Eccentric correction improves the visual function in subjects with larger central visual field loss
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Optometrist and Physicists teamwork
- Jörgen Gustafsson, clinical experience of low vision rehabilitation
- Peter Unsbo and Linda Lundström, developing methods to evaluate off-axis aberrations
- Physicists on the Royal Institute of Technology, KTH, Stockholm, Sweden

Peripheral vision compared to central vision
- Retina: low resolution capacity
  - The primary limitation
  - Help: magnifying devices
- Optics of the eye: poor image quality
  - Important when eccentric aberrations are large
  - Additional help: eccentric correction

When the macula is not working
- Eccentric Viewing
- Preferred Retinal Location (PRL)
- Absolute CFL, lower VA than LogMAR 1.0 (decimal 0.1 20/200, 6/60)

Raytracing in the eye model of Liou & Brennan
Image (spotdiagram) on the retina without and with eccentric correction: sphere and cylinder
Measuring the peripheral optics of the eye

Aim
To find and correct the aberrations in the preferred retinal location (PRL) of subjects with large central field loss.

Methods
- Photorefraction with the PowerRefractor
- Peripheral wavefront aberrations with a Hartmann-Shack (HS) sensor.

PowerRefractor
- Photorefraction and fixation target
- The first results showed that the residual vision could be improved when the oblique astigmatism was corrected

Laboratory wavefront analyser
Hartmann-Shack sensor

- Wavefront aberrations
- Calculation of refraction
  - RMS (root mean square) optimization not useful because of the large aberrations
  - Optimization of the point spread function of the eye

Eccentric measurements

- Poor fixation
  - Fixation targets
  - Eyetracker
- Large wavefront aberrations
  - Set-up specially designed
  - Software unwrapping
- Elliptical pupil shape

Eccentric refraction: defocus and astigmatism

Results from a subject with a PRL 20° off-axis

Central correction

Sph. –3.75 D

Decimal VA 0.04   (20/400)        LogMar 1,4

Eccentric fixation 18° to the right with O.S.

Eccentric correction

Sph. –2  Cyl. –3 ax 90°

Decimal VA 0.063   (20/320)   LogMar 1,2

Eccentric fixation 18° to the right with O.S.
Peripheral Visual Evaluation PVE

- Resolution:
  - Numbers
  - High and low contrast

- Detection:
  - Gratings
  - High and low contrast

Eccentric refraction – Visual function measurements

Results

- 12 CFL subjects corrected with eccentric correction
- 8 showed an improvement in visual acuity: about 0.2 logMar
- Some show larger improvements for low contrast optotypes
- The threshold value for detection show improvement depending on the cause of the visual impairment
- 6 subjects wear their correction regularly

Summary

- Off-axis optical errors have to be evaluated individually at the used PRL
- Eccentric refraction is calculated from peripheral wavefront measurement
- Different visual functions are evaluated with the PVE tests
- Eccentric correction can improve the peripheral visual function in subjects with large CFL

Outlook

- More cases need to be evaluated
- Clinical off-axis Wavefront analyser
- Correction of higher order aberrations
- Psychophysical methods for evaluation of very low residual visual functions
References