Expiratory Muscle Retraining for Neurogenic Speech Disorders in Children and Adults

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# Anatomy Review

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**Muscles of Inspiration**
- External Intercostal Muscles & Intercartilaginous Intercostal Muscles
- Diaphragm
- Sternocleidomastoid & the Scalene Muscles
Inspiration

- Thoracic muscles contract to elevate the lower ribs, increase thoracic space and decrease pressure
- The diaphragm contracts and flattens to also increase thoracic space
- The neck muscles elevate the sternum and upper ribs

Expiration

- Thoracic muscles contract to lower the upper ribs and decrease thoracic space
- The anterolateral abdominal muscle contracts and causes the thorax to decrease and pressure to increase, so we exhale
Neurogenic Communication Disorders

* Various neurogenic communication disorders have detrimental effects on the respiratory muscles
  - impaired respiration
  - weak cough
  - impaired sound pressure generation
  - impaired speech: vowel prolongation, voice quality

* Neurogenic Communication Disorder:
  - Multiple Sclerosis
  - Myesthenia Gravis
  - COPD
  - Various Dysarthrias
  - Parkinson’s Disease
Multiple Sclerosis

- **Multiple Sclerosis (MS)** is a neurogenic disease of demyelination and axonal damage in the CNS.
  - Degeneration has been shown to affect respiratory muscles, particularly the expiratory and laryngeal muscles (2009).
  - This results in decreased pressure build up for speech production (especially sustained phonation)

Chiara, Martin, Sapineza, 2009
Case Study– MS

- **Participants**: 17 subjects with MS
  - 14 healthy control
- **Procedure**: Subjects participated in expiratory muscle training 5 times per week for 8 weeks (once supervised, the rest at home).
  - They used a Positive Expiratory Pressure (PEP) threshold trainer with resistance.
- **Assessment**:
  - Maximum expiratory pressure (MEP)
  - Sustained Vowel Prolongation (SVP)
  - Words Per Minute (WPM)
  - Quality-of-life related to dysarthria and dysphonia

Chiara, Martin & Sapienza, 2009
Results

- Prior to training the participants with MS had a lower expiratory pressure threshold, shorter vowel prolongation, and less words per minute compared to the healthy controls.
- After the 8 week training period, results indicated significant improvements in maximal expiratory pressure thresholds for both groups. These lasted after the training period had ended.
- No improvements in voice production or voice–related quality of life were observed for patients with MS.

Chiara, Martin, Sapineza, 2009
Bilateral Abductor Vocal Fold Paralysis

- Common cause of hoarseness and stridor in children.

- May affect normal laryngeal functions such as, voice production, respiration and swallowing.

- Treatment can include surgery in order to open the airway.

- Tracheostomy is required for some patients.

Baker, Sapienza & Collins, 2003
Case Study: Bilateral Abductor Vocal Fold Paralysis

- **Participant:** 6 year old female diagnosed with congenital bilateral abductor vocal fold paralysis

- **Procedure:** Subject participated in inspiratory pressure-threshold training program.
  - She used a Inspiratory Pressure–Threshold Trainer

- **Assessment:** – Maximum Inspiratory Pressure (MIP)

Baker, Sapienza & Collins, 2003
The patient showed a steady increase each week during the training program. During the third week of the program she recorded her highest MIP of 81 cmH2O. However following the fifth week the patient acquired an upper respiratory infection which caused the program to end for several weeks. During this period her MIP decreased to 61 cmH2O.

After 4 months of participating in the program the parents reported the training was taking its toll on the patient. The number of training sets was decreased to three. The patient maintained an MIP of 63 cmH2O which was 50% higher than her initial MIP. At 8 months of training the patient has now increased her MIP to 81 cmH2O.

Patient reported less breathlessness and ease of speaking during light exercise. Parents reported toleration during increased amounts of exertion.
Case Study: Expiratory Muscle Strength Training Programs in Individuals with Idiopathic Parkinsons disease (IPD).

- **Participant:** 3 participants
  - 1 male
  - 2 females
  Moderately severe IPD

- **Procedure:** Subject participated in a 4 week trial of expiratory muscle strength training program (EMST)
  - They used a Expiratory Pressure Threshold Trainer

- **Assessment:** – Maximum Inspiratory Pressure (MIP)
  Maximum Expiratory Pressure (MEP)
Parkinson’s Disease Affects:

- Swallow
- Cough
- Voice & Speech
- Problems with endurance and maximal fitness levels
- Pulmonary dysfunction (aspiration pneumonia)

Silverman et al., 2006
Results

- **Increased MEP measures**
  - Participant 15 increased 91.3%
  - Participant 21 increased 75.3%
  - Participant 23 increased 79.5%

- **Increased MIP measures**
  - Participant 15 increased 82.9%
  - Participant 23 increased 120%
  - Participant 25 increased 54.4%

- Further research is needed with a larger population size.

Silverman et al., 2006
Conclusion

- Substantial increase in MIP and MEP measures were observed.

- Voice quality effects varied.

- Results suggest it is an appropriate and effective treatment approach for patients with respiratory weakness due to a neurological disorder.

Silverman et al., 2006
References


