Effects of a two-arm clinical trial on voice, cough and swallow function in individuals with Parkinson's disease

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Introduction

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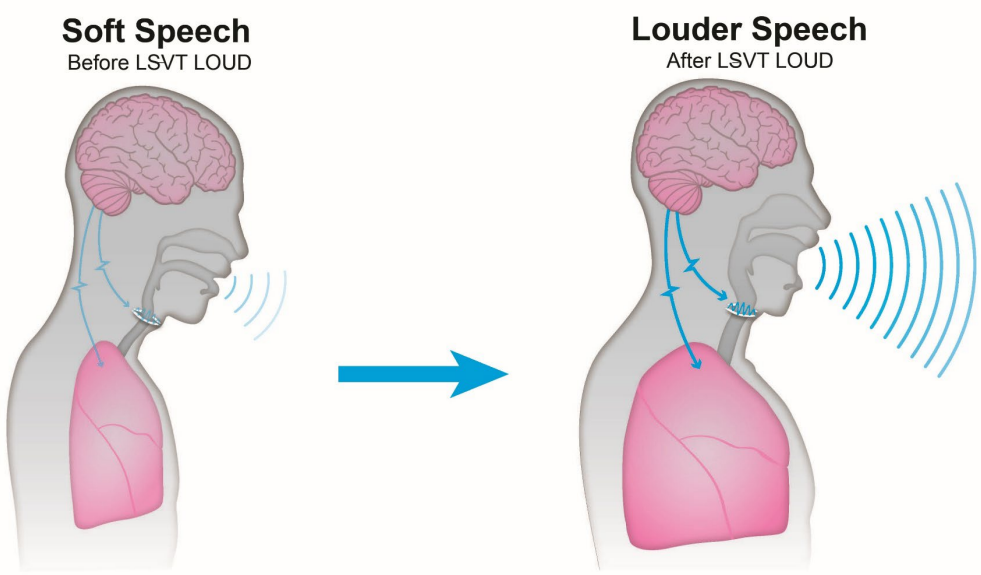
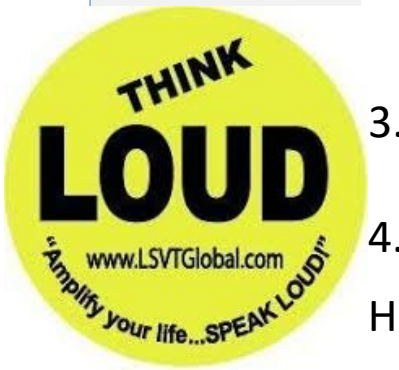
Effectiveness of **Lee Silverman Voice Treatment (LSVT LOUD)** and **Expiratory Muscle Strength Training (EMST)** on voice, swallowing and cough function in Parkinson's



LSVT LOUD has been documented to improve vocal loudness, breath support, voice quality, intonation, and speech articulation (Mahler et al., 2015). The goal is always healthy vocal loudness.

	Lee Silverman Voice Treatment (LSVT LOUD)	Expiratory Muscle Strength Training (EMST)
Focus of treatment	Vocal and speech hierarchical exercises to **improve loudness**	Device-driven treatment to **strengthen expiratory and submental muscles**
Intervention Dosage	**4 days/ week, for 4 consecutive weeks** Total sessions: 16 (one to one session with the clinician) Average session duration: **50-60 minutes**	**5 days/week, for 4 consecutive weeks** Total sessions: 20 (1day/week with clinician and 4 days/week independent sessions at home) Average session duration: **15- 20 minutes**
Activities	1. Sustained vowel /ah/ (15 repetitions) 2. High pitch /ah/ glide (15 repetitions) Low pitch /ah/ glide (15 repetitions) 3. Reading of ten functional phrases (5 repetitions) 4. Reading and spontaneous speech drills Homework tasks: every day for 4 weeks	1. Determining optimal pressure threshold level (75% load). 2. Complete five daily **sets of five breaths in each set (in total 25 blows).** - 15-30 seconds resting time in between blows. - 30-60 seconds resting time between sets.



Research Gap

LSVT LOUD	EMST
Voice exercises → ? Improve swallow function ? Improve cough strength	Expiratory muscle strengthening exercise → ? Improve swallow function ? Improve voice loudness/function ? Improve cough strength

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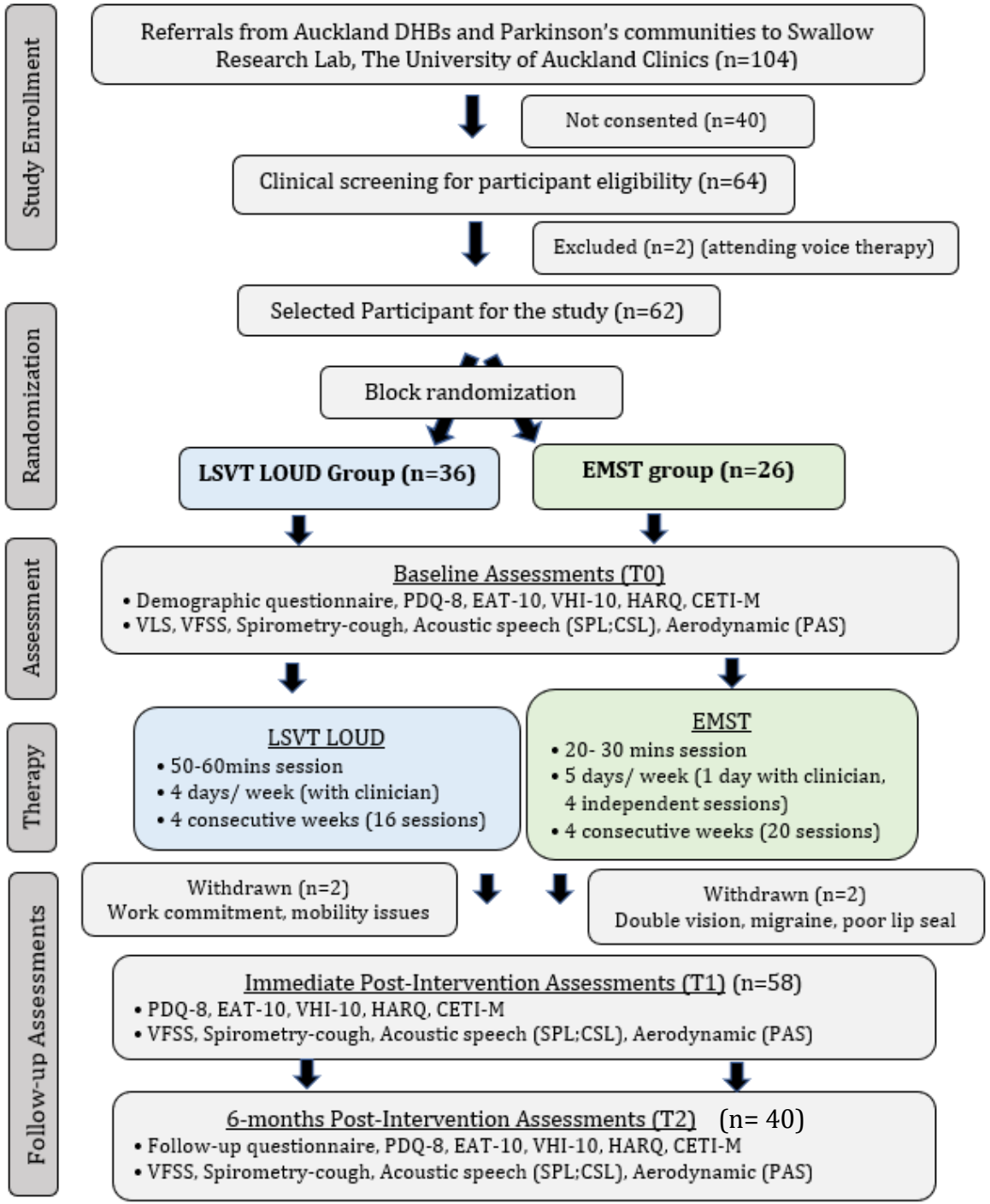
Methods



CONSORT diagram outlining the flow of the participants through the trial

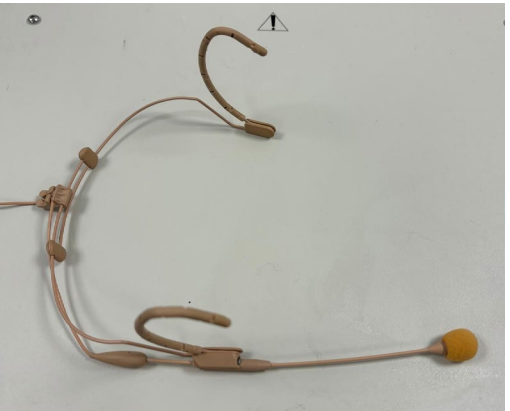
Data acquisition

- VFSS data (Swallowtail™, Bell Medical software)

- Cough study (LabChart™ software)

- Aerodynamic measures (Phonatory aerodynamic system, Model 6600)

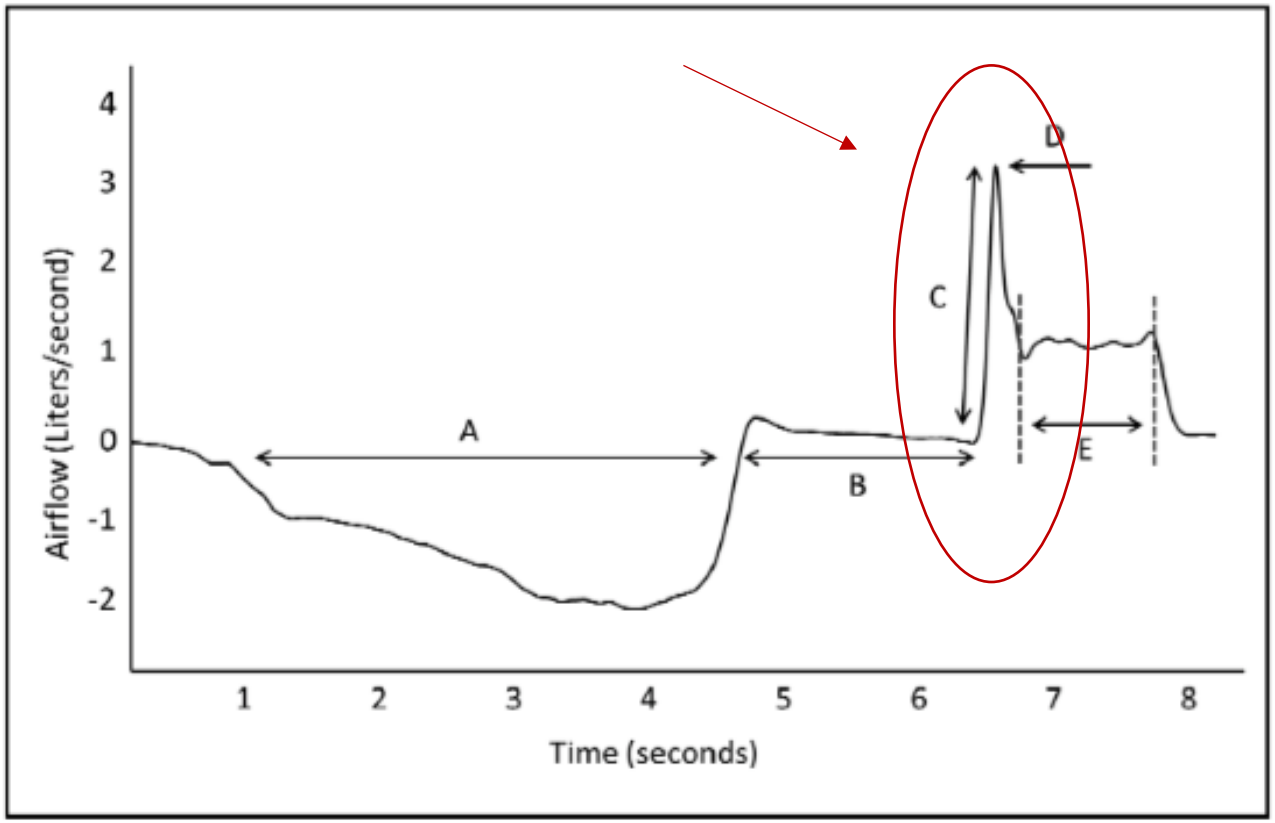
- Acoustic measures (Computerised speech lab)



- Blinded clinicians using specialist software
- Repeated measures mixed model and t-tests (SPSS v 27.0)

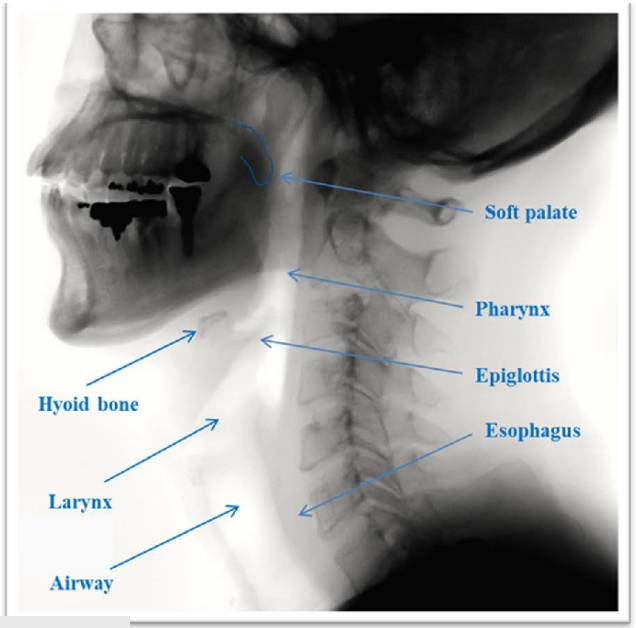
Spirometric cough studies

- **Voluntray cough measures**
- **Cough reflex test- Reflexive cough measures** (response to citric acid tussive irritant (0.8M)



Videofluoroscopy swallow studies (VFSS)

- Standard protocol (IDDSI 0- thin liquid) (using EZ-PAQUE Barium Sulfate suspension)
  - 1ml
  - 3ml
  - 20ml
  - 100ml (Straw drinking)
  - -3 cm^3 barium paste
- Performed using a Videofluoroscope (recorded at 30 frames per second)



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Results

Participants demographics	LSVT LOUD	EMST
Number of participants	**34**	**24**
Age in years (Mean, SD) (Range)	**69.35** ± 8.38 (49- 86)	**68.13** ± 8.52 (48- 81)
Gender (Male/ Female)	26/ 8	19/ 5
Years of Diagnosis (Mean, SD) (Range)	7.00 ± 5.49 (4- 18)	5.08 ± 3.37 (3- 13)
Parkinson's disease questionnaire-8 (Mean, SD) (Range) (0= no impact of symptoms, 100= maximum impact)	31.43 ± 16.55 (0- 63)	27.25 ± 14.96 (3- 53)
Eating assessment tool-10 (Mean, SD) (Range) (0-3 =normal range, 40=worse difficulties)	7.00 ± 5.49 (1- 18)	9.25 ± 6.86 (0 – 26)
Voice handicap index-10 (Mean, SD) (Range) (0-11 =normal range, 40=worse difficulties)	18.14 ± 9.84 (4 - 39)	17.21 ± 9.26 (4 - 39)
Hearing aid users	4/34	3/24
Parkinson's medication (Sinemet/ Madopar)	32/34	22/24

No significant group difference

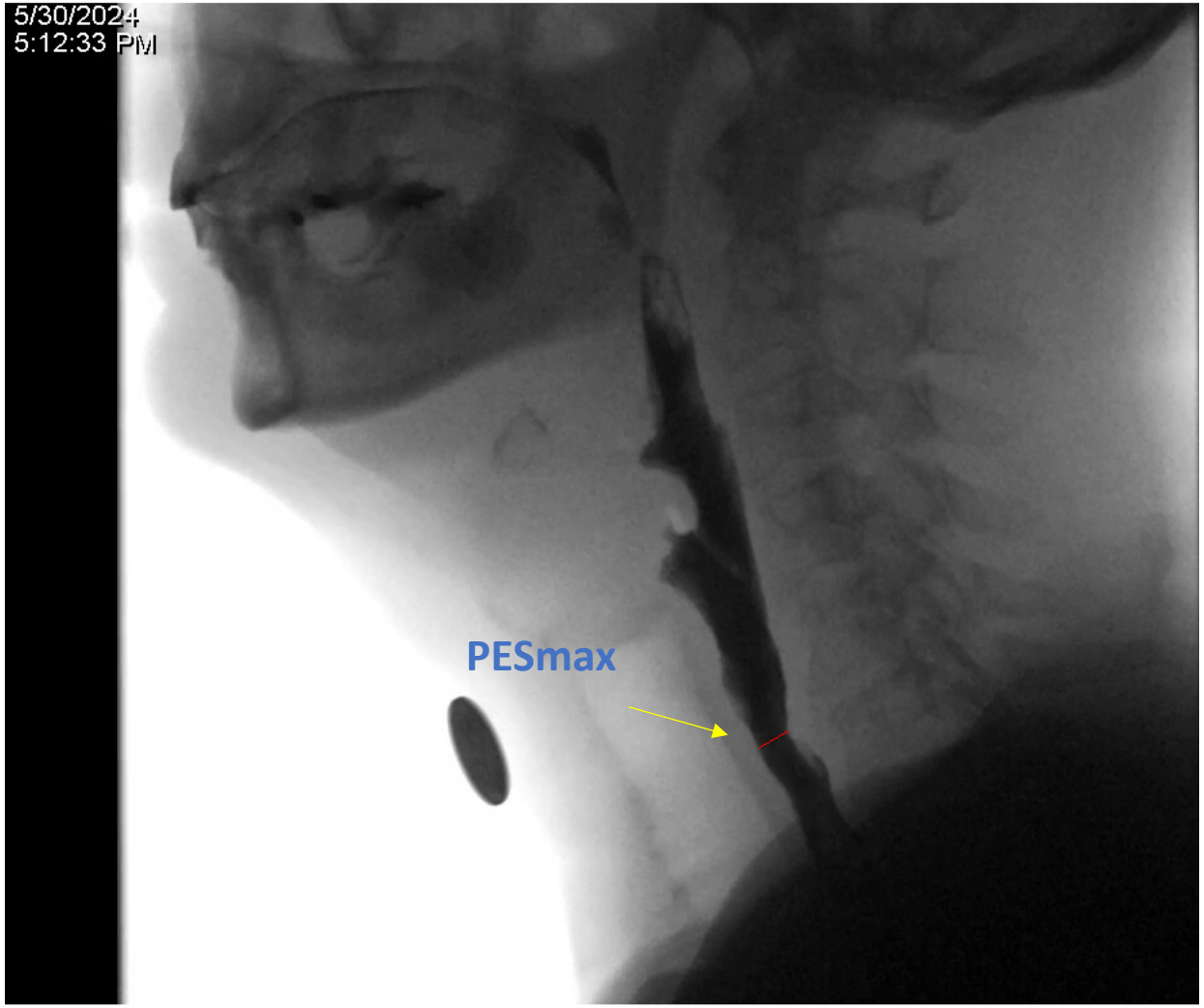
Summary findings (significant changes in the outcome measures)

Measures	LSVT LOUD within-group pre-post comparison	EMST within group pre-post comparison	Time by group interaction between LSVT LOUD and EMST
Objective swallow measures	-↓ Duration between complete closure of airway and onset of PES opening -↑ Hyoid retention at the antero-superior position during swallowing (Hdur) - ↑ Pharyngoesophageal sphincter (PES) maximum opening (PESmax)	-↑ Maximum hyoid displacement (Hmax) - ↓ Hyoid retention at the antero-superior position during swallowing (Hdur) - ↓ Pharyngeal area at rest (PAhold)	- ↑ Maximum hyoid displacement (Hmax) (significantly higher in EMST group) - ↓ Hyoid retention at the antero-superior position during swallowing (Hdur) (significantly lower in EMST group)
Voluntary cough measures	- ↑ Peak expiratory flow rate (PEFR) - ↑ Cough volume acceleration (CVA)	- ↓ Compression Phase Duration (CPD) - ↑ Peak expiratory flow rate (PEFR) - ↑ Cough volume acceleration (CVA)	None
Involuntary cough measures	- ↑ Peak expiratory flow rate (PEFR) - ↑ Cough volume acceleration (CVA)	- ↓ Peak expiratory flow rise time (PEFRT) - ↑ Cough volume acceleration (CVA)	None
Acoustic and aerodynamic measures	-↑ Sound pressure level (SPL)- comfortable sustained vowel phonation - ↑ SPL reading - ↑ SPL monologue - ↑ Maximum pitch - ↑ Pitch range - ↑ Maximum Phonation Time - ↑ Mean peak air pressure - ↑ Aerodynamic efficiency	- ↑ SPL comfortable sustained vowel phonation - ↑ Mean peak air pressure - ↑ Aerodynamic power	Significantly higher in LSVT LOUD Group - ↑ SPL comfortable sustained vowel phonation - ↑ SPL reading - ↑ SPL monologue - ↑ Maximum pitch - ↑ Pitch range - ↑ Aerodynamic efficiency

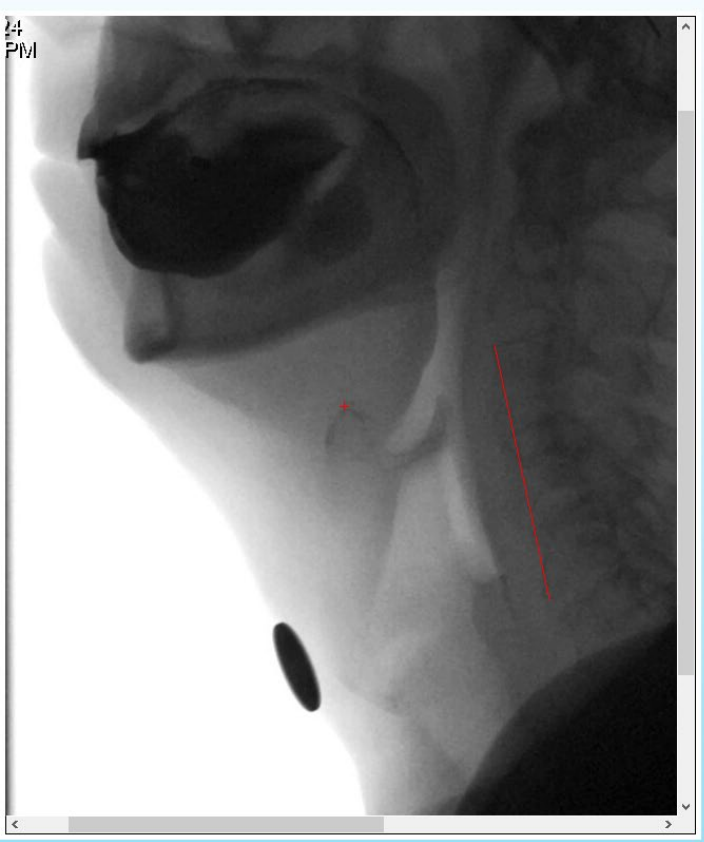
Here's what we found:

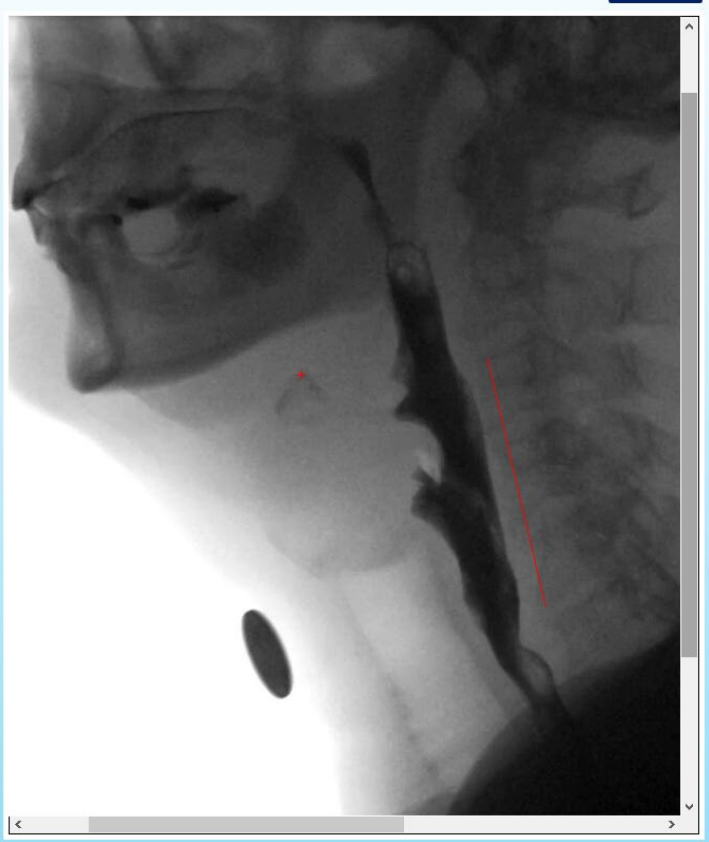
- LSVT LOUD helped more with voice improvements, including louder speech, better pitch control, and more efficiently use the airflow when you speak or make sounds.
- LSVT LOUD also improved function of part of the throat (the pharyngoesophageal segment) that's important for swallowing.
- EMST helped improve a swallowing movement called hyoid displacement that lifts and protects the airway, making it easier to swallow safely without food or drink going down the wrong way.
- There wasn't a big difference in coughing ability between the two group, both got better after treatment.
- Both therapies made people felt more positive about their voice and swallowing symptoms and feel like their voice and swallow had less of a negative impact on their lives.
- Both therapies helped with swallowing and breathing safety overall, even though they target different things.

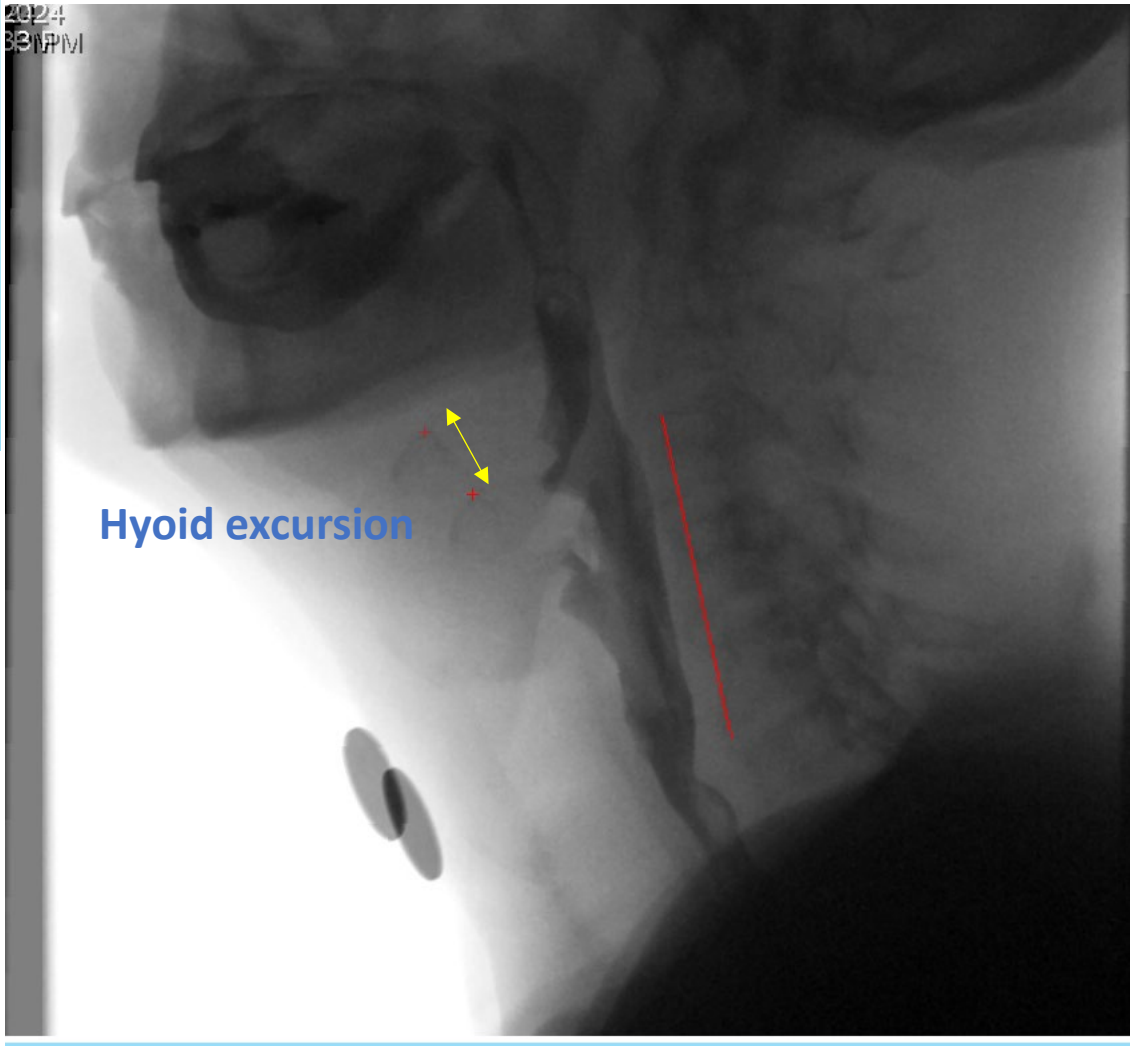
Swallowtail measures



Swallowtail measures







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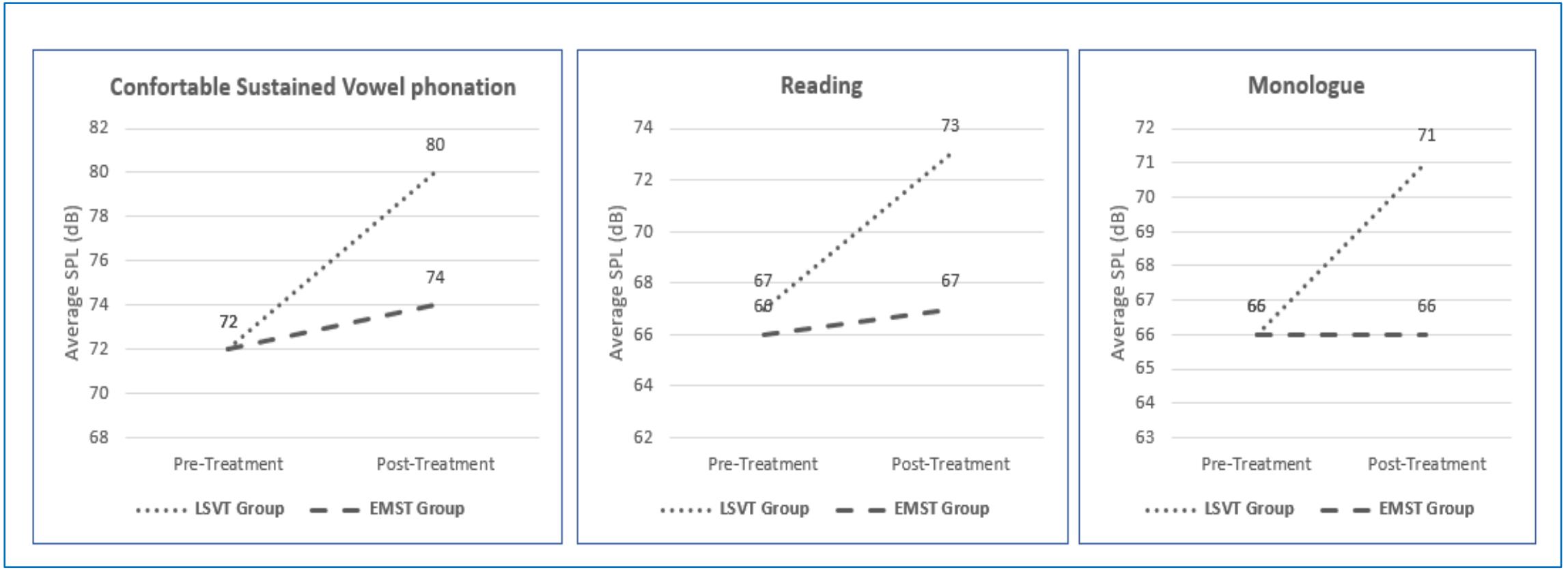
Group comparison of pre and post treatment effects on loudness for three tasks



Means for dB of SPL at 50cm at pre and post treatment for comfortable sustained vowel phonation, Reading grandfather passage, and 60 secs Monologue

Conclusion

- Despite significant differences in task and therapeutic dose, both LSVT and EMST training improved specific objective swallow efficiency and cough strength measures.
- Considering both treatments are non-invasive, viable interventions, the detailed effects of the treatments may be useful in designing a symptom-based treatment planning approach for individuals with early to mid stage Parkinson's disease.

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Thank you

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