



Neurologists often refer to the eye as a window to the brain. Using an ophthalmoscope, an observer can see the depths (the 'fundus') of the subject's eye. The retina and its blood vessels and many pathologies of the retina and the optic structure of the eye can be seen with a hand-held instrument, simply and non-invasively. Developments of the ophthalmoscope have become powerful clinical and experimental tools.

CNS STABILITY & DEGENERATION

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The work of CSD is focused on aspects of cell biology, particularly of cells in the central nervous system (CNS). The CNS has a very high metabolic rate which is required to maintain its function. Deficiencies in metabolism lead to loss of neural function and ultimately, degeneration. Our studies investigate diseases that cause degeneration of the retina (retinitis pigmentosa, macular degeneration) and cerebral cortex (Alzheimer's disease), normal development of the macula, and modeling of normal cell membrane activity.

CSD hosts laboratories central to the work of the ARC Centre of Excellence in Vision Sciences, particularly the 'Vision for Life' theme. These laboratories are exploring development and ageing of the macula, including in age-related macular degeneration (AMD), as well as novel ways of slowing retinal degenerations using near-infrared light, anti-oxidant techniques and management of light exposure.

HIGHLIGHTS

- Large-scale multi-particle simulation methods and supercomputers, have enabled elucidation of the detailed mechanisms of ion permeation across several important types of ion channels, including potassium, calcium and Cl⁻ channels.
- We showed that tetraethylammonium (TEA) ions block potassium channels by binding to an attractive energy well of about 15 kT in depth, created by four tyrosine residues near the external entrance of the channel.
- We recently demonstrated that photoreceptors in both wild-type and rhodopsin-mutant models of human retinal disease, have the capacity to 'self-repair'. Our studies show that in response to management of the animal's environment, the structure and function of outer segment membranes, synapses and organelles can recover from damage. Our findings indicate a possibility for restoring photoreceptor function in failing retinas.
- Comparative studies of human retinas has revealed that cone photoreceptor degeneration is widespread in both normal aged retinas as well as those affected by AMD. Our results indicate that ageing cones have degenerating axons, deteriorating synapses and abnormal distributions of proteins associated with the photo-inductive cascade. The data provides a new basis for understanding the initiating events in AMD.
- Several genes differentially regulated in the developing human macula were identified by microarray analysis. Because neo-vascularization of the macula and fovea is a major cause of visual loss, as in AMD, genes known to inhibit blood vessel growth are the focus of investigations in the immediate future.
- The microvascular basis of Alzheimer-like dementias has been further developed in major publications proposing a novel understanding of the pathogenesis of these increasingly important features of aging.