

## Abstract

Obstructive Sleep Apnea (OSA) is an increasingly common disorder in which the upper airway collapses during sleep, preventing normal airflow from reaching the lungs. This in turn disrupts normal sleep, as well as causing hypoxia and many other medical problems. To better understand the mechanics that cause airway collapse, the goal of this study is to construct an anatomical deformable physical model of an adult upper airway, out of materials whose properties mimic the mechanical properties of the deformable tissues surrounding the human airway, to support numerical simulations of fluid and tissue dynamics of the airway. To build the airway, various materials were researched and tested for their suitability for use in the model. MRI images were taken of a subject with no history of sleep apnea, from which three-dimensional computer models of the airway tissues were created. Deformable structures, such as the tongue, soft palate and tonsils, were created using Polyvinyl Alcohol cryogels with specifically controlled mechanical properties. The epiglottis was created using Sylgard 184 Elastomer, while the choanae, trachea, hyoid bone, and mandible were manufactured out of ABS plastic. The parts were assembled to create the physical deformable model of the airway, and static pressure tests were conducted to test the viability of the model. The assembled airway resisted increases in internal pressure (up to 5.2 cm H<sub>2</sub>O) and decreases in internal air pressure (up to -6.4 cm H<sub>2</sub>O).