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During eye growth, defocus reduces until optical blur is similar to the resolution of the cone photoreceptors

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Purpose Emmetropization is an active process of reduction of defocus, regulated by the optical image on the retina. Rather than the value of defocus approaching zero, a non-zero error has been reported in humans and by us in an animal models. Here we explore the relationship between optical blur and cone photoreceptor sampling in the growing chick eye with and without imposed defocus blur.
Methods The right eyes of fifteen Ross Ross chicks were goggled with -15D lenses on the day of hatching and the left eye grew normally. All measurements were performed from day 9 to 21. Measurements of axial length, using A-scan ultrasound and aberrations and defocus, using a Hartmann-Shack aberrometer were made. The total optical blur and the portion due to spherical defocus and total defocus were estimated from the equivalent blur. Cone photoreceptors were imaged close to the area centralis using adaptive-optics. Angular cone density and angular cone row spacing (RS) were calculated from the images. Point spread functions (PSF) were calculated using Matlab. Data from previous measurements on chick eyes unilaterally googled with a -15D lens were also analyzed.
Results Cone row spacing decreases exponentially to threshold values in both eyes at a slower rate than blur and the decrease was not significantly different between eyes. Optical blur reduces exponentially to threshold values in both control and goggled eyes which did not differ significantly. Cone row spacing changed little after day 14. The estimate of the threshold value of total blur was not significantly different from the cone resolution (2X cone row spacing) in either the goggled or control eyes. After day 14, the estimate of total blur did not differ significantly from the cone resolution in the control eye but optical blur appeared slightly higher than cone resolution in the goggled eye. There was a significant difference in astigmatism between control and goggled eyes on every day ($P<0.001$).
Conclusions Defocus from the goggle does not affect the change with age of cone density. Optical blur reduces to a value above zero, indicating a small amount of residual defocus. This value of optical blur matches or slightly exceeds the amount that can be resolved by the photoreceptor array, indicating that cone photoreceptor density determines the minimum blur achieved.

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