AB007. Visual signals modulate refractive error development through dopamine receptor signaling

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Abstract: Myopia prevalence is dramatically increasing in recent years and in cases in which the refractive error is greater than –6.00 D this disease can lead to severe visual impairment as well as even blindness. Changes in visual input affect the balance between ocular growth and refractive power development. If a mismatch occurs during eye development, the severity of this error affects the degree of myopia. In different animal models of this disease, we found that spatial visual stimuli are essential for maintaining a stable refractive status and normal vision. This is evident because the effects of changes in temporal visual stimuli (e.g., flickering light) on this process depend on whether spatial information is present or absent in the visual environment. Furthermore, the frequency, wavelength and intensity of light are involved in controlling refraction development. However, the molecular mechanisms underlying light-induced refraction changes are still unclear. There is definitive evidence that dopamine (DA) is one of the regulators of this process. This retinal neurotransmitter released by dopaminergic amacrine cells appears to play an important role in vision-guided eye growth because its synthesis and release are positively associated with the light intensity and spatial stimuli impinging on the retina. We found that bright light enhances retinal DA synthesis, and attenuates form deprivation myopia (FDM) development via activation of the dopamine receptor 1 (D1R). A nonselective DA receptor agonist apomorphine (APO) inhibited FDM in dopamine receptor 2 (D2R) knockout mice. These individual similar effects of DA and APO in wildtype and D2R knockout mice suggest that D1R activation has a protective effect against myopia development. On the other hand, D2R activation instead appears to promote myopia development because either genetic D2R ablation or pharmacological inactivation of D2R also attenuates myopia development. Based on these results, we hypothesize that the visual environment regulates the retinal DA levels, which in turn affects the relative balance between D1R and D2R activation. When D1R is relatively hyperactivated, the ocular refractive status shifts towards hyperopia. In contrast, such an effect on D2Rpromotes the refractive status to shift in the opposite direction towards myopia.

Keywords: Myopia; dopamine (DA); dopamine receptor; visual stimuli

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