Abstract

Obstructive Sleep Apnea Syndrome (OSAS) is the most common disorder within the family of disorders known as sleep apnea. OSAS results from the blocking or collapse of the airway during sleep, leading to disruptions in normal breathing patterns. The collapse of the airway can be understood in terms of the geometrical restriction and subsequent pressure drop. In order to quantify the physics of this phenomenon, several three-dimensional computer models were created using physical data from MRI and CT scans. MRI data of the nasal passage was used to determine the appropriate process flow for the creation of a useful virtual model of discretized elements, or “mesh”. Fluid dynamics simulations were used to obtain pressure data for this model, which was compared against experimental rhinomanometry data. Once the appropriate mesh creation procedure was determined, three scripts were created to automate the process. Scripting was performed within commercial meshing software, and was used to create a pharyngeal mesh, which was compared to a manually created mesh through geometry checking and fluid flow simulation. CT scans of the nasal passage before and after nasal valve surgery were then used to obtain and simulate models for nasal resistance calculations, which demonstrated relief in the affected passage. The scripts were then modified to account for the better resolution of the CT models, as well as an ambient hemisphere inlet at the nostrils. The results from the automated mesh simulation were compared to a mesh created manually to verify the scripting process and demonstrate its potential clinical utility. Overall simulation time was reduced in both the pharyngeal and nasal valve models, and the time needed to generate a mesh with high quality elements was greatly reduced in both models.