Analyzing Tongue Asymmetries in Anatomy and Positioning in Patients Following Glossectomy Surgeries.

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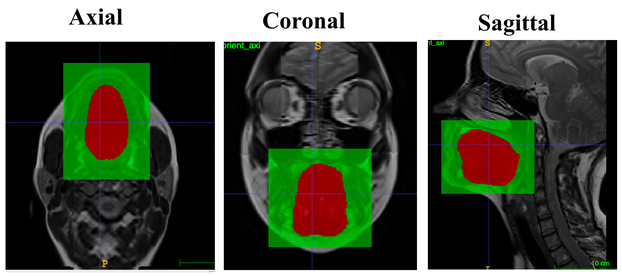
INTRODUCTION AND GOAL

Our goal is to look specifically at the entire tongue volume and determine how it is affected by glossectomy surgery. Previous measurements of controls show that the entire tongue volume is for the most part symmetrical anatomically and symmetrical in the way it rests in the oral cavity.

- The CDC estimates more than 30,000 new cases of oral and pharyngeal cancer each year. One of the most commonly affected sites of oral cancer is the lateral border of the tongue.[1]
- During resection, a margin of clean tissue 1-1.5 cm is removed around the border of the tumor causing the resection size to be 2-3 cm larger than the tumor size.
- After Glossectomy surgery or any surgery for that matter, the body will compensate for lost muscle tissue in some way. By looking at the tongue in this manner and comparing the sheer muscle volume from the side of the tongue with a tumor vs the non tumor side, we can get an idea of how the tongue is compensating for the muscle loss.
- It is of interest to not only look at the tongue anatomy but how the tongue is resting in the oral cavity post surgery.
- It is important to understand the change in muscle volume after a glossectomy procedure for these size tumors and how this affects formation of speech so that we can better equip our patients for post surgical rehabilitation of speech.
- This presentation is part of a larger project, which looks at tongue muscle anatomy and volume in glossectomy patients compared with controls. Future work will tie into the formation of speech sounds in these patients as well.

Fig. 1. Tongue Slices in ITK Snap



A muscle mask from a tongue anatomy atlas (Woo et al.) was overlaid on each subject's supervolume and hand corrected to align with the entire tongue volume, using ITK Snap.

MATERIALS AND METHODOLOGIES

SUBJECTS:

- 6 subjects were used in this study:
  - 3 Glossectomy patients with T1 tumors (P1, P2, P3)
  - 3 Glossectomy patients with T2 tumors (P4, P5, P6)
  - 6 Control patients (C1-C6) ages 31-61***

ID#	TUMOR SIZE	TUMOR LOCATION
Pt 1	T1	Left
Pt 2	T1	Left
Pt 3	T1	Left
Pt 4	T2	Left
Pt 5	T2 (F)	Left
Pt 6	T2	Left

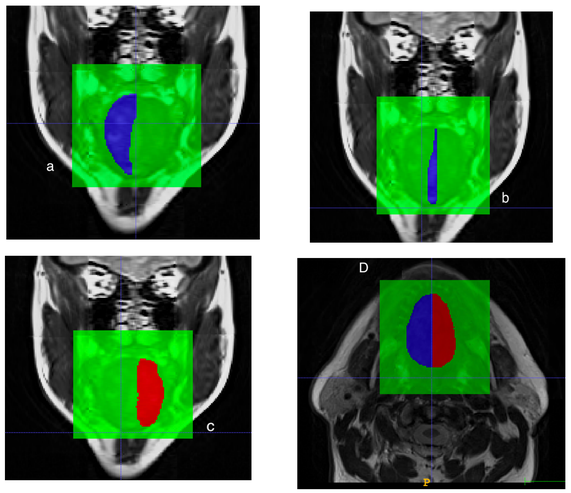
MRI DATA:

- The following parameters were used to collect high-resolution MRI data in 3 orthogonal directions (sag, axial, coronal):
  - In-plane resolution: 0.97 mm/pixel (voxel = 1 x 1 x 3 mm)
  - Slice thickness: 3mm
  - Field of view: 24cm
- Supervolume creates an isovoxel (1 x 1 x 1 mm)
  - The in plane resolution from each stack was used to create additional intervening slices that were each 1 x 1 x 1 mm.

SEGMENTATION AND VOLUME CALCULATION:

- For the anatomy, 3 masks were created that followed the contours of the borders of the tongue and septum. Contrast of supervolume was manipulated to differentiate contours.
- For the oral cavity (OC) calculation, a straight line was drawn from the junction of the central incisors to the midline of the vertebrate, splitting the tongue into tumor/non-tumor halves.

Fig. 2. Segmented tongue volumes in patients



Segmented masks for Non Tumor side (a), Septum (b) Tumor Side (c), and L and R Oral Cavity (OC) (d).

RESULTS

COMPARISON WITH CONTROL SUBJECTS:

- Means and SDs were calculated for the Control group.
- Calculated volume of entire tongue volume as well as right and left halves including and excluding the septum and overall Oral cavity (ITK SNAP v 2.2.0).[2]

Fig. 3. Volume Percentages of Non Tumor Side, Septum, and Tumor Side in Pts

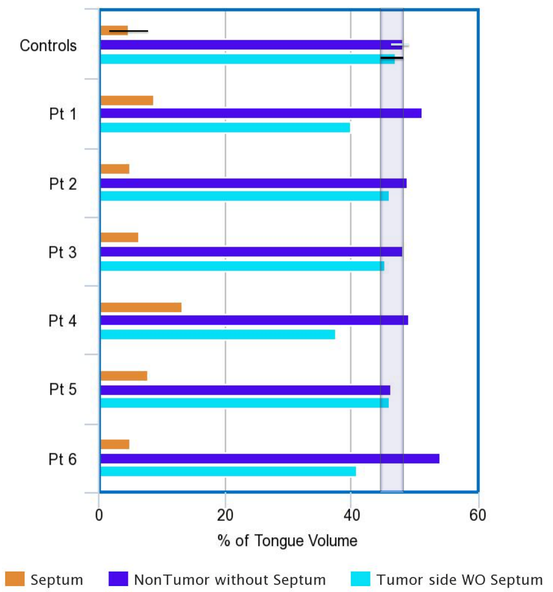
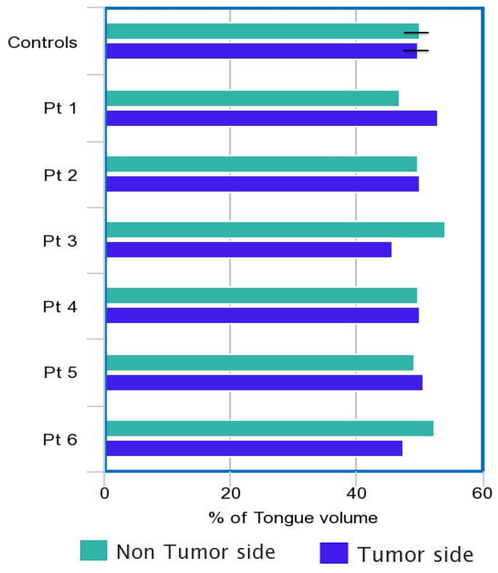


Fig. 4. Percent of Tongue in Non-Tumor vs Tumor side of OC in Pts



DISCUSSION

- In this research there were 5 specific measurements that were analyzed and compared with controls to interpret how the tongue is compensating for the muscle loss following partial glossectomy surgery.
- As expected, the Tumor side of the tongue was most affected (Fig. 3). A two tailed T test was utilized and the tumor side muscle volume % was the only measurement with a P value <0.05.
- The Non tumor side and septum values were much more consistent with the controls.
- The largest variation seen in the patients was the muscle volume of the septum. The range of these patients was as large as 2 standard deviations from the mean of the controls.
- Even with the glossectomy procedure, 3 of the 6 patients' OC measurements fell within 1 standard deviation of control subjects (Fig. 4)
- This implies that for the most part, regardless of the tongue internal symmetry, the tongue will rest symmetrically in comparison to the oral cavity.
- Limitations to this study include small sample size and variation in muscle mapping by human error.
- Future studies will utilize the OC information (Fig. 4) and the anatomical information (Fig. 3) to determine what effects the glossectomy surgery has on the septum location in relation to the oral cavity

CONCLUSIONS

- When comparing the Non-Tumor vs. Tumor side of the oral cavity (OC) there was no significant difference between the controls and subjects. This means the tongue ,despite asymmetry in muscle volume, will lie relatively symmetric in the oral cavity.
- Patients who underwent glossectomy surgery had a high variability of muscle volume on the non tumor side and septum.
- Patients who underwent glossectomy surgery had decreased muscle volume on the tumor side as hypothesized.

REFERENCES

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