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Neural control of tongue movement with respect to respiration and swallowing.

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The tongue must move with remarkable speed and precision between multiple orofacial motor behaviors that are executed virtually simultaneously. Our present understanding of these highly integrated relationships has been limited by their complexity. Recent research indicates that the tongue's contribution to complex orofacial movements is much greater than previously thought. The purpose of this paper is to review the neural control of tongue movement and relate it to complex orofacial behaviors. Particular attention will be given to the interaction of tongue movement with respiration and swallowing, because the morbidity and mortality associated with these relationships make this a primary focus of many current investigations. This review will begin with a discussion of peripheral tongue muscle and nerve physiology that will include new data on tongue contractile properties. Other relevant peripheral oral cavity and oropharyngeal neurophysiology will also be discussed. Much of the review will focus on brainstem control of tongue movement and modulation by neurons that control swallowing and respiration, because it is in the brainstem that orofacial motor behaviors sort themselves out from their common peripheral structures. There is abundant evidence indicating that the neural control of protrusive tongue movement by motoneurons in the ventral hypoglossal nucleus is modulated by respiratory neurons that control inspiratory drive. Yet, little is known of hypoglossal motoneuron modulation by neurons controlling swallowing or other complex movements. There is evidence, however, suggesting that functional segregation of respiration and swallowing within the brainstem is reflected in somatotopy within the hypoglossal nucleus. Also, subtle changes in the neural control of tongue movement may signal the transition between respiration and swallowing. The final section of this review will focus on the cortical integration of tongue movement with complex orofacial movements. This section will conclude with a discussion of the functional and clinical significance of cortical control with respect to recent advances in our understanding of the peripheral and brainstem physiology of tongue movement.

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