Project Title: Functional Modeling of the Pediatric Airway in Children with Obstructive Sleep Apnea

Abstract: Obstructive sleep apnea (OSA) is a common and serious cause of metabolic, cardiovascular and neurocognitive morbidity in children. Airway narrowing often includes a combination of adenotonsillar hypertrophy, mucosal edema, turbinate hypertrophy, micrognathia, and/or maxillary constriction. Adenotonsillectomy is typically the first-line therapy for childhood OSA and generally results in improvement, but approximately 40% of patients will have residual OSA, resulting in considerable morbidity. Adjuvant therapies for OSA are frequently performed, including rapid maxillary expansion, turbinectomy, and nasal septal repair, but there is no consensus on which patients require additional therapy. Surgical and/or medical interventions for OSA cannot be evaluated experimentally on the same patient, and therapeutic trials are logistically and ethically challenging. Tools to predict the response to therapy in childhood OSA are urgently needed to ensure complete resolution of OSA, and to avoid unnecessary interventions. Magnetic resonance imaging can be used to obtain an airway surface mesh suitable for analysis with computational fluid dynamics, yielding an airway flow and pressure profile related to sleep-disordered breathing. Thus, ?virtual? surgical manipulations of MRI data in combination with fluid dynamics could be used to predict therapeutic efficacy. We propose to obtain airway MRI and polysomnography data in a sample of children with OSA, before and after adenotonsillectomy. Computational fluid dynamics will be utilized to model upper airway flow through the collapsible airway mesh in order to predict response to surgery. Modeling techniques could determine the optimal surgical and/or medical intervention, thereby reducing unnecessary procedures and treatment delays.