Deciphering Dysphagia
with E-Stim

Neuromuscular electrical stimulation can help you successfully treat dysphagia by **jump-starting** the biomechanical movement of swallowing.

By Russ Campbell, LPT, Ronda Polansky, MS, CCC-SLP, and Rick McAdoo, MS, CCC-SLP

EATING AND DRINKING COMES NATURALLY FOR MOST OF US. For people with dysphagia, swallowing a bite or a sip is difficult—and in some cases deadly.

This complex condition is not easily solved. But a new treatment approach using neuromuscular electrical stimulation (NMES) may hold a hint to the riddle of dysphagia.

NMES has proven successful in treating a variety of neuromuscular and musculoskeletal problems, provided the peripheral nervous system is intact. It has been reported to increase strength and range of motion, facilitate weak contractions due to upper-motor neuron lesions or disuse atrophy, and re-educate muscles.[1-5]

In dysphagia rehabilitation, NMES can jump-start the biomechanical movement of the anatomical structures associated with swallowing. These include the mylohyoid, geniohyoid and anterior belly of the digastric muscles, which are primarily responsible for anterior and superior movement of the hyoid bone during a swallow. This movement of the hyoid and laryngeal elevation is vital in preventing aspiration. The superior movement of the larynx helps bring the airway safely away from the path of the bolus.

A preliminary study performed at our facility has located a motor point that can be stimulated to promote laryngeal elevation, which is often a problem in dysphagia. A physical therapist set the parameters for the electrical stimulation, and a speech-language pathologist analyzed the laryngeal elevation.

A Computerized Laryngeal Analyzer (CLA),[6] approved by the FDA for diagnosing and treating swallowing disorders, was used as the measuring instrument.

The technology is noninvasive; it measures the biomechanical movements during the swallow and automatically calculates and displays the duration of the laryngeal motion. This allows the clinician to record the swallow pattern, intensity and timing and assign them a quantitative value.

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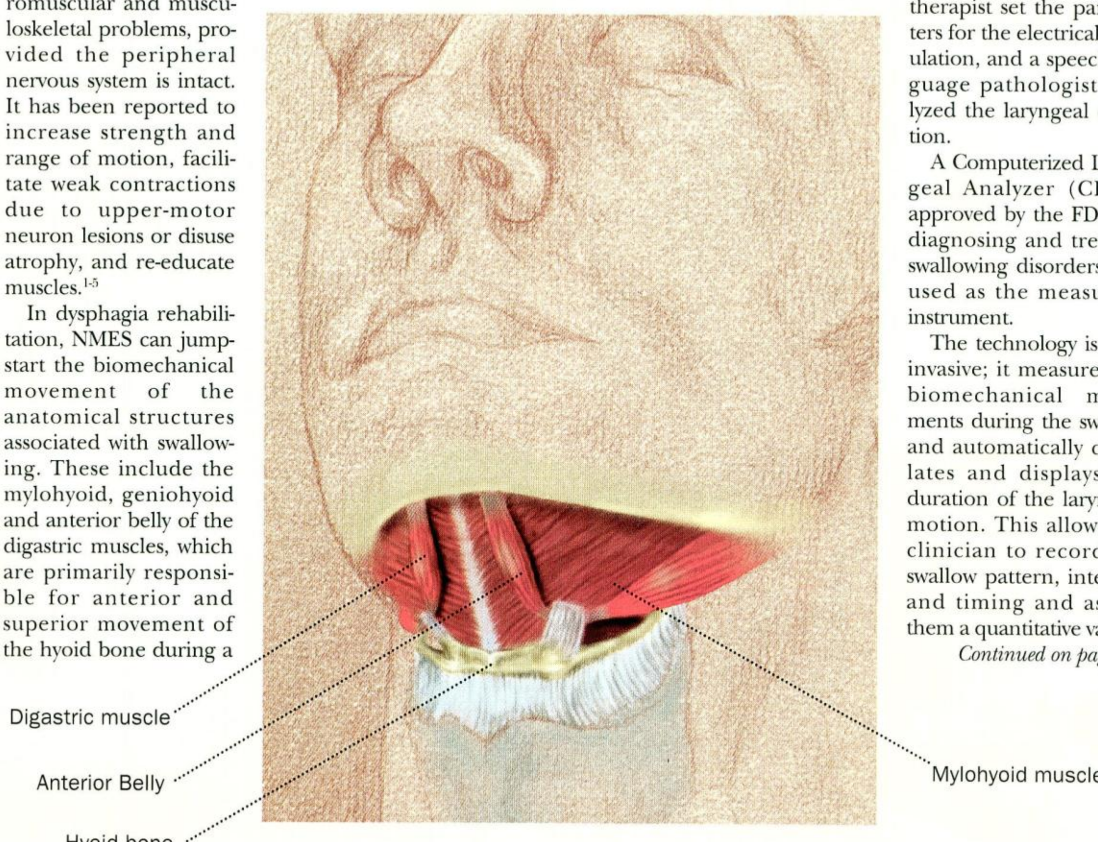

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The CLA uses a thin film piezoelectric transducer, software and a high-speed computer to provide on-line and real-time display. The graph displays superior and anterior planes of movement upward and inferior, and posterior planes of movement downward. Wave forms on the CLA correspond to the laryngeal muscles' activity during the swallow.

To use NMES to promote laryngeal elevation while recording it using the CLA, clinicians attach a piezoelectric transducer to the subject's thyroid cartilage. Three dry swallows are monitored by the CLA.

Next, two moveable electrodes connected to a neuromuscular electrical stimulator are placed over the region of each belly of the anterior digastric and mylohyoid muscles. The benefits of targeting these muscles are twofold: They voluntarily assist the end of the oral stage through the elevation of the tongue, and the muscles contract during the pharyngeal stage, assisting elevation of the larynx.[7]

The electrodes are placed on an area between the oral cavity and the circumference of the neck to decrease the risk of adverse effects as listed by the FDA. The electrodes are housed in plastic caps with a moist sponge of water conducting the current to the muscles.

The patient is asked to hold the NMES unit while pressing the constant stimulation (CS) button and increasing the intensity until a vibration is felt. The physical therapist moves the electrodes on the muscle until he finds a motor point and observes visual tetanizing contraction. A motor point is where a motor nerve enters the muscle it innervates.[8]

To achieve a visible contraction, the patient may need to increase the intensity. If the intensity becomes uncomfortable without visible contraction, the electrodes may be over a sensory nerve point. Once the motor points are found, the patient will increase the intensity to maximum tolerance and release the CS button.

The physical therapist then takes the NMES unit from the subject and stimulates the area three times for approximately four seconds each, while the patient holds the electrodes and maintains a neutral head and neck position. Each subject is instructed to look straight ahead and not assist or resist the contraction in any way during each four-second trial.

Approximately 15 to 30 seconds of rest time are given between stimulation trials while the speech-language pathologist assesses the elevation in millivolts on the CLA. The parameters include:

- a pulse rate of 30 Hz with a preset pulse width to produce a tetanizing muscle contraction with minimal muscle fatigue[5]
- a .4-second ramp to allow for rise in intensity
- symmetrical biphasic waveform to efficiently stimulate both electrodes.[9]

After the .4-second ramp of stimulation, an initial recruitment of the platysma creates a downward motion of the larynx. The platysma—a broad thin layer of muscle situated on each side of the neck immediately under the superficial fascia—draws the lower lip and corner of the mouth to the side and down. When moved forcefully, it expands the neck and draws the skin upward.[10] After involving the platysma, the suprahyoidal musculature then elevates the larynx. This pressure is maintained with some fasciculations until the stimulation is released at the four-second frame on the CLA graph.

Properly placing the two electrodes over the motor points of each belly of the anterior digastric and/or mylohyoid muscles elicited mea- ▷

PHOTO/COURTESY BOWIE REHABILITATION SERVICES

In using neuromuscular electrical stimulation to treat dysphagia, therapists place the electrodes on an area between the oral cavity and the circumference of the neck. The patient is then asked to hold the NMES unit while pressing the stimulation button and increasing the intensity until a vibration is felt.

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The movement recorded averaged a mean of 40.04 mV on 25 people through using NMES only. The participating subjects recorded a mean of 52.6 mV on a normal dry swallow, with consistent waveforms. These two results denote that NMES elicited 76 percent of the mean laryngeal elevation of the normal swallows.

The initiation of movement achieved through electrical stimulation recorded on the CLA resembles a pattern that demonstrates laryngeal elevation while maintaining stimulation for four seconds.

Movement of the larynx was displayed when the stimulation began. During the stimulation, the larynx is held in position; therefore, there are no changes in pressure from the thyroid cartilage and the piezoelectric transducer. This is demonstrated by the return of the graphic display to the 0 millivolt level.

At the stimulation release, a new change in pressure occurs when the larynx returns from the elevated position. It is significant that a sustained elevation was achieved by stimulation only (no swallow initiation) and required no understanding or mastering of a special instruction or technique. Patterns and millivolts were comparable to each person's normal laryngeal elevation pattern and the amount of intensity tolerated (intensity range 15-25).

These preliminary findings indicate a positive breakthrough in the

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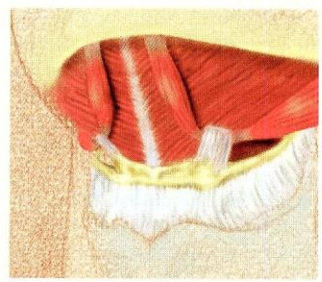

use of NMES in dysphagia rehabilitation. Electrical stimulation can promote laryngeal elevation without a volitional response from the subjects. In the future, this process could be used with other instrumental examinations to investigate epiglottic closure and esphageal sphincter elongation. One day, this research could yield the final clue to deciphering dysphagia. ■

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