4386 - A0113

Threshold versus intensity functions in two-color perimetry

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PURPOSE

- To determine the adaptational state and isolation of rod- and cone-mechanisms in two-color perimetry, a technique developed for assessing visual function in inherited retinal disease.[1,2]

METHODS

- Seven subjects aged from 16 to 46 years of age, all with normal vision and normal ophthalmic examination were examined using a MonCV Perimeter (MetroVision, Paris, France).
- Subjects underwent pupil dilatation with tropicamde 1% and were dark-adapted
- Visual field tests were undertaken under scotopic conditions and then from -1.5 log cd.m to 2 log cd.m^{-2} (white background) in 0.5 log unit steps.
- Sensitivities were determined using a 4-2-2 dB staircase for 480nm and 640nm Goldmann size V targets at 17 locations within the central 60 degrees, including fixation, (±3°, ±3°), (±9°, ±9°), (±15°, ±15°), (±21°, ±21°).
- The generated data were converted to log trolands and fitted with threshold versus intensity (tvi) functions of the form: $\log T = \log T_0 + \log((A+A_0)/A_0)$, where T is threshold, T_0 is absolute threshold, A is background intensity and A_0 is the "dark-light" constant and n is a gain constant.
- Assumptions regarding the identity of detection mechanisms were based in part on our previous study of spectral sensitivity under scotopic, mesopic and photopic conditions.[3]

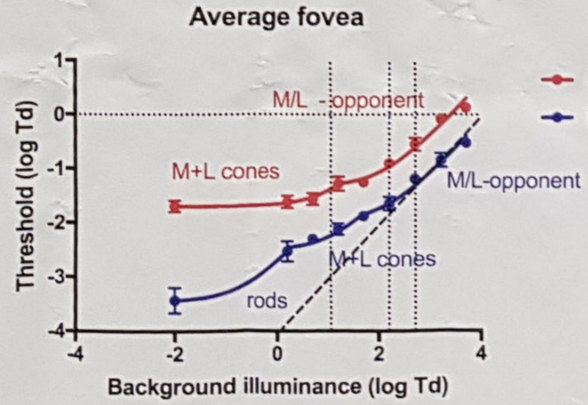

Figure 1. Threshold versus background retinal illuminance at the point of fixation for Goldmann Size V targets presented on a white background. Data are fitted with tvi curves (see text). Vertical dashed lines from left to right indicate retinal illuminances for standard mesopic perimetry (3.2 cd.m^{-2} background) and standard photopic perimetry (10cd.m^{-2} background) through a natural and a dilated pupil respectively.

RESULTS

- Testing was completed in less than 1.5 hours for all subjects.
- No clear rod-cone break was observed for 640nm stimuli at any stimulus location (Figure 1, Figure 2).
- For 480nm stimuli at all stimulus locations, there was evidence of transition from rod-detection to cone-detection at mesopic illumination levels (Figure 1, Figure 2).
- Cone-mediated detection mechanisms did not display Weber behaviour until the background luminance approached 1 log cd.m^{-2} (Figure 1, Figure 2).

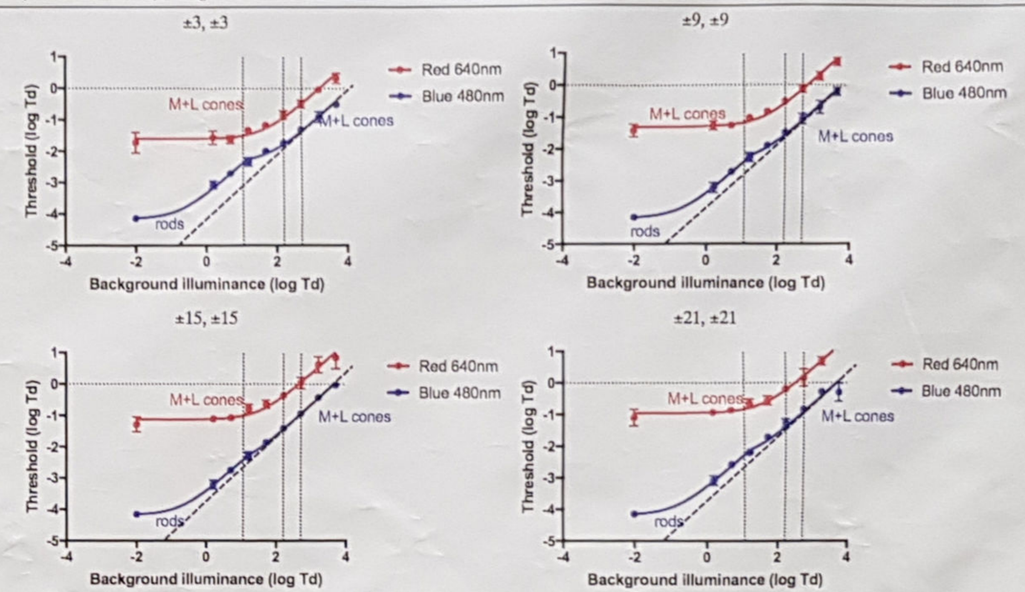

Figure 2. Threshold versus background retinal illuminance at (±3°, ±3°), (±9°, ±9°), (±15°, ±15°), (±21°, ±21°) for Goldmann Size V targets presented on a white background. Data are fitted with tvi curves (see text). Vertical dashed lines from left to right indicate retinal illuminances for standard mesopic perimetry (3.2 cd.m^{-2} background) and standard photopic perimetry (10cd.m^{-2} background) through a natural and a dilated pupil respectively.

CONCLUSIONS

- Under the conditions typically employed in two-color perimetry, 640nm targets are primarily detected by the cones under all background conditions; 480nm targets, however, appear to be detected by rods until mesopic background illumination levels are reached. These data are in keeping with previous observations utilising spectral sensitivity testing at fixed background intensities.[3]
- Our results also show that the tvi functions do not display Weber-like behaviour until photopic illuminations levels are reached (1 log cd.m^{-2}).
- Because of the adaptational states of detection mechanisms under scotopic, mesopic and photopic conditions, any process causing a so-called "filter effect"[4] will result in pseudo-selective loss of scotopic and mesopic thresholds and may lead to erroneous conclusions regarding the selectivity of functional loss in clinical two-colour perimetry.

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DISCLOSURES: None.

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