FEM Based Study for Estimation of Applanation Force and Influence of Intraocular Pressure on Tonometry

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Abstract

Purpose: Excess force on cornea during eye care testing procedure such as tonometry may damage the internal structure of eye or may result in erroneous results. The proposed work can be utilized or incorporated as an additional feedback mechanism in the technology innovation of design of eye care instruments.

Method: This work is focused on biomechanical simulation of human eye to determine applanation force on cornea and also to find the influence of intraocular pressure (IOP) of eye on Tonometry.

Results: The results summarise that force applied by the tonometer will increase linearly for increase in deformation of cornea and the junction of cornea and sclera will undergo maximum deformation and hence will experience maximum stress compared to the centre of cornea where tonometer applanates the cornea.

Conclusion: The tonometry will result in deformation of cornea in vertical elongation and the maximum stress is concentrated at the tonometer periphery as well as at the junction of cornea and sclera. The investigation also report that rise in IOP of eye demands higher force of applanation to get the prescribed deformation of cornea.

Full Text

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Figures

Figure 1

key point sketches (dimensions in mm)

Figure 2

Deformation of cornea under tonometry for varying displacement of tonometer, a) 0.3mm, b) 0.4mm, c) 0.5mm, d) 0.6mm, e) 0.7mm, f) 0.7mm isometric view with tonometer with 20mmHg of IOP

Figure 3

Stress distribution(MPa) of cornea under tonometry for 20mmHg IOP for displacement of, a) 0.3mm, b) 0.4mm, c) 0.5mm, d) 0.6mm, e) 0.7mm, f) 0.6mm cut section view

Figure 4

Force exerted on cornea by tonometer for varying deformation of cornea

Figure 5

Validation Plot