



LETTER TO THE EDITOR

Mechanisms of upper airway remodeling following surgical interventions remain elusive

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Dear Editor,

The article by Sutherland et al. [1] makes interesting reading. There are several items within the methodology that are noteworthy. First, the complex dynamics of the upper airway suggest that current imaging modalities attempting to quantify upper airway volume changes are deficient, partly due to concerns about the respiratory cycle. Since 3D imaging protocols are not standardized, and no consensus currently exists, the influence of the respiratory cycle can thwart putative findings, as noted in this study. I posited that upper airway measurements need to be taken at known phases of the respiratory cycle to produce meaningful clinical results [2].

Second, there is the issue of positioning during upper airway imaging. Most 3D cone-beam (CB) CT scans are taken with the patient either standing or sitting during wakefulness, while MRI scans were taken in the supine position in this study, which makes it difficult to generalize the current findings. In addition, there is residual debate as to whether the patient should be imaged in the supine position, since it is thought that upper airway behavior during wakefulness differs from that during sleep, and sleep position varies during the night. Therefore, another need for upper airway imaging is a consensus on clinical positioning protocols.

The notions of “anatomical improvement” and “lack of measurable volume change” in this study appear to be *non-sequitur* and might be predicated on the deficient use of homologous landmarks. Specifically, the nasal airway was excluded from this study and might explain the observation of “non-responders” since the site of that obstruction would be omitted from the surgical procedure deployed in the study. Moreover, if the tip of the

uvula was resected, the use of this homologous landmark in a comparison of pre- and postsurgical configurations is rendered invalid. To quantify and localize upper airway allometry and anisotropy, the use of geometric morphometrics [3] might be useful to determine if the upper airway undergoes postoperative remodeling and then regresses to a new level of (functional) homeostasis.

Despite the findings of this study, there is evidence of 3D CBCT-measured morphologic airway changes with surgery and oral appliance treatment for obstructive sleep apnea (OSA) [4, 5]. However, the underlying mechanism(s) require elucidation, although it is thought that postsurgical wound healing is dependent on stem cell differentiation [6]. Thus, the concept of a “reduced need for neuromuscular compensation” may simply represent the wound-healing mechanism with concomitant scarring/fibrosis that can affect the tonicity/compliance of the upper airway since MRI images taken both before and after surgery at a scan depth of 3 mm in this study failed to detect volumetric changes. In other words, the postoperative pharyngeal tissues might be functionally rendered as being more akin to the non-collapsible pharyngobasilar fascia.

Clinically, the adaptive capability of the upper airway should not be overlooked. I reviewed upper airway remodeling [7] based on the premise that stem cells are distributed and localized in various regions of the upper airway, ranging from nasal epithelial stem cells [8] to basal alveolar and mesenchymal populations [9]. In fact, mesenchymal stem cell migration and adhesion, as well as endothelial repair, may be involved in the physiological responses to OSA-associated airway changes [10]. Therefore, these mechanisms may play a significant role in physiologic airway remodeling and provide intriguing avenues for further research.

Disclosure Statement

G. Dave Singh is the Founder and Chief Medical Officer of Vivos Therapeutics, Inc. and is currently collaborating with Stanford University Sleep Medicine in the development of a craniofacial facility.

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