# 3D Hydrodynamic and Mass Transport Simulations of Ocular Drug Delivery

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## Abstract

The present study is motivated by the recent concerns raised over the existence of segmental outflow of the aqueous humour (AH) and its implications on ocular drug delivery. A 3D model of the human eye is developed, where hydrodynamic and mass transport analyses, specifically after eye drop instillation, are carried out. To model segmental outflow, the permeability of the trabecular meshwork (TM) is assumed to vary spatially following a rectangular function. The choice of the rectangular function is based on the results from the tracer distribution study of Chang et al. [Chang et al, Multi-scale analysis of segmental outflow patterns in human trabecular meshwork in changing intraocular pressure. J Ocular Pharm Therap, 2014; 30:213-223]. Results from the numerical simulations show that eye orientation plays a more dominant role than segmental outflow in determining the ocular drug route. For an eye in the standing position, the majority of the drugs will egress through the bottom half of the eye regardless of the position of the active region. For an eye in the supine position, the unique AH flow profile led to the majority of the drug to egress throught the non-active region; hence nullifying the concerns of potential segmental-induced 'under-treatment' of the disease. The results suggest that there may be a need to re-evaluate the design of ocular drug delivery system to take into account the potential advantage of instilling eye drops in the supine position.