عنوان مقاله:

Numerical simulation of the fluid dynamics in a 3D spherical model of partially liquefied vitreous due to eye movements under planar interface conditions

محل انتشار:

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خلاصه مقاله:

Partially liquefied vitreous humor is a common physical and biochemical degenerative change in vitreous body which the liquid component gets separated from collagen fiber network and leads to form a region of liquefaction. The main objective of this research is to investigate how the oscillatory motions influence flow dynamics of partial vitreous liquefaction (PVL). So far computational fluid dynamics modeling of the PVL has not yet been well studied. To this end, a spherical model of the vitreous is subjected to harmonic motion and the numerical simulations are performed for various planar interface conditions in linear viscoelastic regimes. A numerical solver is developed in the OpenFOAM toolbox which is based on finite volume method and uses the PIMPLE algorithm and the dynamic mesh technique. This solver also uses modified classic volume-of-fluid approach to capture the interface effects and dynamic characteristics of two-phase viscoelastic-Newtonian fluid flow. The numerical model is validated by comparing the obtained results with the analytical solution which excellent agreement was observed. The results showed that the intensity of secondary flow in the vertical direction was much higher for the PVL with a higher liquefied fraction. Also, the obtained maximum stresses were dependent on the liquefied fraction of the PVL and located on the equatorial plane at the cavity wall near the interface layer and within the vitreous gel.

کلمات کلیدی:

Two-phase flow, Viscoelastic-Newtonian fluid, Partial vitreous liquefaction, Harmonic motion, Vitreous

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