Regional differences in parafoveal cone density distribution investigated with a compact adaptive optics ophthalmoscope

Marco Lombardo[1], Giuseppe Lombardo[2,3], Sebastiano Serrao[1], Domenico Schiano Lomoriello[1], Pietro Ducoli[1]

[1] IRCCS Fondazione G.B. Bietti Onlus, 00198 Rome (Italy)

[2] CNR-IPCF Unit of Support Cosenza, LiCryL Laboratory, University of Calabria, 87036 Rende (Italy)

[3] Vision Engineering, 89123 Reggio Calabria (Italy)

mlombardo@visioeng.it, giuseppe.lombardo@cnr.it, serrao@serraolaser.it, dodoschiano@libero.it, p.ducoli@tin.it

Purpose

The parafoveal variations in human photoreceptor cells distribution and spacing along the horizontal meridian passing through the fovea has been analyzed in twelve healthy young subjects using a compact flood illumination Adaptive Optics Ophthalmoscope (*rtx1* retinal camera, Imagine Eyes, Orsay, France).

Methods

The *rtx1* retinal camera was used to obtain images in 12 subjects, 6 emmetropes (mean age: 30.86 ± 5.76 yrs; mean axial length, Axl: 23.35 ± 0.49 mm; mean spherical equivalent refraction, SEr: -0.13 ± 0.20 D) and 6 myopes (mean age: 30.67 ± 5.35 yrs; mean Axl: 25.14 ± 0.94 mm; mean SEr: -3.96 ± 1.04 D). Both eyes of each subject were imaged to resolve the photoreceptor cells mosaic within 5° visual angles along the horizontal meridian passing through the fovea.

The acquired images were stitched together to create a larger montage image of the photoreceptor mosaic. Photoreceptors density (cells/mm^2) and center-to-center cell spacing (um) were estimated at 24 fixed locations at specific eccentricities (± 0.5°, ± 1°, ± 2° and ± 4°) from the fovea throughout these montages. At each retinal location, fixed 50 um^2 window sizes were used for photoreceptor counting, assuming an uniform density distribution within the sampling window. A combination of both manual and automated methods was used for analyzing the photoreceptor mosaic using ImageJ (version 1.45a). Center-to-center cone spacing was calculated from density by assuming that photoreceptors are arranged in a perfect hexagonal lattice. Statistics was performed using the SPSS software (version 17.0).

Results

The *rtx1* retinal camera was successful in imaging the photoreceptor cone mosaic in all eyes. The cones within 0.5° eccentricity remained unresolved in most eyes.

A statistically significant decrease ($p<0.001$) in photoreceptor density with eccentricity was measured in all subjects. A nasal-temporal symmetric decline in photoreceptor density and spacing was measured in both emmetropes and myopes. A systematic local packing distribution of photoreceptors was observed in all eyes, with a higher cone density ($p<0.001$) in the half/superior retinal locations than in the half/inferior locations across the horizontal meridian passing through the fovea.

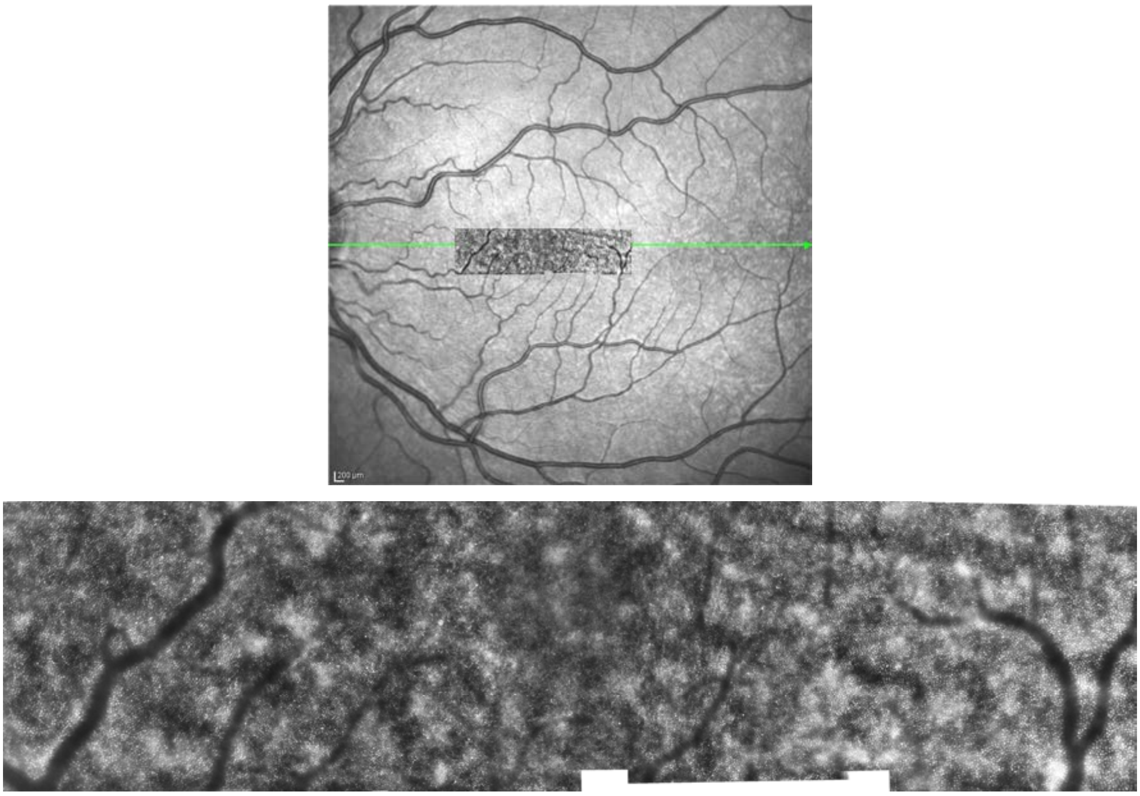

Fig. 1. The left eye of an emmetropic subject, 30-yrs old. In the upper, the SLO image with the superimposed AO retinal montage. In the lower, from left to right, the corresponding photoreceptor mosaic montage of the parafoveal region (retinal area: 3.6 x 0.92 mm).

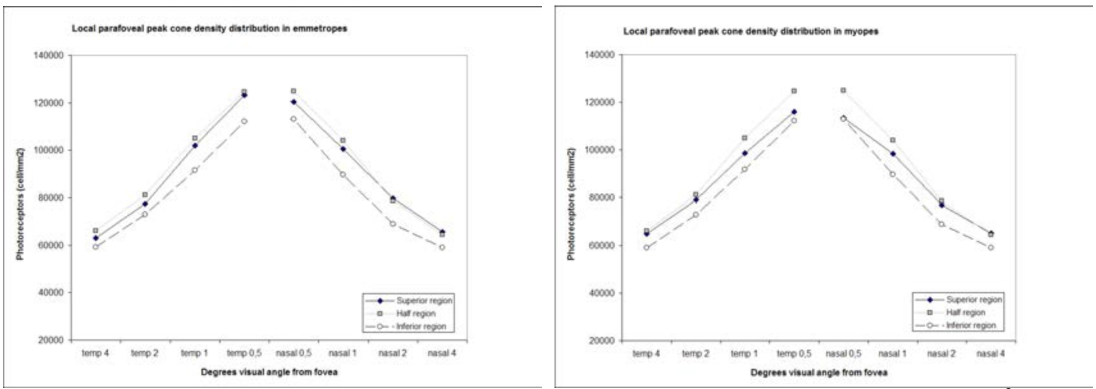

Fig. 2. The mean peak cell packing density decreases from a mean of 120.000 cells/mm^2 to 65.000 cells/mm^2 from 0.5° to 4° eccentricities in both study groups. A lower cone packing density in the inferior locations of the horizontal meridian than in superior was measured in all eyes. The cone de nsity decline was almost symmetrical between nasal and temporal regions of the retina.

Conclusions

The *rtx1* retinal camera represents one of the for mer compact adaptive optics ophthalmoscope prototypes available for research purpose into the clinical environment. In this study, we observed a sy stematic regional distribution of parafoveal cones along the horizontal meridian passing through the fovea.