

# **Cerebral Palsy and The EmBrace®**

## **How Weak Breathing Muscles Affect Vocal Skills and Function**

### **A Case Study**

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*Weak breathing muscles  
impact posture, head  
position, cough quality,  
communication, and fine  
motor skills*

Weak breathing muscles are a common issue for many diagnoses and conditions. Individuals with Cerebral Palsy are not exempt from this.

In the clinical setting, a realization is needed that symptoms of poor endurance, weak voice, weak cough, poor posture, poor head control, and restricted shoulder range of motion indicate a root cause of weak respiratory accessory muscles. Clinicians and therapists tend to overlook this underlying factor. The concerns related to weak breathing muscles have been researched, but the treatment options available are limited. The most widely recognized method to strengthen respiratory accessory muscles is by using a type of airflow restriction – with devices such as a POWERbreathe® or an incentive spirometer – to impede airflow during inspiration or expiration.

The purpose of this case study is to review the impact of weak breathing muscles, identify the functional implications for Cerebral Palsy and share the story of one child's response when addressing the issue of weak breathing muscles using an alternative strengthening approach, The EmBrace® Exercise Device.

#### **Overview of weak breathing muscles**

Individuals who have been diagnosed with Cerebral Palsy are often observed to present with challenges in communication, poor core stability and posture, decreased endurance, along with being at risk for respiratory infections.

It has been shown that every muscle of the lower and upper core has two roles – respiratory and postural function (Hodges et al., 2002; Siafakas et al., 1999), and the effects of weak breathing muscles are multiple: impacting language, posture, mobility, head position and control, cough quality and fine motor skills.

Weak ribcage muscles are unable to lift the ribs (Massery, 2005). This “collapse” of the ribcage – because of the weak breathing muscles – makes it difficult to sit upright regardless of the time and effort spent in practice. With this poor posture, the natural need to breathe automatically overrides the posture role of the trunk muscles (Hodges et al., 2001; Gandevia et al., 2002). Then, as the respiratory muscles become overworked, they are less able to assist with posture. (Massery, 2005).

With this weakness of the respiratory muscles, the “collapse” of the chest prevents lung expansion and causes restricted air movement in

*A weak upper core has a negative effect on vocal skills*

and out of the lungs, resulting in shortness of breath, poor endurance and general fatigue. (Shahrizaila et al., 2006; Syabbalo, 1998).

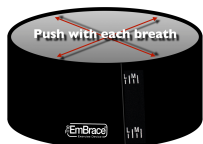
Diminished lung expansion limits a person's cough quality since the small breathing muscles are not strong (Park et al., 2010), and speech can be challenging, requiring multiple breaths to say a full sentence. The small inspirational volume results in a quiet speaking voice (Huber, 2008). If a child, who is developing in his speech, does not have adequate breath support, he will most likely experience articulation difficulties. He may shorten his words by saying "ca" the word "car." The very short vocal production does not give the child enough time to learn the oral motor pattern to include the "r" at the end of the word. The result is that the parent, or classroom instructor may not understand the vocal attempts correctly.

Weakness of the respiratory accessory muscles may cause a slouch in posture, along with a forward head position (Hodges et al., 2002). The result is a downward gaze, creating a low and limited visual field (Massery, 2005). Along with these issues, a decline in mobility is directly associated to the weakness of the breathing muscles (Buchmana et al., 2008). The slouched posture affects the function of the shoulder, as the shoulder blade cannot be held in a stable position and results in decreased support required for arm and hand movements. For children with developmental delays, this interferes with the progress of fine motor skills and coordination of the hand (Lauer & Prosser, 2009; Ludewig & Reynolds, 2009; Massery, 2005).

With all of the functional impacts that weakened respiratory accessory muscles have, the positive side is that research has shown that breathing muscles can be strengthened through exercise (Baldwin & Haddad, 2002; Booth & Thomason, 1991; Enright & Unnithan, 2011).

### **A new approach to strengthening weak breathing muscles**

The EmBrace<sup>®</sup> Exercise Device was designed by a physical therapist specifically to exercise and strengthen breathing muscles. It is not a support or bracing device, but it is worn around the chest and activates strengthening of the upper core muscles through gentle resistance to inspiration. When wearing The EmBrace<sup>®</sup>, exercise occurs with the gentle push of each inspiration as the breathing muscles are triggered to work harder than they normally do.



Designed for the medically fragile, The EmBrace<sup>®</sup> does not restrict any air flow, but strengthens the respiratory accessory muscles using a graded and progressive resistance band around the chest. The EmBrace<sup>®</sup> has been designed to be used by children and adults; it can even be used by any individual who is unable to follow instructions, as a caregiver can assist in putting it on the individual, making the adjustments, and removing it.

### **Impacting function for Oscar**

Oscar, a 10-year-old with Cerebral Palsy, was referred to physical therapy by his Speech Therapist. The assessment of his functional skills, vocal challenges, posture, along with his mother's concerns

*An alternative approach was taken to address the underlying weakness – that of the small accessory breathing muscles*

identified the following:

- He used a wheelchair for mobility
- Had had a history of receiving Speech Therapy (ST) for most of his life
- His Speech Therapist stated that she was unable to make any improvement in his vocal ability or breath suspension necessary to speak louder and clearer, after two years of therapy
- He was described as withdrawing from group settings because he was unable to vocally participate in peer or family activities
- His speech was weak and very quiet
- He had extremely poor articulation with any attempt to speak quickly or loudly
- He was unable to be understood when attempting to say more than 3-4 words per sentence
- His mother reported daily frustration on her part and the child's part, due to his communication difficulties
- He had a kyphotic (rounded) back posture while seated
- He could only sit on the sofa for a few seconds without support before falling to the side or backward
- He had a very weak cough
- He had minimal chest rise with inspiration, as observed by the Speech and Physical Therapist

**Pre-Test ST Vocal Skills: Generating Specific and Maximal Sounds on a Single Breath** (Measurements in seconds unless indicated)

Sustained ah-ah	3.1
Sustained s-s-s	3.2
Oo-ee Repetitions - Timed	2.5
Oo-ee Repetitions Max	3 reps
Pa-pa Repetitions - Timed	1.4
Pa-pa Repetitions Max	4 reps
La-la Repetitions - Timed	2.7
La-la Repetitions Max	7 reps
Ca-la Repetitions - Timed	2.0
Ca-la Repetitions Max	4 reps
Pa-ti-ka-pa-ti-ka Repetitions - Timed	2.2
Pa-ti-ka-pa-ti-ka Repetitions Max	3 reps
Counting 1-50: Number of breaks to take a breath	3 breaks
iPhone dB Meter @ 3'	Not tested

In review of this child's issues and the therapeutic interventions generally used to address the concerns, his Speech Therapist requested the use of The EmBrace® to address the underlying weakness of the small accessory breathing muscles.

Oscar was fitted for The EmBrace® and the protocol of wearing it for three hours per day was initiated. His mother was diligent in using it as instructed for most of the six months. Adjustments were made at monthly intervals per the protocol. No other therapeutic interventions

were used during the six-month time period of using The EmBrace® Exercise Device.

The changes in Oscar’s vocal skills were significant. Improvements were seen at the start of the second month as his ability to easily communicate with family members, who were either across the room or even in another room, was observed. Measurements were taken monthly and steady vocal improvements were noted. At the end of the six-month protocol of The EmBrace®, the changes were significant and life changing for this child and his family. Oscar’s improved breath suspension provided a foundation for better articulation, as outlined below:

*Improving vocal abilities directly impacts quality of life*

**6 Month Post-Test ST Vocal Skills: Generating Specific and Maximal Sounds on a Single Breath** (Measurements in seconds unless indicated)

Sustained ah-ah	14.3
Sustained s-s-s	7.1
Oo-ee Repetitions - Timed	7.9
Oo-ee Repetitions Max	12 reps
Pa-pa Repetitions - Timed	13.3
Pa-pa Repetitions Max	24 reps
La-la Repetitions - Timed	9.6
La-la Repetitions Max	25 reps
Ca-la Repetitions - Timed	9.1
Ca-la Repetitions Max	12 reps
Pa-ti-ka-pa-ti-ka Repetitions - Timed	7.4
Pa-ti-ka-pa-ti-ka Repetitions Max	6 reps
Counting 1-50: Number of breaks to take a breath	1 break
iPhone dB Meter @ 3’	87.1 dB

The functional changes were remarkable for Oscar.

- He became very social – able to vocally participate in peer or family activities, and no longer withdrawing from group settings
- His speech was strong and very loud – able to compete with peers in a loud group
- He had a significant improvement in his articulation when speaking quickly or loudly
- He could easily be understood when saying more than 3-4 words per sentence
- His mother reported that her frustration with his communication, and Oscar’s frustration in not being able to communicate, had resolved due to his vocal skills and communication improvements
- His kyphotic (rounded) back posture with sitting corrected significantly as he could sit up straight for up to 30 minutes at a time
- He was able to sit unsupported on sofa for more than 90 minutes without falling to the side or backward
- He had a very strong cough

*Weak breathing muscles: a roadblock to function that can be removed!*

*In general, the link between weak breathing muscles and function cannot be stressed enough*



*Oscar's life has forever changed!*

- He had good chest rise with inspiration, as observed by the Speech and Physical Therapist

In addition to the vocal changes and improved core strength, Oscar's mother reported that his asthma symptoms had decreased significantly by the end of the second month of using The EmBrace®. She stated that he did not use his inhaler for almost four months, whereas he had needed it daily prior to starting with The EmBrace®.

Oscar is a good example of how addressing the issue of weak breathing muscles can have a direct impact on life for a person with Cerebral Palsy. In general, the link between weak breathing muscles and function cannot be stressed enough: the ability to maintain posture and head control, and to vocalize and communicate, impacts every aspect of a person's development and daily activities.

### **Conclusion:**

While this case study is only regarding one individual, the significance of improvement was noted in multiple areas. For Oscar, these improvements provided a foundation necessary for general communication with his family, and for Speech Therapy to work on social communication skills.

The EmBrace® Exercise Device is a new exercise option for individuals dealing with Cerebral Palsy. In six months, Oscar's life and abilities have forever changed by strengthening his upper core muscles! He is one example of how significantly life can be affected when the respiratory accessory muscles are strengthened through the progressive resistance home exercise program of The EmBrace®.

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