Ultrawide field perimetry and imaging comparison

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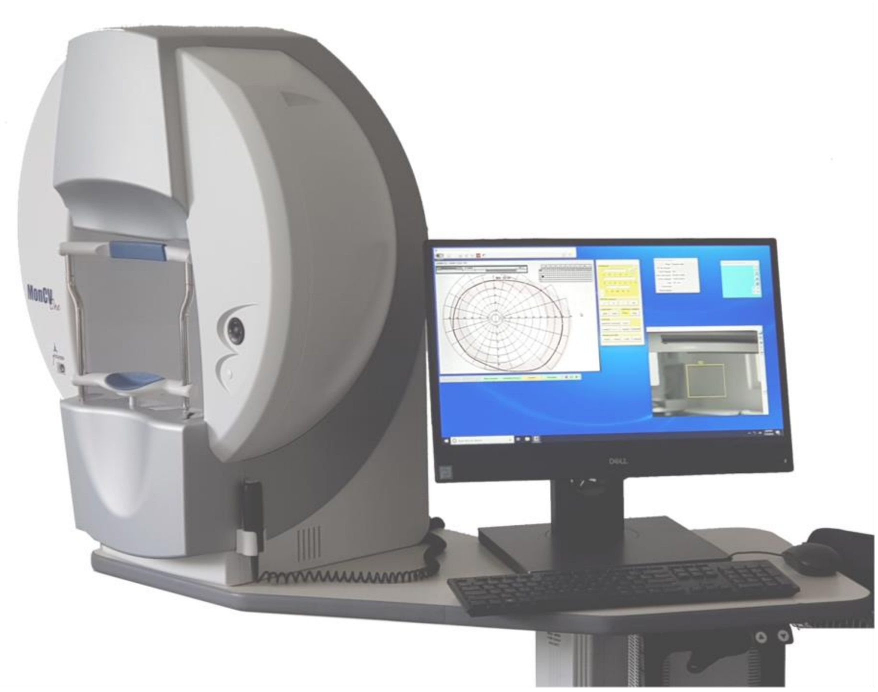
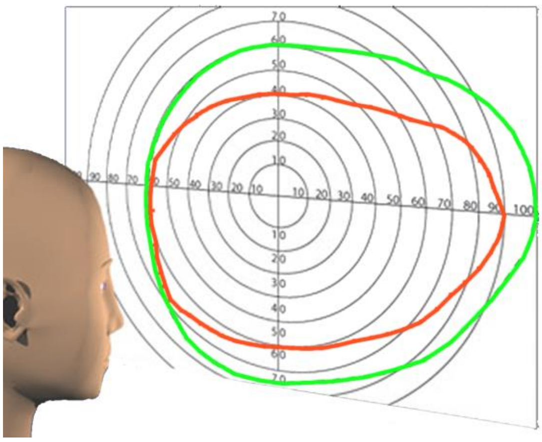


CONTENT

Ultra-wide field (UWF) visual field perimetry

The MonCvONE perimeter allows the projection of visual stimuli up to the true limits of the visual field.

(degrees)	MonCvONE limits	HFA3 limits	Normal limits
Temporal	105	89	~105
Up	60	40	~60
Down	70	60	~70



Comparison of visual field range in standard perimetry (red) and MonCvONE (green)

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The recent development of UWF imaging techniques has triggered a regained interest for the far peripheral retina:

1- studies using ultra-wide field imaging have found peripheral lesions in numerous diseases such as retinitis pigmentosa, retinal vein occlusion, age-related macular degeneration (QUINN & al, 2019, FORSHAW & al, 2019)

2- studies have shown that far peripheral vision does have some functional importance due to the presence of a cone-rich rim (WILLIAMS, 1991, MOLLON & al, 1998).

3- studies related to negative dysphotopsia showing that far peripheral vision, beyond 60 degrees of visual angle, is important to the evaluation of peripheral dark shadows seen by some patients with intraocular lens (SIMPSON, 2017).

As usual, it is of interest to compare structure and function. For this reason, new tools have been implemented on the MonCvONE perimeter to allow the superposition of UWF images and UWF perimetry results.

This new feature can be used

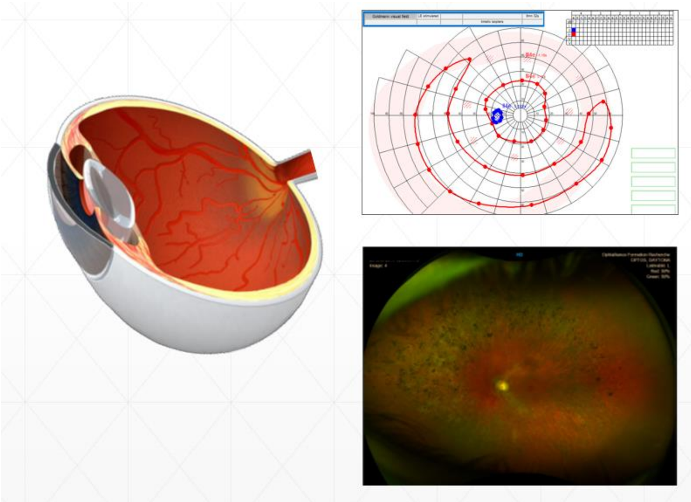
1- to import the eye fundus image and thereafter run a visual field test on top of the image

2- to perform a comparison of the visual field result and the eye fundus image and to quantify the resulting deficits

Superposition of UWF perimetry and imaging

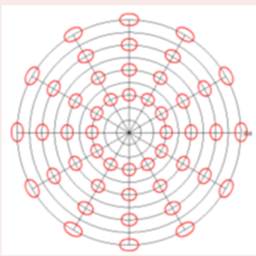
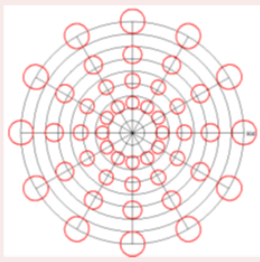
Comparing eye fundus images with visual field maps allows a better understanding of the relationship between structure and function. The technique using the positions of the fovea and papilla as references (BEK, 1990) provides reasonably good results for the central retina with an accuracy of 0.5 degrees (BEK, 1990) even with ametropic eyes and changes in visual field magnification resulting from the correction of refractive errors.

However, this approach is not suitable for large field imaging and perimetry, the reason being that different projection methods are used to convert the 3D retina (which may be assimilated to a sphere) in the 2D representations of perimetry and imaging (Figure below).



Conversion of the 3D retina to the 2D representation of the visual field (top right) and imaging (bottom right)

The projection technique used for perimetry is the Azimuthal equidistant projection whereas the projection used for wide field imaging is the stereographic projection.
Each of these techniques presents some problems (table below):

Projection technique	Azimuthal equidistant	Stereographic
Application	Perimetry	Wide field imaging
Representation of circular retinal scotoma		
Default	Does not respect scotoma shape and scotoma area	Does not respect distances and scotoma area

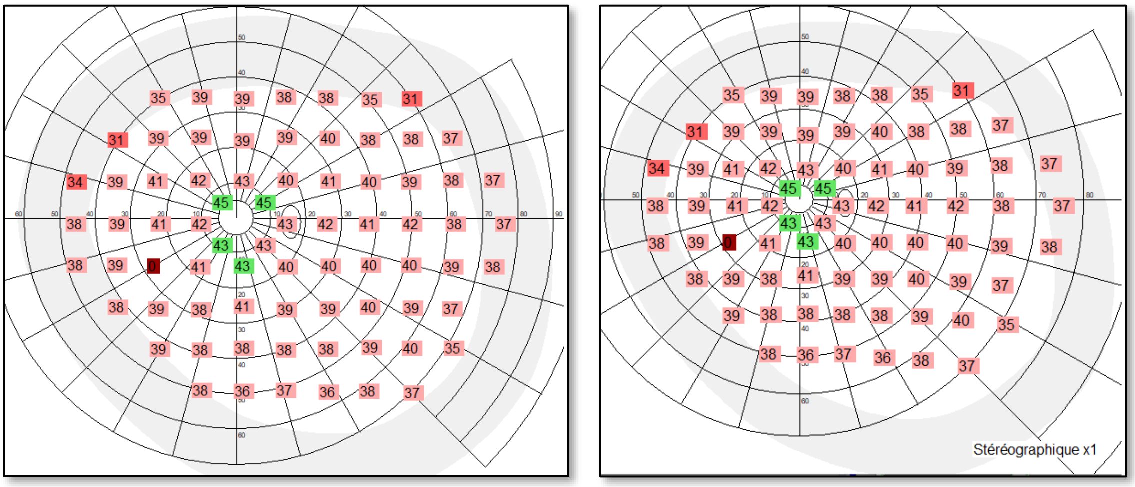
Projection of a deficit with a circular shape and covering a constant area on the retina

The azimuthal equidistant technique used for perimetry does respect distances along meridians but, at large eccentricities, the shape of scotoma is elongated along the parallels.

In contrary, the stereographic technique does respect the shape of scotoma but distances along meridians appear elongated at large eccentricities.

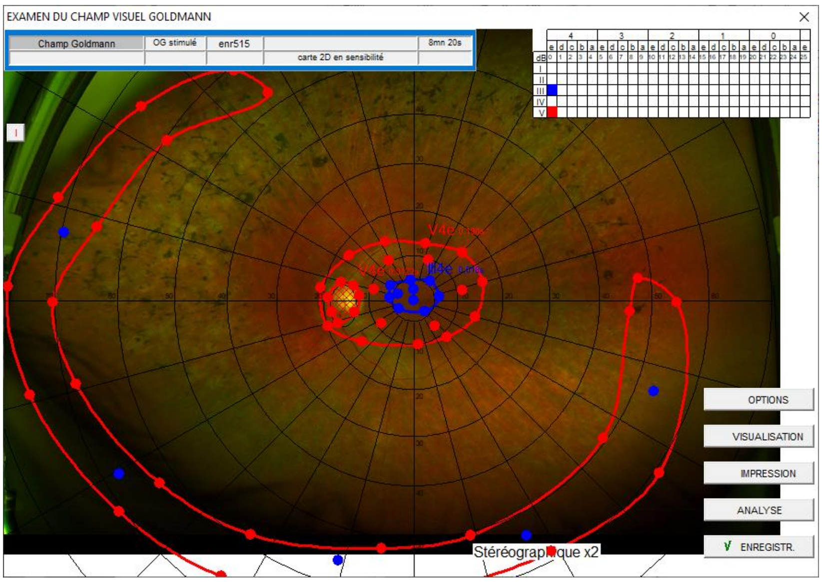
In both cases, the surface area of deficit is not respected: at 80 degrees eccentricity the surface area is increased by 40 percent for perimetry and 190 percent for imaging.

The software of the MonCvONE allows the selection between the two projection modes for the display of the visual field maps (figure below).



Visual field map with the "classic" Goldmann projection (left) and with the stereographic projection (right)

The stereographic projection mode can then be used to import images from wide field imaging systems and run the visual field exam with the eye fundus image displayed in the background (figure below).

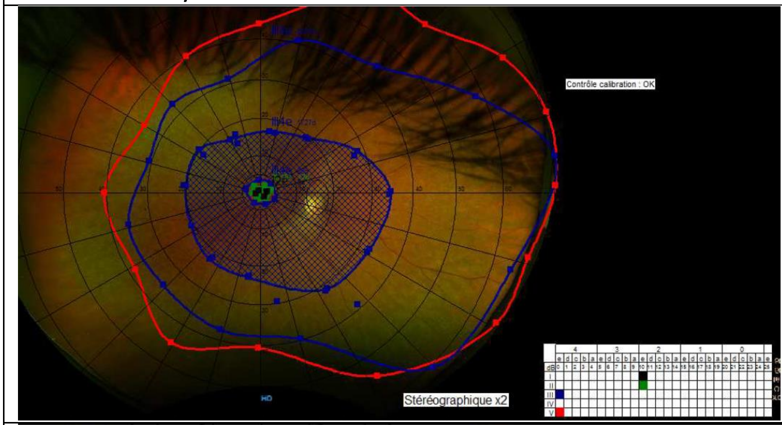
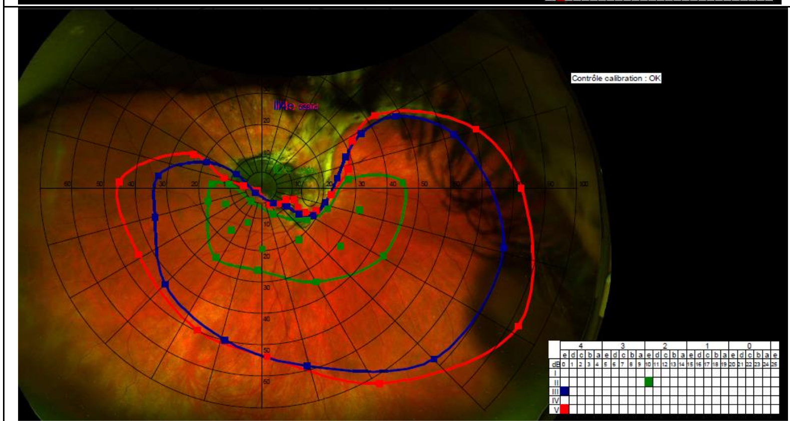
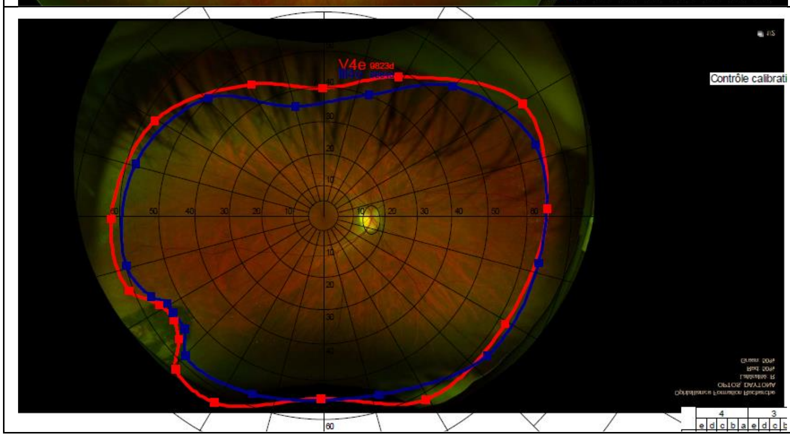


Kinetic perimetry exam superimposed upon the eye fundus image imported in stereographic mode. Note the increase of distances along meridians at large eccentricities

Clinical examples

Results from tests performed by Dr ZANLONGHI, ophthalmologist and Mr. Tanguy BIZEAU, clinical research technician both at Clinique Jules Verne, Nantes

Images imported from the OPTOS ultra-wide field imaging system compared with the results of manual perimetry.

Result of analysis	Description
	Patient with retinitis pigmentosa.
	
	peripheral laser scar (bottom left of the image)

References

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MOLLON J.D., REGAN B.C., BOWMAKER J.K. What is the function of the cone-rich rim of the retina? Eye. 1998, 12, 548-552.

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