Customized Vision Correction Using Wavefront Technologies

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Wavefront sensing technique allows us to precisely understand optical quality of the eye by measuring the optical defects called "wavefront aberration". It also makes it possible to correct the aberration using advanced methods such as adaptive optics, laser refractive surgery and customized optics. Optical and Psychophysical tests have demonstrated that correcting these aberrations significantly improves visual performance especially when the pupil size is relatively large. The visual benefit is even more substantial when correcting the aberration in eyes having abnormal corneal conditions such as keratoconus (abnormal cone shape cornea) and penetrating keratoplasty (corneal transplant).

Adaptive optics is a powerful and noninvasive tool to achieve higher order correction. However, it is an impractical method simply because of the size of the entire system. Although refractive surgery has been proven to be practical and effective to correct the aberration, it is a non-reversible surgical method and its availability is restricted by factors such as corneal thickness and the amount of the aberration. The interest in vision correction using customized optics to correct the aberration has been increased. These special optical components include phase plates, customized contact lenses and intraocular lenses (IOLs). The focus of this talk will be on two subjects: (1) a robust wavefront sensor that can reliably measure large amounts of the aberration in eyes with abnormal corneal conditions and (2) the feasibility of using the customized optics to improve human vision by correcting it.

Dr. Yoon is an Assistant Professor in the University of Rochester's Ophthalmology and Biomedical Engineering departments. He is also a research scientist at U of R's Center for Visual Science. He has a BS in physics from SungKyunKwan University, Seoul, South Korea. He also has an MS and PhD in laser optics from the Institute of Laser Engineering, Osaka University, Osaka, Japan. His research interests include:

-Development of a large dynamic range Shack-Hartmann wavefront sensor without losing measurement sensitivity

-Wavefront analysis of eyes with corneal disorders such as keratoconus and penetrating keratoplasty

-Improvement of outcome of conventional and customized laser refractive surgery by analyzing the surgically induced wave aberrations

-Vision correction using optical methods such as adaptive optics, phase plate, customized contact lenses and intraocular lenses

-Effect of tear film dynamics on retinal image quality in normal and dry eye patients