

The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar



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Lecture Title: High Speed Camera and Glaucoma

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Abstract

Glaucoma is a condition of eyes that shows characteristic changes in the visual field and optic disc. The reduction of intraocular pressure (IOP) can contribute to maintain visual function. After diagnosing glaucoma, it is recommended to determine the target pressure, depending on the individual condition and risk factor of patients and to start treatment to decrease IOP. Precise tonometry is an important factor for the management of glaucoma. All tonometers estimate IOP by deforming the eyeball. The IOP reading is always affected by ocular rigidity. To capture images during an IOP measurement with a non-contact tonometer, we employed a high-speed camera with a spatial resolution of 512×600 pixels, and time resolution of 5kHz. The camera and tonometer were placed at right angles. The camera shutter and the tonometer switch were synchronized. After obtaining 3 images and 3 IOP readings, tonometry was performed using the Goldmann tonometer. Displacement of the cornea is measured from the side of the cornea. We captured 111 images from 111 normal volunteers. We also compared the corneal changes in subject after LASIK (laser surgery to correct the refractive error) during tonometry to that of normal eyes.

The results, analyzed using the multiple regression method, revealed that corneal displacement is significantly related to the IOP, age, and sex. The flat applanated area in subjects is almost the same. In the late phase, the air puff force decreases and the corneal shape returns to the initial shape, and we can see that only the center of the cornea moves and returns to the initial condition in young subjects. However, in the older group, the area of movement is wider and the total cornea seems to move, keeping the initial corneal shape in the late phase. The difference of corneal deformation between male and female is now under investigation. We also compared the differences of transformation of cornea between normal eyes and eyes after LASIK, because laser abrasion of cornea decreases the corneal thickness and weakens the structure of cornea. It was found that the displacement of cornea caused by air puff was significantly larger in LASIK eyes than normal eyes ($p=0.047$). Results on the study on the ocular rigidity and glaucomatous optic neuropathy will also be presented.

Biography

Dr. Yoshiaki Kiuchi is a Professor at the Department of Ophthalmology and Visual Science, Hiroshima University Japan. He received M.D. in 1983 from the Hiroshima University. He was a postdoctoral associate at the Yale Eye Center in Yale University from 1990-1992, and was an Assistant Professor in the Department of ophthalmology at Hiroshima University in 1995. In 1997-2003, he was appointed as the Staff Ophthalmologist in Osaka National Hospital; and in 2003-2006 as the Director of the Department of Ophthalmology at the Otemae Hospital. He has been a Professor and the Chairman of the Department of Ophthalmology and Visual Science at Hiroshima University in Japan since 2006.

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