The effect of flicker adaptation on contrast sensitivity in the inferred magnocellular visual pathway in glaucoma patients

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1. INTRODUCTION

Contrast sensitivity deficits in the inferred magnocellular visual pathway have been reported in glaucoma patients [1]. Studies have also showed temporal desensitization (i.e., reduction of contrast sensitivity) in the magnocellular pathway from flicker adaptation [2, 3].

PURPOSE: To investigates whether flicker adaptation would cause a larger temporal desensitization effect in glaucoma patients as compared to visually normal subiects.

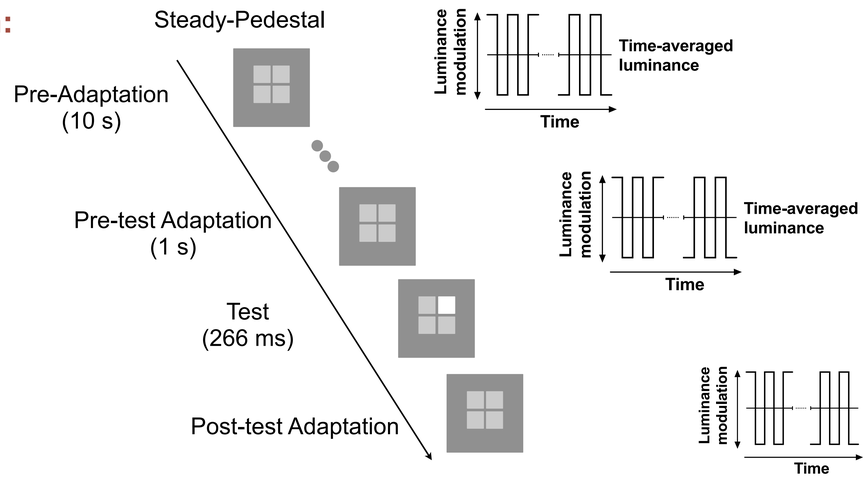
2. METHODS

Observers: Two groups of subjects, a glaucoma patient group and an age-matched control group with 9 subjects in each, were tested.

Stimuli: The steady-pedestal paradigm was used [4]. A pedestal of four 1°x1° squares with a predefined luminance (15.0, 16.86, 18.88, 21.19, or 23.77 cd/m^2) in a background at 15.0 cd/m^2.

Apparatus: An apple computer and a 21" NEC CRT monitor.

Paradigm:



Task and Threshold Estimation: To identify the test square that differs from the other three in a 4AFC double-random staircase procedure, with the average of last six reversals taken as the estimate of contrast threshold.

Adaptation Conditions:

- **Non-flicker:** Steadily present pedestal at a predefined luminance (15.0, 16.9, 18.9, 21.2, or 23.8 cd/m^2).
- **Flicker:** **7.5 Hz** square-wave luminance modulated pedestal at time-averaging luminance of 15.0 cd/m^2 and 50% contrast.

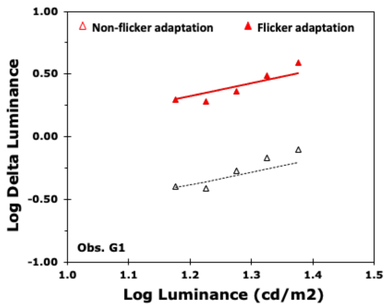
3. RESULTS

Analysis:

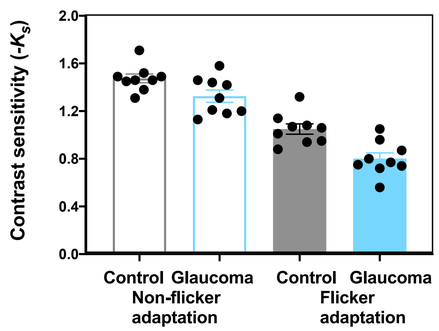
(1) Steady-pedestal model based on primate physiology findings [4, 5] :

- $\log(\Delta I) = K_s + \log(I)$
- $-K_s$: the log sensitivity of the MC-pathway

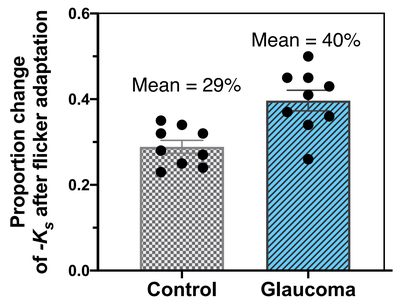
(2) Linear mixed model was used to analyze the effects of patient group, visual adaptation condition, and their interaction on contrast sensitivity in the magnocellular pathway.



Example of an individual's results: shows the main effect of adaptation



Contrast sensitivity by group by adapting conditions



Desensitization effect by subject group

Results:

(1) significant main effect of adaptation condition (p<0.005), indicating reduction of contrast sensitivity from flicker adaptation; and

(2) significant main effect of patient group (p=0.003), indicating contrast sensitivity in the glaucoma group is significantly lower than in the control group; and

(3) significant interaction effect (p=0.017), showing a larger desensitization effect from flicker adaptation in the glaucoma patient group than in the control group.

4. CONCLUSION

The study showed significant reduction of contrast sensitivity in the magnocellular pathway for glaucoma patients. Furthermore, flicker adaptation leads to larger temporal desensitization in the magnocellular pathway in glaucoma patients when compared to age-matched control subjects. These results suggest that flicker adaptation may be a tool to temporally amplify the contrast sensitivity loss in glaucoma patients, which might help facilitating early detection of glaucoma.

References

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