Research

Colloquium

Corneal biomechanics for disease diagnosis

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摘　要：

Cornea is the transparent front part of the eye that covers the iris, pupil, and the anterior chamber. Cornea is also the medium which helps to measure the intraocular pressure of eyeball, that the intraocular pressure is a significant index for glaucoma. In addition, the cornea disease is serious condition that causes clouding, distortion, scarring, and eventually blindness, where the three major types are keratoconus, Fuchs' endothelial dystrophy, and bullous keratopathy. In the talk, we will focus on Keratoconus. On the other hand, a noncontact tonometry, using air-puff to bend cornea during measuring, helps to obtain the intraocular pressure, and the bending information also helps studying the corneal biomechanical properties from dynamics. The noncontact tonometry is popularly used in eye clinics; nowadays, it combines with high speed camera and the Scheimpflug imaging technology and becomes a novel requirement to helps yield biomechanical indexes. To enhance these indexes, accordingly, we develop some methods to analyze biomechanical properties. A static-large deformation model helps analysis energy and consider the bending in procession steps. A liquid-filled spherical diaphragm model helps represent the vibration of the whole eyeball and decouple into several modes. The explicit frequency functions (eigenfunctions) as well as the resonance frequencies (eigenvalues) are derived by the modal analysis, and they consist of an intraocular pressure and seven other physiological parameters. Furthermore, this modal analysis helps decouple the corneal curves during air-puff and the decoupled modes develop criterial of early diagnosis of keratoconus. Here the corneal mechanical properties are obtained from 507 normal subjects, 62 undergone LASIK subjects, and 26 keratoconus patients. Some results show their accuracy for the early diagnosis criterial by applying the ROC courves.