World Academy of Science, Engineering and Technology
International Journal of Health and Medical Engineering
Vol:15, No:07, 2021

Two-Phase Flow Study of Airborne Transmission Control in Dental Practices

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Abstract : Occupational Safety and Health Administration (OSHA) identified dental workers at the highest risk of contracting COVID-19. This is because aerosol-generating procedures (AGP) during dental practices generate aerosols (< 5µm) and droplets. These particles travel at varying speeds, in varying directions, and for varying durations. If these particles bear infectious viruses, their spreading causes airborne transmission of the virus in the dental room, exposing dentists, hygienists, dental assistants, and even other dental clinic clients to the infection risk. Computational fluid dynamics (CFD) simulation of two-phase flows based on a discrete phase model (DPM) is carried out to study the spreading of aerosol and droplets in a dental room. The simulation includes momentum, heat, and mass transfers between the particles and the airflow. Two simulations are conducted and compared. One simulation focuses on the effects of room ventilation in winter and summer on the particles' travel. The other simulation focuses on the control of aerosol and droplets' spreading. A suction collector is added near the source of aerosol and droplets, creating a flow sink in order to remove the particles. The effects of the suction flow on the aerosol and droplet travel are studied. The suction flow can remove aerosols and also reduce the spreading of droplets.

Keywords : aerosols, computational fluid dynamics, COVID-19, dental, discrete phase model, droplets, two-phase flow
Conference Title : ICDATTD 2021 : International Conference on Dental Applications, Tools and Techniques in Dentistry
Conference Location : Toronto, Canada
Conference Dates : July 19-20, 2021