Rod Vision – Structure, Function, Treatment and Rehabilitation

Joint AAO/ARVO Symposium
American Academy of Optometry Annual Meeting 2012

SPONSORING SECTION: Vision Science (VS)

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OVERVIEW:

The goal of this symposium is to bring together thought leaders covering the spectrum of study related to the rod division of the visual system. The symposium will take a 'front to back' approach to the rod division of the visual system examining novel new imaging methodologies for assessment of the structure of components of the retina, visual function as experienced through rods, the genetics of inherited rod disease and the potential for gene therapies and treatments and conclude with assistive and rehabilitative tools for those with rod diseases.

By assembling basic science and clinical researchers, our goal is to educate clinicians and vision scientists about the most recent advances and future directions related to assessment of the structure and function of rods and emerging treatment and rehabilitation techniques. These presentations should be of interest to both clinicians and vision scientists alike.

PROGRAM

1. Introduction to the symposium (5 min)

   Alex Bowers, MCOptom, PhD
   Schepens Eye Research Institute
   Harvard Medical School
   Boston, MA 02114
   Email: alex.bowers@schepens.harvard.edu

2. In-vivo imaging of rod photoreceptors in humans using AOSLO (20 min)

   Alfredo Dubra, PhD
   University of Rochester Eye Institute
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   The rod photoreceptors are implicated in a number of retinal conditions, including retinitis pigmentosa, cone-rod dystrophy, congenital stationary night blindness and age-related macular degeneration. Recent improvements in scanning adaptive optics ophthalmoscopes have allowed us to visualize the rod mosaic in vivo. By applying this new capability, we have observed that the image intensity of each individual rod varies over time in subjects free of eye disease, as it had been previously observed in cones. Studying this signal might provide information on the health of the disc shedding and renewal processes. In addition, the description of the geometry of the rod mosaic through metrics such as density and nearest neighbor distance, could be applied to early detection and progression monitoring of eye disease.

   List of the topics to be covered:

   - Brief description of the technology used for imaging the photoreceptor mosaic (i.e. scanning adaptive optics ophthalmoscopy).
   - Brief description of one approach that we are exploring to further improve this technology, so that we can see more rods in more people (pupil apodization).
   - Show images of the rod mosaic in subjects free of eye disease, and discuss our attempts and using metrics to describe it.
   - Show a movie (sequence of 10 or so images) to show the rod scintillation.
   - Show images of subjects with retinal conditions (e.g. blue cone monochromacy).

3. Function of the rod photoreceptor – the vision of rod monochromats (20 min)

   Gunilla Haegerstrom-Portnoy, OD, PhD
   School of Optometry
   University of California, Berkeley
   Berkeley, CA
   Email: ghp@berkeley.edu
   Rod monochromacy or achromatosia is an autosomal recessive genetic condition characterized by poor spatial and color vision, light sensitivity, nystagmus and normal fundus appearance. To what extent can we predict the vision of rod monochromats from what is known about normal rod function? The vision characteristics of a large number of achromats will be presented including visual acuity and its development with age, contrast

sensitivity, color discrimination including spectral sensitivity measures and supra-threshold light perception. The rationale for light protection will be discussed.

4. Lebers Congenital Amaurosis: genetic defect, scotopic vision and gene therapy (20 min)

Artur Cideciyan, PhD
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Leber congenital amaurosis (LCA) refers to a molecularly heterogeneous group of retinal diseases caused by mutations in at least 16 different genes. Common among all LCA is the early onset of severe visual loss that is often associated with progressive degeneration of rod and cone photoreceptors. The age of onset and the rate of degeneration vary not only across the retina but can also show major differences between and within LCA genotypes. Further complicating the LCA phenotype is an additional dysfunction component that substantially exacerbates the visual deficit in some genotypes; RPE65 form of LCA is the best known example. Our clinical trial of gene augmentation therapy in 15 children and adults with RPE65-LCA has demonstrated how the dysfunction component of vision loss can be bypassed and how large improvements of rod- and cone-mediated vision can occur as a result. These improvements are measured within days to weeks of therapy and continue unabated for up to three years after a single injection.

5. New approaches to rehabilitation of severe peripheral field loss (20 min)

Gang Luo, PhD
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Severe peripheral visual field restriction due to retinitis pigmentosa can greatly impair mobility. Apart from traditional aids such as the long cane or guide dog, there are relatively few devices that address such mobility problems. Presenting a minified view of a scene is one approach that may be helpful. However, while existing minifying devices, such as handheld divergent lenses and reversed telescopes expand the field of view, they also reduce resolution and the ability to discern fine details. Dr Luo will describe a series of studies evaluating a new approach to providing visual field expansion for severe peripheral field loss - a head mounted display (HMD) visual field expander based on the principle of spatial multiplexing, whereby minified edge images of the wide scene are superimposed over the wearer's natural view seen through an optical see-through display. In lab-based studies, the HMD field expander improved visual search performance when patients searched for targets outside their remaining visual field. Furthermore, despite the great visual direction change due to minification (about 5x), patients did not overestimate collision risks in a virtual mall walking simulator. These findings suggest that the device has the potential to provide mobility assistance to people with severely-restricted peripheral vision. Inspired by a possible mechanism underlying the collision judgment of patients in the study, Dr Luo is developing a novel computer vision system that can

estimate collision risk; provide auditory collision warning to patients with severe visual field loss. In this presentation, He will also mention the system.

6. Clinical management of patients rod disease (20 min)

Ian Bailey, OD, MS, DSc
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Helping patients with rod disease depends on gaining an understanding the patient's functional limitations. Visual acuities, contrast sensitivity and visual fields should be measured at different luminance levels. Color vision should be evaluated. Consideration should be given to filters to ameliorate adaptation difficulties. Individualized modifications may needed for computer or video-magnifier displays

TENTATIVE BUDGET FOR THE SYMPOSIUM

Applying the guidelines in the suggested implementation plan to the proposed Symposium yields the following budget for speakers:

In the proposed Symposium, 3 speakers (Drs. Dubra, Cideycian, and Luo) are qualified for ARVO support (i.e. ARVO, non-AAO fellows). The following is an estimate of the funds required to cover the expenses for these 3 speakers:

Airfare (estimates based on current rates — roundtrip economy, multiplied by 20% to allow for possible increases by 2012)	Applying Kayak's current lowest fares (with a 20% increment): Boston to Phoenix $360.00 Philadelphia to Phoenix $380.00 Rochester, NY to Phoenix $400.00
Ground transportation (N = 3)	Estimated $120.00 per person $120 X 3 people = $360.00
Hotel accommodations for 2 nights (N = 3)	Estimated $250.00 per night per person, $250 X 2 nights X 3 people = $1,500.00
Meals for 2 days (N = 3)	Estimated $90.00 per day, $90 X 2 days X 3 people = $540.00
Estimated total budget:	$3,540.00