Original articles

Patient-specific geometry modeling and mesh generation for simulating Obstructive Sleep Apnea Syndrome cases by Maxillomandibular Advancement

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Abstract

The objective of this paper is the reconstruction of upper airway geometric models as hybrid meshes from clinically used Computed Tomography (CT) data sets in order to understand the dynamics and behaviors of the pre- and postoperative upper airway systems of Obstructive Sleep Apnea Syndrome (OSAS) patients by viscous Computational Fluid Dynamics (CFD) simulations. The selection criteria for OSAS cases studied are discussed because two reasonable pre- and postoperative upper airway models for CFD simulations may not be created for every case without a special protocol for CT scanning. The geometry extraction and manipulation methods are presented with technical barriers that must be overcome so that they can be used along with computational simulation software as a daily clinical evaluation tool. Eight cases are presented in this paper, and each case consists of pre- and postoperative configurations. The results of computational simulations of two cases are included in this paper as demonstration.
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1. Introduction

Obstructive Sleep Apnea Syndrome (OSAS) is one of the most common sleep disorders and an important public health problem to address. There is increasing evidence that OSAS is associated with a considerable number of adverse sequelae, both behavioral and physical. Behavioral consequences include daytime sleepiness, impaired concentration and neuropsychological dysfunction, whereas physical consequences include cardiovascular disorders, particularly myocardial infarction and hypertension. Young et al. estimated that 2% of women and 4% of men in the middle-aged work force meet the minimal diagnostic criteria for sleep apnea syndrome [36]. Approximately one in five adults has at least mild OSAS, and one in 15 adults has OSAS of moderate or worse severity [37]. The prevalence of OSAS

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