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Multiscale Analysis of a Collapsible Respiratory Airway[1] SAMIR GHADIALI, E. DAVID BELL, Lehigh University, J. DOUGLAS SWARTS, Children's Hospital of Pittsburgh — The Eustachian tube (ET) is a collapsible respiratory airway that connects the nasopharynx with the middle ear (ME). The ET normally exists in a collapsed state and must be periodically opened to maintain a healthy and sterile ME. Although the inability to open the ET (i.e. ET dysfunction) is the primary etiology responsible for several common ME diseases (i.e. Otitis Media), the mechanisms responsible for ET dysfunction are not well established. To investigate these mechanisms, we developed a multi-scale model of airflow in the ET and correlated model results with experimental data obtained in healthy and diseased subjects. The computational models utilized finite-element methods to simulate fluid-structure interactions and molecular dynamics techniques to quantify the adhesive properties of mucus glycoproteins. Results indicate that airflow in the ET is highly sensitive to both the dynamics of muscle contraction and molecular adhesion forces within the ET lumen. In addition, correlation of model results with experimental data obtained in diseased subjects was used to identify the biomechanical mechanisms responsible for ET dysfunction.

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