

# SPECIAL SECTION GUEST EDITORIAL

## Ophthalmic Diagnostics

Throughout history, advances in medicine have been directly related to increases in our understanding of disease pathogenesis. When we know only a little about a condition, we are limited to surgical treatment modalities. "When in doubt, cut it out..." said the immortalized but unnamed professor of surgery as he expressed the prevailing condition of the time. However, as our knowledge increases, we are able to progress to more subtle medical treatments of disease, as evidenced, for example, by the transition in the treatment of infection from the past practice of surgical drainage to the present regimen of antibiotics. When we truly understand a disease, we are able to prevent it. Critical to this evolution is the ability to diagnose abnormalities early in the natural history of disease so as to be able to intervene before the onset of advanced or even irreversible changes.

The eye is more than a remarkable feat of nature and one of the most essential organs, it is also a microcosm of the body, containing tissue elements representative of most of the body's organs. Moreover, as much of the eye is transparent, indeed *designed* to facilitate the unhindered transmission of light to the retina, many of these representative tissues can be easily accessed by light. This attribute formed the basis for the ophthalmoscope, originally designed by Jan Purkinje in Holland in 1823 and introduced by Hermann van Helmholtz in Germany in 1850, and the slit lamp biomicroscope, invented by Gullstrand in Sweden in 1917. These remarkable technological innovations enabled ophthalmology to be recognized as the first organ-based specialty in medicine. Yet, with time, this technological blessing became an albatross.

In current ophthalmic practice, the absence of an identifiable abnormality equates with health and normality. If the cornea, aqueous, lens, and vitreous are not found to be abnormal by slit lamp biomicroscopy and if the vitreous, retina, and optic nerve are free of any observable abnormalities by ophthalmoscopy, the patient is told that the eye is healthy and all is well. This statement, however, is predicated upon diagnostic techniques that were once revolutionary but are now antiquated. Whereas these diagnostic methodologies may be reassuring as to the lack of visible abnormalities, the histopathology we currently recognize as ophthalmic disease is known to be preceded by a phase of physiopathology dur-

ing which there are many physiologic and molecular abnormalities that are not detectable by conventional diagnostic technologies. The greatest challenge facing ophthalmology today is to identify these early stages of disease on a molecular level, so as to enable the development of less invasive and more potent therapeutic interventions, and ultimately preventative treatment modalities. Such landmark innovations will allow us to prevent early physiopathology from advancing to the histopathology we currently recognize as disease and thereby enable us to prevent irreversible damage to the eye and deleterious effects upon vision.

To help meet this challenge, the *Journal of Biomedical Optics* has dedicated a special section in this issue to ophthalmic diagnostics. In this special section, the editors have assembled expertise from multiple disciplines to present emerging methodologies for the early diagnosis of ophthalmic disease. Five review articles discuss new noninvasive techniques to evaluate vision, diagnose disease at the molecular level, and image transparent and opaque ocular tissues with ultra-high resolution. The accompanying thirteen original contributions discuss fundamental physical and mathematical models of interest to vision scientists, as well as noninvasive technologies to measure physical properties of ocular tissues and new miniaturized instruments for imaging. These papers exemplify another unique attribute of ophthalmology—that it represents a domain in medicine where there is considerable collaboration with the fundamental disciplines of mathematics, physics, optics, and laser engineering. The contributors to this special section of JBO are pioneers who have translated their expertise from these fields to the applications in ophthalmology that are presented herein. They are to be congratulated for their vision in recognizing the importance of this work in shaping the future of eye care and thereby measurably improving the lives of people throughout the world.

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**Special Section Guest Editors**