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Assessment of thermal models for human eye

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Abstract

With the increase in laser technology for ophthalmic surgeries, the knowledge of the heat transfer mechanism in the human eye becomes increasingly important. The accuracy in predicting thermal behavior is linked to the use of adequate thermal and numerical methods. In this way, this study presents the results of two two-dimensional models, cartesian and axisymmetric in cylindrical coordinate, to calculate transient temperature of the human eye. Heat transfer was modeled using the Pennes' thermal model, and the mechanism of heat conduction was assessed through two different approaches, classical Fourier law and non-Fourier law also known as Cattaneo and Vernotee modification. The Fourier and non-Fourier bio-heat equations were solved using the finite element method and the numerical solutions were compared to solutions reported in the literature, as well as numerical results were presented under various conditions to evaluate the differences between the two approaches to predict the diffusion of heat inside the retinal region of human eye subjected intentionally and accidentally to heat sources.