Does asymmetry in tongue anatomy affect asymmetry in tongue position? Glossectomy and control subjects.

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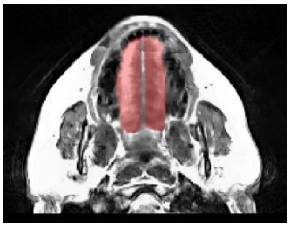
Glossectomy surgery removes part of the tongue due to cancer. If the surgery is unilateral, the resection will result in left-right anatomical asymmetry, which may affect tongue asymmetry at rest and during motion. On the other hand healthy speakers also have some asymmetry in left-right tongue size and motion (Stone et al, 2018, Stone et al, 2014). Thus, we are interested in what constitutes normal asymmetry and how asymmetry due to surgery differs from this. The present study measures left-right anatomical asymmetry in the tongue volume of glossectomy and control subjects to consider the extent of its effects on resting and movement asymmetry. We expect that patients with unilateral resections will be more asymmetrical anatomically than controls, but it is not clear that their midline tongue will be off-center when resting in the oral cavity, because their dentition is unchanged and the tongue may rest in its familiar position. In addition, we cannot predict motion asymmetry due to small tumor resection, because adaptation may occur on the tumor side (cf Stone et al., 2014), or the non-tumor side may compensate as well.

Methods. Twenty subjects were used in the study. They included ten controls and ten glossectomy patients with fairly small tumors: T1N0M0 or T2N0M0. Three-dimensional tongue volumes were segmented from high-resolution MR images of the tongue at rest using custom software written in Matlab (Lee, et al, 2014). From these segmentations, volumes were calculated for the whole tongue, for both halves and for the septum using ITK-SNAP (Yushkevich et al, 2006).



Second, we bisected the oral cavity in the sagittal plane from the mandibular symphysis to the center of the spinal cord and determined the proportion of the tongue resting in each half of the oral cavity, including the septum, the left and right tongue. Asymmetry in volume distribution was compared with asymmetry in anatomy of the tongue. Finally, we measured several muscles on both sides of the tongue and tracked changes in their length during the speech task “a shell” to see whether there was a relationship between any asymmetry in the tongue motion and the anatomical and resting asymmetries. The word “shell” requires a complex motion deformation as the tongue shape changes from a midline jet stream with elevated lateral tongue margins and lateral palatal contact during /ʃ/ to an elevated tongue tip and lowered lateral margins during /l/.

Results showed less anatomical asymmetry in the controls as expected. Ten out of 20 subjects (7 controls and 3 patients) had a volume difference of less than 2% between the left and right half of the tongue. The visible septum varied across subjects from 1% to 8% of the tongue volume. Positional measures showed that the septum was typically split unevenly between the two halves of the oral cavity. When the septum volume was removed from the calculation, the tongue volume distributed fairly equally in the OC both for patients and controls, despite the anatomy. Muscle shortening results are currently being analyzed.

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