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RESPONSE TO LETTER

Finite Element Analysis of Changes in Deformation of Intraocular Segments by Airbag Impact in Eyes of Various Axial Lengths [Response to Letter]

Tomohiro Ueno, Hideaki Fujita, Aya Ikeda, Kazuhiro Harada, Tomoko Tsukahara-Kawamura, Hiroaki Ozaki, Eiichi Uchio

Department of Ophthalmology, Fukuoka University School of Medicine, Fukuoka, Japan

Correspondence: Eiichi Uchio, Department of Ophthalmology, Fukuoka University School of Medicine, 7-45-1 Nanakuma, Jonan-ku, Fukuoka, 814-0180, Japan, Tel +81 92 801 1011, Fax +81 92 865 4445, Email euchio@fukuoka-u.ac.jp

Dear editor

We appreciate Asmaria et al for their interest in our study "Finite element analysis of changes in deformation of intraocular segment by airbag impact in eyes of various axial length".[1] Our development of the human eyeball model in 1999 allowed us to conduct finite element analysis (FEA) of intraocular foreign body injury simulation using time rental supercomputer.[2] This facilitated subsequent studies on the likely effects of traumatic impacts on eyes that have undergone various ocular surgical procedures in workstation due to the improvement in machine performance in the 2000s. Notable progress in computer technology since 2010 has enabled us to perform FEA of eyes in airbag injury with the addition of several refinements in personal computers.[1]

As pointed out by Asmaria et al, ocular components, such as vitreous, lens, and cornea change over age, thereby alter the pathology of ocular complications with airbag impact. We acknowledged this point as one of the limitations of our study, which requires further refinements.[1] Asmaria's suggestion on the modification of simulation configuration of airbag in its location or distance to the passengers or its expansion rate holds great significance for our future study. Clinical observations in traumatic ocular injuries of the anterior and posterior segment of the eye correlate with and provide important qualified validation of FEA computer model of the eye in blunt trauma.

Gray et al reported in numerical simulation that high pressure in the anterior chamber during impact compression results in rearward lens displacement and zonule rupture. In addition, pressure reflections off the posterior segment result in a localized negative pressure region of sufficient magnitude to cause detachment of the retina from the choroid.[3] Our study showed a similar result on vitreous elongation to support this.[1] Stein et al also noted that collision between the airbag and the eye in severe blunt trauma results in the indentation of the cornea, a reduction in anterior-posterior diameter of the globe, and horizontal expansion of the equatorial zone after lens decompression.[4] These studies indicate that kinetic change in the physical property in each intraocular components closely correlate to the key mechanism of blunt ocular trauma. We agree with Asmaria's suggestions on the necessity for further research utilizing the FEA method and are committed to further investigating the kinetic phenomenon of airbag impact on simulated eyes. This will help us determine the sequential response of pressure and volume in the anterior chamber, lens and vitreous components.

Disclosure

The authors report no conflicts of interest in this communication.

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