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Title: How should nasal anatomies be compared before and after surgery? A CFD study.

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Abstract

A consistent part of world population has some anatomic deformity of the nose and usually those are difficult to diagnose [1]. Clinicians face the issue of understanding if the deformities that are detected in the medical examination are the cause of patient's symptoms and many times the answer is not straightforward. This leads surgeons to rely on their experience, without an objective tool to choose whether to do surgery, and thus errors are unavoidable [2]. CFD enables diagnosis of NBD and surgery planning [3]: currently, this comparison is carried out with more than one strategy, under the implicit assumption that results are unaffected. In the present work this question is examined: how should the anatomies be compared before and after the surgery? The pre-op anatomy considered in the present study is derived from the CT scan of a 67 years old patient while the post-op one is obtained by doing a virtual surgery of the previous, operation did in [4]. To ensure a high realism of the surgery, it is executed under the guidance of an ENT surgeon. The pre- and post-op flow fields are computed with a high-resolution Large-Eddy Simulation (LES). This choice depends mainly on two factors: in physiological conditions the nasal flow is typically transitional and it is often unsteady. The flow is numerically computed assuming three different forcings, the first two of which are spread in the literature: a constant pressure drop (CPG) between the external ambient and throat, a constant flow rate (CFR) through the airways, and a constant power input (CPI) from the lungs. A significant difference in the quantities of interest is observed when the type of flow forcing is varied. Both global and local quantities are affected by the comparison criterion. The type of flow forcing affects the outcome of the comparison between pre-op and post-op anatomies. Among the three available forcings, we argue that CPG strongly depends on the computational domain and, thus, is not adequate for proper comparisons; the choice of either CFR or CPI is still not clear.

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