Effects of Expiratory Muscle Strength Training on Voice and Speech in Parkinson's Disease

Hallie Samuel, BS[1]; Martin Kams, MS[2]; Kenny Nguyen, MD, MEd[1]; Lindsay Blake[1]; Ozlem Tulunay-Ugur, MD[1]

[1]University of Arkansas for Medical Sciences, Little Rock, AR [2]Arkansas Colleges of Health Education, Fort Smith, AR

Background

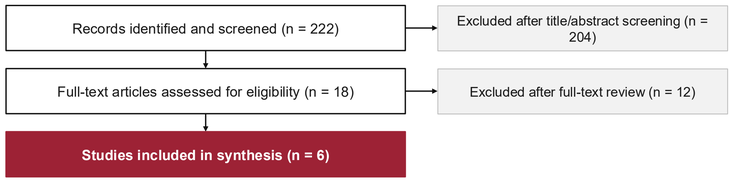
- **Up to ~90% of individuals with Parkinson's disease (PD) develop voice or speech impairment** over the course of the disease.
- The characteristic pattern is **hypokinetic dysphonia/dysarthria**: reduced loudness (hypophonia), monotone pitch, breathy or hoarse voice quality, imprecise articulation, and reduced intelligibility.
- Rigidity and bradykinesia of the respiratory and laryngeal muscles reduce **subglottic pressure and respiratory support**; vocal fold bowing and incomplete glottic closure further limit voice production.
- These deficits impair daily communication and are linked to social withdrawal and reduced quality of life. Weak expiratory muscles also contribute to **ineffective cough and aspiration risk**.
- **Expiratory muscle strength training (EMST)** is a resistance exercise for the muscles of exhalation. The patient blows forcefully through a handheld device with a calibrated one-way valve that opens only once a set pressure threshold is reached; the threshold is raised over time to progressively overload the expiratory muscles and increase maximum expiratory pressure (MEP).

Objective: To evaluate the effects of EMST on expiratory strength, voice, and speech outcomes in individuals with PD.

Methods

- Systematic review conducted according to **PRISMA** guidelines.
- **Databases:** PubMed, Embase, and Web of Science (2000–2025).
- **Inclusion:** adults with PD receiving EMST as a primary intervention; randomized and non-randomized designs.
- **Data extracted:** EMST protocol (device, duration, resistance), maximum expiratory pressure (MEP), acoustic and perceptual voice/speech outcomes, and patient-reported measures.
- Findings synthesized narratively due to heterogeneity in outcome measures.

Figure 1. Study selection



Results

Of 222 records screened, 18 full-text articles were reviewed and **6 studies met inclusion criteria**, comprising **88 individuals with PD**. EMST was delivered as the primary intervention in all studies.

Table 1. EMST protocol characteristics across included studies

Parameter	Finding
Device	EMST150
Training duration	4-8 weeks
Resistance	50-75% of baseline MEP
Participants	n = 88; mean age 66.4-70.1 y; Hoehn & Yahr I-III
Study designs	Randomized and non-randomized trials

Table 2. Outcomes following EMST by domain

Outcome domain	Measures	Studies	Direction of effect
Expiratory strength	Maximum expiratory pressure (MEP)	**6 / 6**	**Improved in all studies**
Sustained phonation	Sound pressure level; maximum phonation time	4 / 6*	Modest improvement
Patient-reported voice	Self-rated voice handicap / quality	4 / 6*	Improved in select cohorts
Connected speech	Sentence intelligibility; utterance length	4 / 6*	Variable or inconsistent

**Four studies reported voice or speech outcomes; not every study reported every measure. MEP, maximum expiratory pressure.*

- All six studies demonstrated **increased MEP** following EMST, confirming a consistent physiologic training effect.
- Gains in sustained-vowel measures (loudness, phonation time) were **modest** and were accompanied by improved patient-reported voice outcomes in some cohorts.

KEY FINDING EMST strengthened the expiratory muscles in every study, yet the gains reached conversational speech only inconsistently.

Discussion

- Improved respiratory drive did not translate uniformly into better functional speech. **Incomplete glottic closure** may limit the conversion of higher subglottic pressure into vocal output: the laryngeal valve, not the expiratory muscles, may be the rate-limiting step.
- Heterogeneous protocols, small samples, and short follow-up limit conclusions about durability and optimal dosing.

Figure 2. Where the training effect may be lost



Conclusions

- EMST **improves expiratory muscle strength** in individuals with PD.
- EMST is associated with **modest gains in sustained phonation**.
- These benefits **do not consistently extend to conversational speech**.
- **Impaired glottic closure may limit functional communication despite improved respiratory support.**

Future Directions

Studies are needed to evaluate EMST after interventions that improve glottic closure (e.g., injection laryngoplasty or medialization) in patients with PD, and to define optimal training intensity and duration.