Faculty Profile: Guilherme Garcia, PhD

Guilherme Garcia, PhD, began his career in biomedical research as a PhD student in Physics at the Universidade Federal de Minas Gerais (UFMG) in Belo Horizonte, Brazil. While studying for his doctoral degree, he attended a seminar by a visionary otolaryngologist named Dário Martins, MD. Dr. Martins realized that the field of rhinology often lacked the scientific knowledge that otolaryngologists needed to provide more effective treatments for patients with nasal pathologies. As a physicist, Dr. Garcia was intrigued by the gaps in medical knowledge. Most of all Dr. Garcia was stunned by a disease that Dr. Martins described as atrophic rhinitis or "empty nose syndrome". Although these patients had a nasal cavity that was wider than normal, they paradoxically complained of nasal obstruction. "After this seminar", Dr. Garcia says, "learning about the biophysics of nasal airflow and its relationship to human health became my career goal."

Dr. Garcia, an Assistant Professor in Otolaryngology and Communications Sciences and in the Biotechnology and Bioengineering Center at the Medical College, has extensive expertise in computational fluid dynamics (CFD) simulations of airflow in the nasal cavity. In collaboration with Dr. John Rhee, Chair of the Department of Otolaryngology and Communications Sciences at MCW, he is applying CFD models to correlate the subjective perception of nasal airflow to objective measures. The motivation is that surgical outcomes for chronic nasal airway obstruction remain unsatisfactory, with a significant proportion (23-37%) of patients having persistent symptoms postoperatively. **His long-term goal is to improve surgical planning by employing virtual surgery and CFD techniques**. In one study, Dr. Garcia used virtual surgery software to create septal deformations in different regions of the nasal cavity of one individual and study whether the location of a septal deviation was an important parameter determining nasal resistance. The simulations revealed that septal deviations located near the nostrils caused the greatest increase in nasal resistance, which is in agreement with the clinical observation that patients with anterior septal deviations tend to benefit the most from nasal surgery.

Dr. Garcia is planning on expanding his translational endeavors by starting research on obstructive sleep apnea (OSA). He is working with a research team whose overarching hypothesis is that pharyngeal compliance and airway shape are key physiological parameters that must be better understood and clinically quantified to improve treatment of OSA patients. The team's goal is to evaluate the role of pharyngeal compliance and airway shape in OSA pathophysiology and treatment by performing objective *in vivo* measurements. Another goal is to develop validated computational models of pharyngeal collapse that can be used to improve the understanding of OSA pathophysiology. In the future, surgeons may use these patient-specific computational models in a virtual surgery environment to identify the primary site of airway collapse (i.e., the surgical target) and to test the efficacy of various surgical approaches as part of their surgical planning.

In terms of collaborative relationships, Dr. Garcia says "I am interested in collaborating with physicians and basic scientists who need help quantifying biophysical parameters. In addition, I am also interested in collaborations with other researchers with expertise in fluid mechanics and computer science."