Using real time magnetic resonance imaging to measure changes in articulatory behavior due to partial glossectomy

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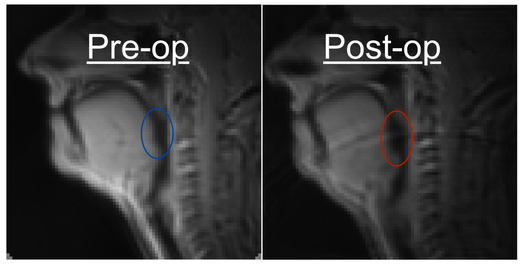
Introduction

Partial Glossectomy

Removal of cancerous tongue tissue



Provides *isolated* morphological change

Forward Map

Maps articulator position to constriction degree

Hypothesis & Predictions

Coordinated Articulator Accommodation

Jaw will compensate for change in tongue

Scarring Lessens Tongue Mobility

Post-op will have fewer degrees of freedom

Methods

Subject

Adult male speaker of British English with advanced stage tongue cancer

Scanned just before and 6 months after surgery

Real Time MRI

Images dynamic vocal tract at 83-90 fps

Crucial to observe global coordination

Stimuli

Sentences and monosyllabic words

Analysis

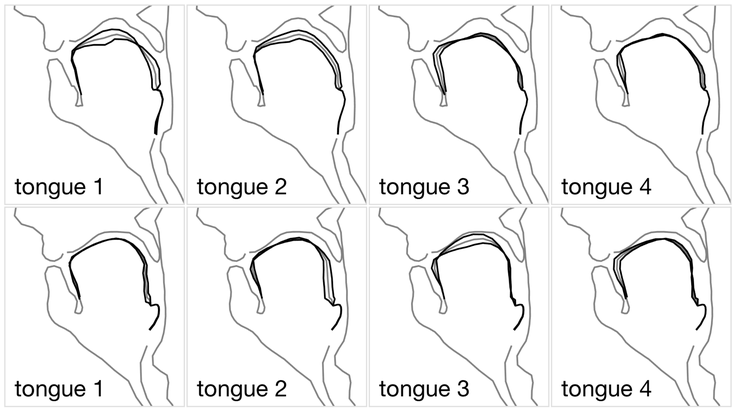
Air-Tissue Boundary Segmentation [1]

Estimates each articulator's position in every MRI frame (see highlighted frame below)

Guided Factor Analysis [3]

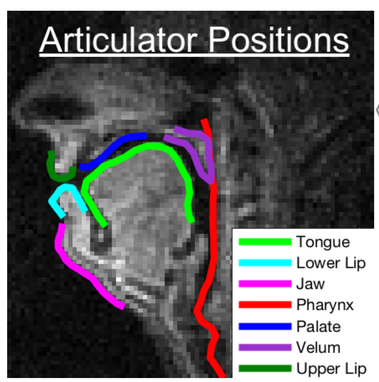
Extracts independent movement of jaw, tongue, lips, and velum

Pre-op (Top) and Post-op (Bottom) Tongue Factors

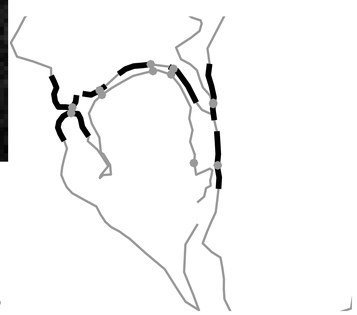


Post-op factors are *more* independent

Forward Map Estimation [2]



Constriction Degrees



Determines activation of each factor comprising an MRI frame

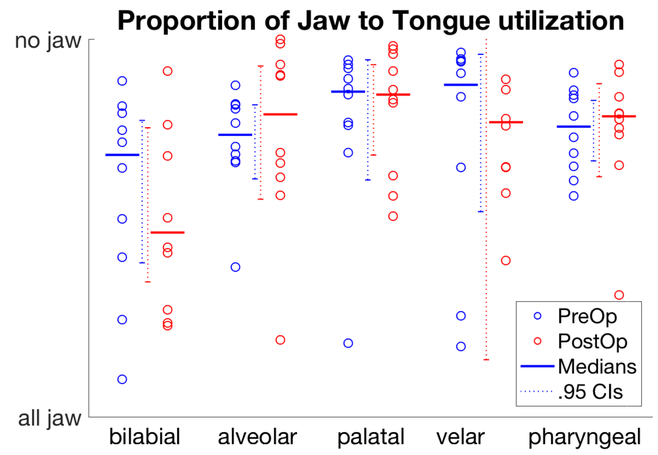
Dataset Subsampling

Created 10 subsets for each allowing within as well as across condition comparison

Results & Discussion

No Significant Jaw Compensation Found

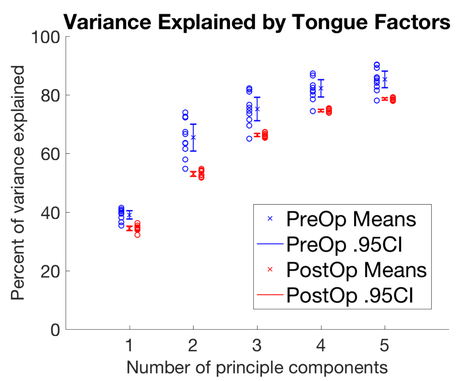
Simulated constriction task goals reveal no significant difference in articulatory strategy



Intact genioglossus and basal surgery site may mean relatively unaffected tongue

Reflects qualitative impression of relatively unaffected post-op speech intelligibility

Post-op Tongue Exhibits More Variance



Smaller tongue may require more movement to achieve same articulatory goals

Tongue backing and raising more correlated pre-op, possibly due to tumor presence