Numerical simulation of septal deviation effects in nasal flow

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Abstract:
The purpose of this article is to analyze the effects of septal deviation on the aerodynamic flow pattern compared with a normal nose by Computational Fluid Dynamics (CFD) tools. The software MIMICS 12.0 was used to perform the image segmentation and meshed model generation from CT scans. Thereafter high resolution 3D volume meshes comprising boundary layer effect and computational domain exterior to the nose were constructed. Numerical simulations were then carried out using FLUENTS for computational fluid dynamics simulations. The overall flow was assumed to be incompressible, quasi-steady and laminar. The same oxygen (flow rate) amount with a normal nose for a deviated one was also assumed. The results were shown with the contours of velocity for exhalation and inhalation. The distribution of wall shear stress and flow partitioning were also investigated. It was found that the existence of “dead space” might cause turbulence due to the deviated nasal septal structures.

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I. Introduction

The human nasal septal deviation is one of the challenging problems in septorhinoplasty as the airflow domain inside the nose is complex. It can be classified into liner (I-shaped), C-shaped and S-shaped [1]. The complex geometry with septal deviation makes it a challenge to conduct experimental measurement in vivo. Usually MRI and CT scans are used to analyze the anatomical details for physical models [2].

Keywords

IEEE Keywords
Numerical simulation, Nose, Computational fluid dynamics, Pattern analysis, Aerodynamics, Software performance, Image segmentation, Computed tomography, Computational modeling, Stress

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