Contribution ID: **750** Type: **Oral (Non-Student) / orale (non-étudiant)**

The Rate of Reduction of Defocus in the Chick Eye is Proportional to Retinal Blur

Tuesday 16 June 2015 08:45 (15 minutes)

PURPOSE. Calculations of retinal blur and eye power are developed and used to study blur on the retina of the growing chick eye. The decrease in defocus and optical blur during growth is known to be an active process. Here we show that the rate of defocus reduction is proportional to the amount of blur on the retina.
METHODS. From literature values of chick eye parameters, the amounts of defocus and optical axial length were fitted as a function of age. Pupil size was used to calculate blur on the retina due to defocus. Eye length and calculated eye power were compared up to day 75 to examine their contributions to decreasing retinal blur. Novel equations were used to calculate eye power and a new definition of the end point of active defocus reduction is introduced.
RESULTS. During initial growth, eye length increases while blur from defocus decreases. Eye power decreases exponentially reaching and closely matching eye length after day 35. This gives an almost stable value of defocus beyond day 50. Retinal blur decreases almost exponentially until between days 40 and day 50. After day 50, angular retinal blur changes in agreement with predictions of a uniformly expanding eye model and passive growth.
CONCLUSIONS. Concurrent variations in eye power and length produce smaller changes in defocus. We define the time at which angular retinal blur becomes stable as the completion of active reduction of defocus. Prior to this time, the rate of defocus reduction is proportional to the amount of blur on the retina. After this time, the measured eye properties are consistent with uniform eye expansion and angular blur is close to the presumed resolution limit of the cone photoreceptors. The eye power calculation presented is accurate and simpler than other approaches without the need for additional dimensional data.

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Session Classification: T1-11 Medical Imaging (DMBP) / Imagerie médicale (DPMB)

Track Classification: Medical and Biological Physics / Physique médicale et biologique (DMBP-DPMB)