Patient info

2 Exam info

3 Examined eye

4 Threshold values over red-free retinal Image

5 Color image of ONH

6 Mean Deviation and Pattern Standard Deviation

7 Mean Deviation separately for 6 clusters

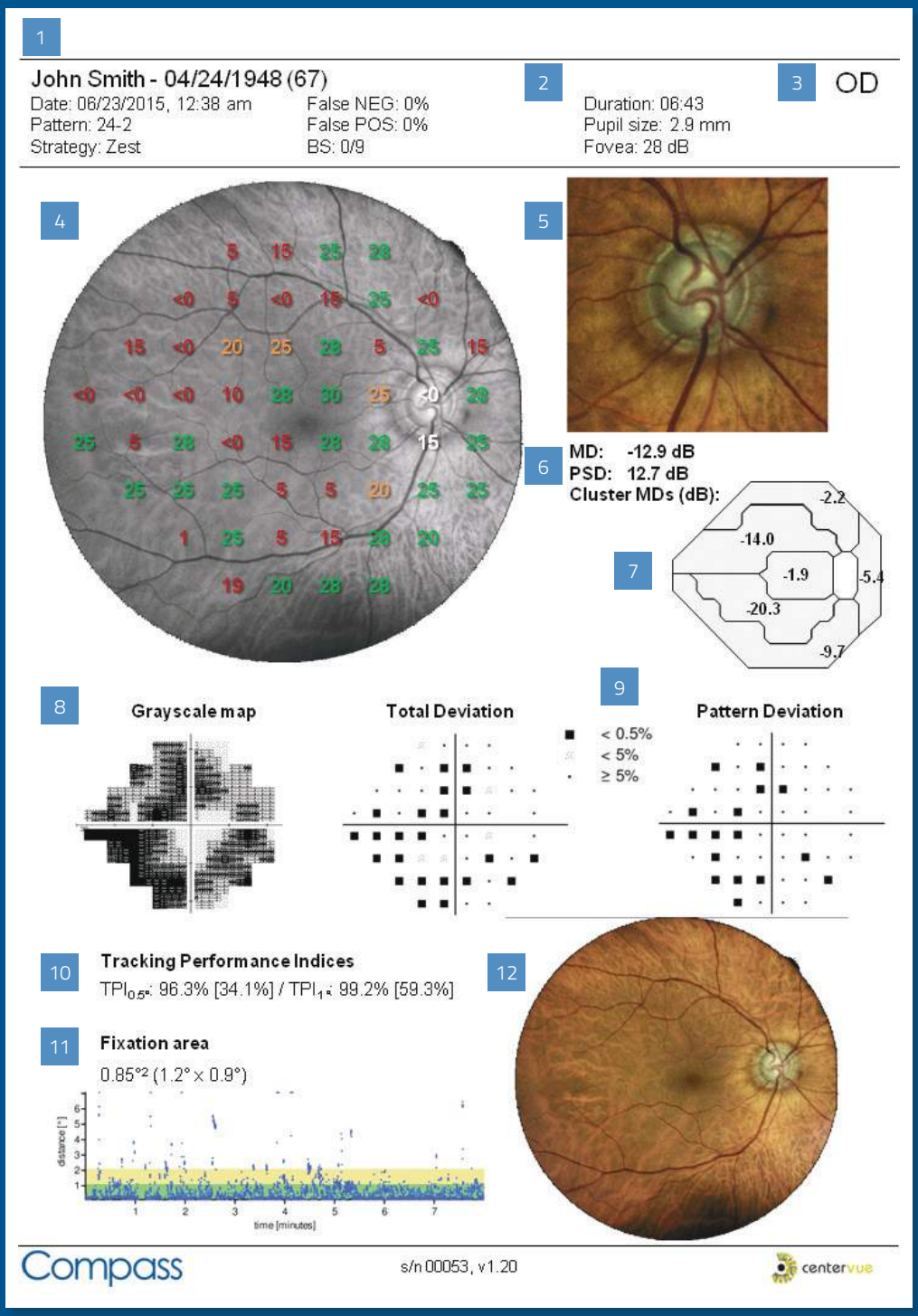
8 Standard VF map

9 Deviation maps

10 Retinal Tracking Performance results

11 Fixation area and graph describing amplitude of eye movement vs. time

12 True-color 60° confocal fundus image



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The smartly simple approach

COMPASS performs the entire 24-2 test, including capture of infrared, red-free and color retinal images, in a fully automatic way.

The complete process includes:

- automated alignment of the instrument to the patient, using bilateral pupil tracking;
- auto-focus, correcting for the patient's spherical refraction;
- automated acquisition of live, infrared, retinal images;
- automated execution of the VF test;
- automated collection of fixation data throughout the VF test;
- automated compensation of eye movements during VF testing, using retina and pupil tracking;
- automated acquisition of a color retinal image, including auto-exposure;
- the only intervention by the operator during the process is the selection of the center of the ONH.

Ergonomic and motorized chin rest. Improved cleaning ability of the patient rest cushions.

Touch screen interface and high resolution, 2560x1600 pixel display.

The patient push button is designed for improved ergonomics.

Connectors on the back include 3 USB ports and 1 Ethernet port.

Digital joystick is used for manual alignment and focusing.

Technical specifications*

Class and type of applied part

1, B (according to EN 60601-1).

Fundus Automated Perimetry:

- Projection field: 30° (radius)
- Background luminance: 31.4 asb
- Maximum luminance: 10000 asb
- Dynamic range: 0 - 50 dB
- Stimulus size: Goldmann III (26")
- Stimulus duration: 200 ms
- Threshold tests: 24-2, 10-2
- Fixation control: 25 Hz automated retinal tracking
- Foveal threshold testing
- Automatic pupil measurement

Fundus Imaging:

- Field of view: 60° (diameter)
- Sensor resolution: 5 Mpixel (2592x1944)
- Light source: infrared (825-870 nm) and white LED (440-650 nm)
- Imaging modalities: color, infrared, red-free
- Resolution: 17 microns

Other features:

- Automatic operation: auto-alignment, auto-focus, auto-retinal tracking, auto-pupil tracking, auto-exposure, auto-capture
- Non-mydriatic operation: minimum pupil size 3 mm
- Working distance: 28 mm
- Auto-focus range: -12D to +15D
- Fixation target: programmable, internal
- User interface: Tablet multi-touch screen
- Connectivity: Wi-Fi and Ethernet
- Printer: any printer compatible with Tablet
- Hard disk: SSD, 240 GB

Dimensions:

- Weight: 25 Kg
- Size: H 620 X W 590 X D 360 mm

Electrical requirements:

- Power: 100-240 VAC, 50-60 Hz
- Consumption: 80 W

CE 0123

* Specifications are subject to change

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