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Recovery from amblyopia enhanced by daily stimulation during development

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Footnotes

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Abstract

Purpose : Daily stimulation of rodents by exposure to optokinetic tracking (OKT) assessment in a critical period of early development leads to above normal spatial frequency (SF) thresholds (Prusky & Douglas, 2003). Here, we investigated whether the visual benefit of daily OKT would affect development of or recovery from amblyopia.

Methods : C57BL/6J mice underwent monocular form-deprivation (FD) from post-natal day 23 (P23). Only contralateral (CL) eyes were then either stimulated with OKT testing (OKT group, n=6) or exposed to grey screens (control group, n=5) daily for two weeks from P24-P36 (amblyopia phase). FD was removed on P37 for a recovery phase (P37-P44), when both groups received daily OKT testing in both eyes. An additional OKT group (non-post-OKT group, n=6) was not stimulated during recovery to elucidate the effects of stimulation during the two phases of the experiment. All mice were tested weekly from P23 for refractive error, and weekly during recovery for SF and contrast sensitivity (CS).

Results : All groups developed a myopic shift (FD-CL eyes) during development (mean myopic shift in diopters, baseline at P23: -0.0752 ± 0.293; at P37: -1.727 ± 0.317, p=0.001) and recovered to baseline after FD removal (P44: 0.0311 ± 0.313). However, refractive error did not differ with visual stimulation. In the CL eye, SF increased more than 15% in OKT mice compared to controls at P37 ($p<0.001$, Figure). In the FD eye, although SF was not different between groups at FD removal (SF in cyc/deg, OKT: 0.308 ± 0.004, control: 0.304 ± 0.004, $p>0.05$), OKT eyes reached hypernormal thresholds compared to controls after recovery (at P44, OKT: 0.464 ± 0.004, control: 0.407 ± 0.004, $p<0.001$). This was also true for the non-post-OKT group (0.466 ± 0.005, $p<0.001$). These effects were paralleled by CS measurements, where CS of both OKT groups increased more than 40% compared to controls in the CL eye ($p<0.001$) and the FD eye ($p<0.001$).

Conclusions : Although all mice were effectively amblyopic throughout the experiment, OKT-stimulated mice not only developed hyperacuity in CL eyes, but also recovered to comparable hypernormal SF and CS thresholds in their FD eyes. However, refractive error was not affected by OKT stimulation. Future studies are necessary to elucidate the mechanism of this recovery effect.

This is an abstract that was submitted for the 2017 ARVO Annual Meeting, held in Baltimore, MD, May 7-11, 2017.

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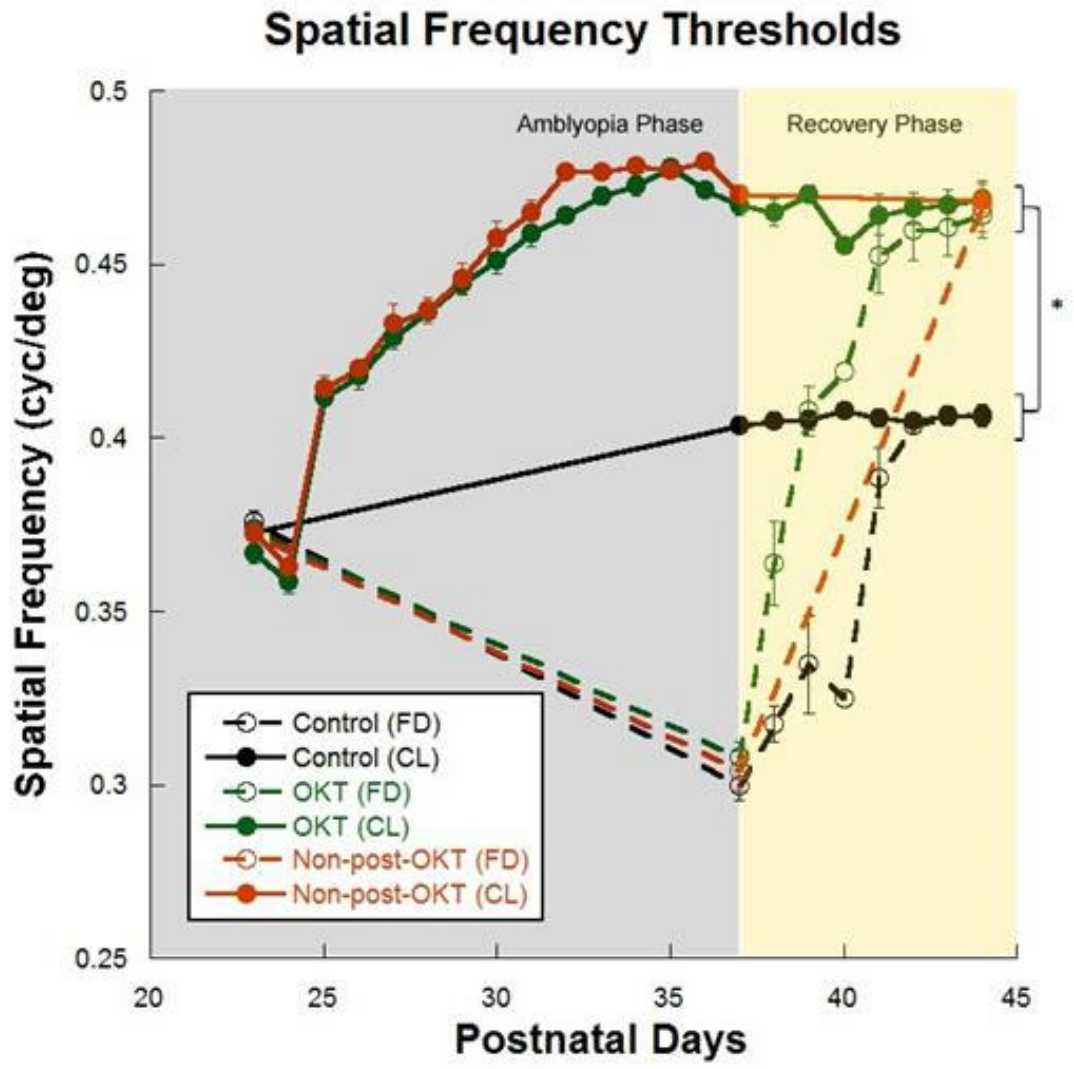

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OKT-stimulated mice develop hyperacuity in both eyes following FD removal