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Opinion

Dynamic Magnetic Resonance Imaging Provides Insight into Upper Airway Mechanics in Obstructive Sleep Apnoea

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Opinion

Key point of interest

This perspective should help in the interpretation of the paper: ‘Regional respiratory movement of the tongue is coordinated during wakefulness and is larger in severe obstructive sleep apnoea’ by Juge et al. [1]. A powerful imaging technique for dynamic motion tracking has been used to better understand airway mechanics.

Linked articles: This Perspectives article highlights an article by Juge et al. [1]. To read this paper, visit https://doi.org/10.1113/JP278769.

A new study from Juge et al. [1] from L. Bilston’s laboratory gives us basic information on tongue motion from mechanical analysis of motion-tagged magnetic resonance imaging (MRI) in a cross-section of normal and severe sleep apnoea patients (N 63). They concluded, contrary to their own hypothesis, that in the awake state severe sleep apnoea patients have greater tongue motion, including coordination of regional tongue muscle compartmental motion compared to normal patients without sleep apnoea, based on the apnoea hypopnoea index (AHI) Although only a relatively limited cross-section was studied (without strong statistical power to control for weight and other variable factors), the basic correlation between increased severity of sleep apnoea (as AHI) and awake tongue motion was shown. Not surprisingly, this result is consistent with seminal work by Mezzanotte et al. [2] who also found that genioglossus EMG was increased in awake sleep apnoea patients. However, the current paper by Juge et al. [1] is not simply a validation of EMG-based studies because analysis of MRI-tracked tissue motion in the upper airway gives direct insight into respiratory-related mechanical changes. The final output measure, i.e. displacement of the tongue and soft tissues, does not rely on assumptions of geometry that would include the length–tension relationship of EMG to muscle force and displacement [3].

MRI tagging for muscle motion analysis has been predominantly used for cardiac analysis and differential diagnosis in myo- cardial infarcts [4]. However, in a series of papers, including Brown et al. [5], this powerful technique has been used in the Bilston lab to help understand the pathogenesis of obstructive sleep apnoea. Thus, although sophisticated tools are available in MRI, knowledge of how to apply MRI to help understand mechanics in the upper airway requires experience and carefully designed experiments because data overload can often sidetrack an important objective. One of the key aspects to this study is the way in which the upper airway geometry is visualized and regionally divided to maximize tongue motion data collected in two-dimensional (2-D) (midsagittal sections but with high time resolution so that movement is revealed. One drawback to this study was that airway dimensions and some airway soft tissues such as the soft palate were obtained from spin-echo and Dixon fat discriminating image protocols that do not resolve the acquisitions in the same respiratory time frame as the fast gradient echo motion-tagged imaging used for the midsagittal tongue images. However, the lack of 3-D time-resolved analysis does not prevent us from learning valuable information from the overall data and results in this paper.

The current study has an a priori system to examine tongue regions and within those defined regions so that soft tissue motion evaluation can be averaged and compared between patients. Thus, the concept of ‘coordinated motion’ among regions in the tongue was assessed and those results were compared across the patient data set.

The regions as shown in Figure 1 of Juge´ et al. [1] were chosen from previous work from this lab where patterns of tongue movement were characterized. When the genioglossus fibres contract during neural activation, tongue motion in the anterior direction results and this tongue protrusion can lead to either nasopharyngeal and oropharyngeal airway dilatation or both. Thus, a physiologically relevant method of examining motion of the tongue has been used and this approach helps to compare tongue motion that is not always the same in the overall population, whether normal or apnoeic patients are studied.

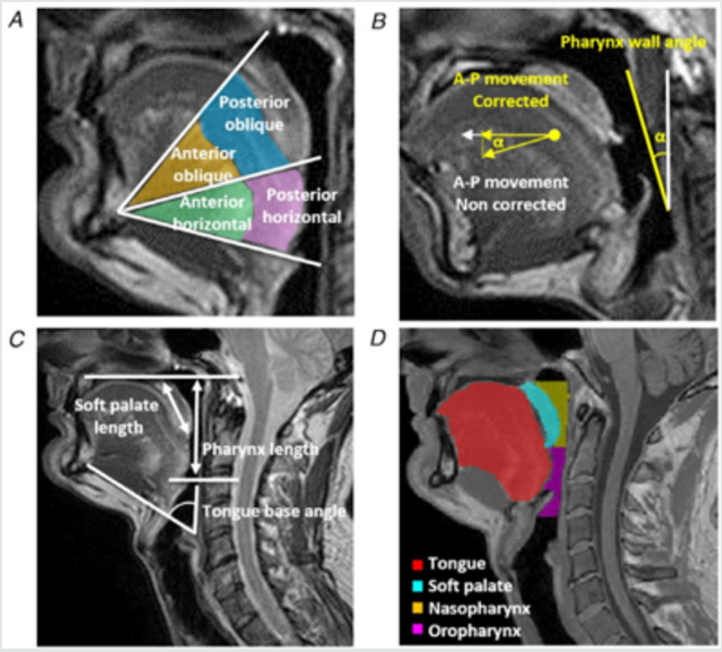

Figure 1.

Finally, the conclusions from this work support the view that patients with severe sleep apnoea have to compensate for an existing predisposition to occlusion during awake breathing by tongue activity and tongue motion that is both co-ordinated in several regions of the tongue and is quantifiably greater in displacement that tends to dilate the upper airway. These findings should be of great inter- est towards the continued development of hypoglossal electrical stimulation treatment methodologies, especially where selective hypoglossus nerve stimulation may be used to augment specific regions of tongue motion at specific respiratory phases for the most efficient improvement of airway patency in predisposed individuals.

Additional Information

Competing interests

The author declares no conflicts of interest.

Author contributions

The author is the sole contributor to the essay.

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