Abstract Submitted
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Mathematical Modeling of Tear Film Break up Modes and Fluorescent Intensity[1] JAVED SIDDIQUE, Penn State York, RICHARD BRAUN, Department of Mathematics, University of Delaware, CAROLYN BEGLEY, ADAM WINKELER, School of Optometry, Indiana University, Bloomington IN, PETER E. KING-SMITH, College of Optometry, Ohio State University, Columbus, OH — The purpose of this study is to develop mathematical model for variables of interest in tear film break up (TBU) to compare with experimental images of TBU to better predict local values of tear film osmolarity and fluorescence during and following the TBU. Models are developed for local changes tear film thickness, insoluble surfactant concentration as well as osmolarity and fluorescein concentration inside the tear film. Fluorescence concentration was converted to fluorescent intensity using the expression involving film thickness and the full range of fluorescence as described by Nichols et al (IOVS 2012). The fluorescent intensity response is a primary tool for visualizing the tear film thickness, and it is qualitatively different in the dilute vs concentrated regimes. Computed results over a wide range of fluorescein concentrations show that elevated surfactant concentration or evaporation rate led to thinner regions where TBU first occurs. The model predicts locally elevated concentration of osmolarity within areas of TBU and fluorescence intensity patterns very similar to computed thickness and the observed experimental results. The osmolarity may increase from 50% to 1300% of the isosmolar value, depending sensitively on the corneal permeability.

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