Spasmodic Dysphonia (SD) is a neurological disorder of unknown pathophysiology, characterized by involuntary spasms in laryngeal muscles predominantly during speaking. Neural markers of SD are nonexistent, resulting in significant delays in diagnosis and treatment of this disorder.

### Background – Diagnosing spasmodic dysphonia is a challenging task

Spasmodic Dysphonia (SD) is a neurological disorder of unknown pathophysiology, characterized by involuntary spasms in laryngeal muscles predominantly during speaking. Neural markers of SD are non-existent, resulting in significant delays in diagnosis and treatment of this disorder.

### Aim – Identify objective markers of SD with structural MRI and machine learning

- 104 high-resolution T1-weighted images (52 SD patients and 52 controls)
- Two pipelines for the identification of diagnostic markers
- Four machine-learning (ML) algorithms for diagnostic classification

### Methods – Two alternative pipelines for selecting classification features

#### Supervised pipeline

- Meta-analysis (GingerALE) on six SD studies for feature selection
- Gray matter volume (GMV) and Cortical thickness (CT)

#### Semi-supervised pipeline

- Ensemble of convolutional neural networks (CNNs)
- $64 \times 256 \times 256$ $128 \times 256 \times 256$ $256 \times 96 \times 96$

### Results – Objective markers of SD diagnosis

- Linear discriminant analysis (LDA)
- Support vector machines (SVM) linear kernel and C=100
- AUC = 72.2%
- AUC = 70.2%
- AUC = 66.4%
- Neural network (NN) one hidden layer, 12 neurons
- Ensemble of CNNs
- AUC = 68.0%

### Conclusions and Future Work

- High accuracy of objective diagnosis based on the use of both supervised and semi-supervised ML and neural alterations in spasmodic dysphonia
- Accuracy of ML-based diagnosis outperforms more than two-fold the diagnostic agreement between physicians: 72% (this study) vs. 34% (Ludlow et al., 2018)
- Future: Larger sample size may improve the accuracy of CNNs

### $ Funding

Funding provided by the National Institute of Dental and Craniofacial Research (NIDCR) and the Richard and Linda Richardson Foundation.