Commentary: Evaluation of amblyopic eyes with optical coherence tomography angiography and electrophysiological tests

Amblyopia, with a prevalence of 1%–5% in the general population, is a treatable disorder if detected timely. However, being asymptomatic, a large majority of cases are diagnosed only in early adulthood and hence restoration of visual acuity becomes very challenging. This calls for continued efforts at a better understanding of the pathophysiology of amblyopia, with the objective of furthering prognosis.

Is the pathology in amblyopia solely at the neurotransmitter level, receptor level, synaptic level or are there concurrent anatomical (morphological) aberrations and abnormalities of the cellular structures along the visual pathway? (including the retina). When do these changes reach a tipping point and become irreversible and unresponsive to any intervention? These are some of the critical questions that need to be answered.

Neurophysiologic and pathological changes due to stimulus deprivation or abnormal binocular interaction have been established at the level of the lateral geniculate body and visual cortex. Based on chemical changes at the cortical level, reactivation of cortical plasticity by pharmacologic reduction of Gamma-aminobutyric acid (GABAergic) inhibition using selective agents, has been attempted. For example, the antidepressant fluoxetine by virtue of selective serotonin reuptake inhibition has been reported to be of some benefit in one animal study.[1]

At the functional level, a large majority of electrophysiological tests, particularly visual evoked potential (VEP), concur that there is indeed a recordable and statistically significant difference in amplitude as well as implicit time in amblyopic eyes. Some authors even believe that parameters like P100, have predictive value about response to treatment.[2] Unlike VEP, there is greater ambiguity on the correlation and clinical utility of electroretinography (ERG) in this disorder. Results from functional magnetic resonance imaging (fMRI) in patients with amblyopia have also aided our understanding of amblyopia.

While definitive alterations at the neurotransmitter and synaptic levels within the visual cortex is well established, very little is known about both functional and morphological changes at the level of the retina, which harbors the retinal photoreceptors as well as first- and second-order neurons of the visual pathway. Animal studies have failed to unequivocally establish changes in morphological features of the retinal architecture. Until about two decades ago, when optical coherence tomography (OCT) became available, in- vivo study of the retinal architecture was not possible. Continuous advances in OCT technology have enabled the detection of retinal architecture with resolutions ranging from 5–8 microns. Inbuilt software and automatic segmentation methods allow quantitative measurements of predefined layers of the retina, for example, the nerve fiber layer, and the ganglion cell layer.

Though a multitude of studies have been undertaken using OCT to study eyes with amblyopia, none has shown irrefutable evidence of any structural changes within the retina. Reports of changes in the thickness of ganglion cell layers etc., have been strongly disputed. Though several authors have reported their observations on retinal nerve fiber layer thickness, macular thickness, and central choroidal thickness, there is no clear consensus. While some studies have reported greater RNFL thickness and/or macular thickness in amblyopic eyes,[3-5] others[6,7] have found no significant difference. Similarly, increase in choroidal thickness has been a subject of debate.[8] Some authors even claim a significant reduction in central macular thickness after occlusion therapy.

OCT-angiography (OCT-A) is the most recent addition to the plethora of retinal imaging techniques. It is but natural for specialists to explore its utility, in better understanding and managing clinical disorders and this is true of amblyopia as well. OCT-A very vividly captures the retinal capillary vasculature in a noninvasive and rapid manner. As in the case of OCT, advances in software allow quantification of some of these vascular layers, in terms of vascular flow and vascular density.

Few authors have observed changes in OCT-A in amblyopic eyes compared to normal eyes, including the study 'Evaluation of Amblyopic Eyes with Optical Coherence Tomography Angiography and Electrophysiological Tests' in the current issue of IJO.[9] Some observations noted on OCT-A in published reports include changes in choriocapillaris vessel density and/or FAZ, localized areas of vascular damage within the papillomacular bundle, and alterations in superficial retinal vascular plexus. In addition to the small sample size and inherent biases in studies, issues of image magnification due to variability in axial length and its bearing on the vascular density and FAZ measurements restricts the extrapolation of the data generated thus far. Importantly, one must consider if there is a compelling hypothesis or rationale to support observations that are interpreted *post hoc*. Only when this initial step is well supported, can we progress to talk about correlations and clinical relevance.

A systematic review to understand the level of collective evidence that is currently available, with regard to functional and structural (including vascular) changes within the retina, would better enable us to understand if OCT and OCT-A have indeed contributed to a better understanding of this enigma, amblyopia.

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References

1. Sengpiel F. Plasticity of the visual cortex and treatment of amblyopia. Curr Biol 2014;24:936-40.
2. Chung WC, Hong S, Lee Bok, Han SH. Pattern visual evoked potential as a predictor of occlusion therapy for amblyopia. Korean J Ophthalmol 2003;22:251-4.
3. Alotaibi AG, Al Enazi B. Unilateral amblyopia: Optical coherence tomography findings. Saudi J Ophthalmol 2011;25:405-9.
4. Al-Haddad CE, Mollayess GMEL, Cherfan CG, Jaafar DF, Bashshur ZF. Retinal nerve fibre layer and macular thickness in amblyopia as measured by spectral-domain optical coherence tomography. Br J Ophthalmol 2011:1;95:1696-9.
5. Silva F, Alves S, Pina S, Azevedo A, Azevedo AR, Pego P, Santos MJ. Comparison of macular thickness and volume in amblyopic children using time domain optical coherence tomography. Oftalmologia 2012;36:231-6.
6. Firat PG, Ozsoy E, Demirel S, Cumurcu T, Gunduz A. Evaluation of peripapillary retinal nerve fiber layer, macula and ganglion cell thickness in amblyopia using spectral optical coherence tomography. Int J Ophthalmol 2013;18:6:90-4.
7. Repka MX, Kraker RT, Tamkins SM, Suh DW, Sala NA, Beck RW, *et al*. Retinal nerve fiber layer thickness in amblyopic eyes. Am J Ophthalmol 2009;148:143-7.
8. Liu Y, Dong Y, Zhao K. A meta-analysis of choroidal thickness changes in unilateral amblyopia. J Ophthalmol 2017;2017:1-10.
9. Hamurcu M, Ekinci C, Koca S, Tugcu B. Evaluation of amblyopic eyes with optical coherence tomography angiography and electrophysiological tests. Indian J Ophthalmol 2021;69:105-10.

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