Deciphering Dysphagia with Ampcare's Effective Swallowing Protocol (ESP™)

Training for the Use of Ampcare's ESP in the Treatment of Dysphagia

PRESENTED BY:

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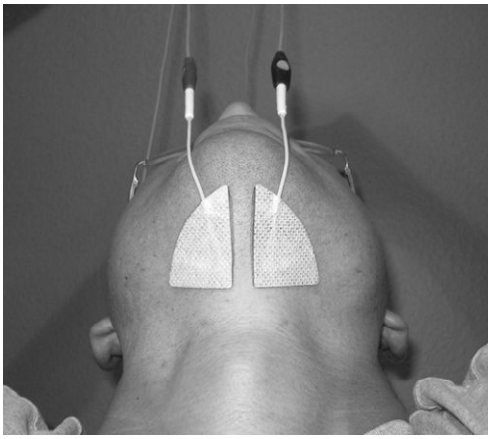

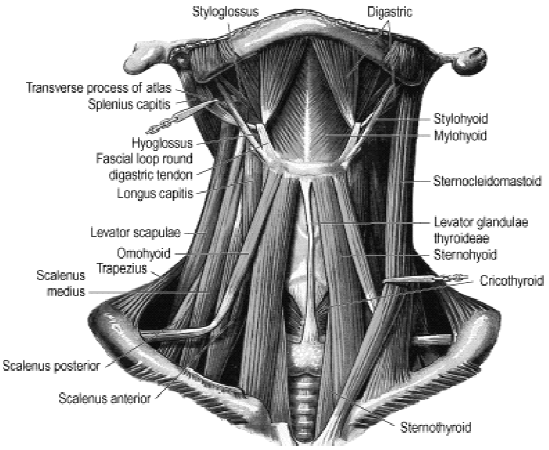

Presenters

Russell Campbell, PT Ronda Polansky, M.S., CCC-SLP Rick McAdoo, M.S., CCC-SLP

- Russ Campbell practices physical therapy and specializes in the areas of neurology, orthopedics and gerontology; he brings over 30 years of extensive experience in using therapeutic modalities to maximize patient outcomes and is licensed in Texas and Illinois.
- Ronda Polansky is an active clinical Speech Pathologist and co-owner of DiagnosTEX, a mobile modified barium swallow study company in Dallas/Fort Worth, Texas. For over 25 years she has focused her interests on patients with dysphagia.
- Rick McAdoo is recognized for his expertise in working with the adult neurogenic population with specialized emphasis in dysphagia. He was the first to show laryngeal elevation using transcutaneous electrical stimulation on both a computerized laryngeal analyzer and under video fluoroscopy in 1997.
- Collectively Russ, Ronda and Rick are the founders and co-owners of Ampcare, LLC, which was established to develop therapeutic neuromuscular stimulation technologies for the treatment of dysphagia. Among other accomplishments, Ampcare has built a strong patent portfolio, generated clinical data and developed an FDA-cleared therapy system known as the Effective Swallowing Protocol (ESP™) for the treatment of dysphagia. Ampcare is committed to delivering positive patient outcomes and innovative products specifically designed to meet the needs of the patient, medical professional and payer by improving the options and availability of dysphagia treatment techniques.

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Presented by Ampcare, LLC
- Rick McAdoo, M.S., CCC-SLP
- Russ Campbell, PT
- Ronda Polansky, M.S., CCC-SLP

Deciphering Dysphagia with Ampcare's Effective Swallowing Protocol (ESP™)

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Disclosures

Rick McAdoo and Russ Campbell receive a salary and have intellectual property rights, hold a patent on the equipment, and have an ownership interest in Ampcare LLC. They have employment, a management position, an ownership position, and speak for Ampcare, LLC. Rick and Russ have no existing non-financial relationships.

Ampcare

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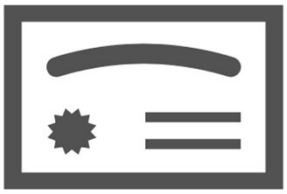
Purpose



Certification Training for Ampcare's
Effective Swallowing Protocol (ESP)
in the treatment of Dysphagia

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Objectives

- **Review research data using ESP**
- **Enhance knowledge in anatomy, physiology and kinesiology for swallowing**
- **Discuss rationale for using NMES for improving swallowing muscle function**
- **Understand the principles of electrophysiology**
- **Demonstrate and practice the protocol**
- **Educate on documentation and billing specifics**

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Dysphagia Prevalence

6% of Overall Global Population (8B $\Rightarrow$ 480M)

36.5% in Hospital Setting

42.5 % in Rehabilitation Setting

50.2% in Nursing Home Setting

Rivelsrud et al., 2023

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Risks for Aspiration

Reduced or delayed hyolaryngeal elevation is the most common cause of dysphagia and aspiration.

Sundgren et al., 1993,, Leopold et al., 1997, Nagaya et al., 1998, Lundy et al., 1999, Burnett et al., 2003

Reduced hyoid movement – 3.7 times greater likelihood that the person is aspirating.

Perlman et al., 1997, Murray, 1999, Steele et al., 2011

The paired anterior belly of the digastric, mylohyoid and geniohyoid, are responsible for the anterior and superior movement of the hyoid.

Anterior movement of the hyoid in conjunction with laryngeal elevation helps to pull open the UES/PES so food and liquid may be propelled into the esophagus.

Yokoyama et al., 2000

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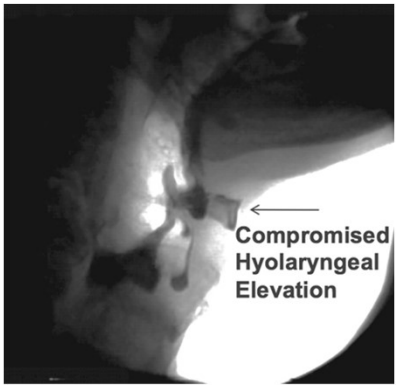
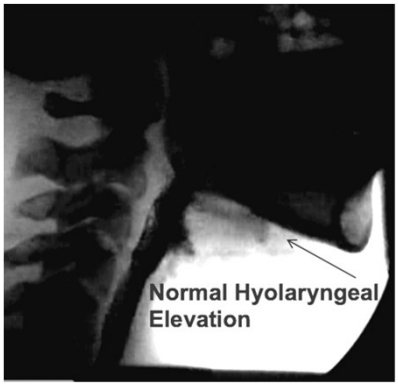
Dysphagia and Reduced Hyolaryngeal Elevation



Penetration/Aspiration



Normal swallow

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Dysphagia Management

POSTURAL TECHNIQUES

DIET MODIFICATIONS

THERAPY INNOVATIONS

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Postural Techniques

NO single posture improves swallowing in all patients.

Correct physiologic/anatomic disorder must be identified in order to implement the correct compensatory postures.

Changing the head or body posture can be effective in eliminating aspiration 50% of the time.

Logemann, 1995

Upright at 90 degrees with head in neutral position IS a postural technique in some circumstances.

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Diet Modifications

Goals

- Modifications to solid foods to puree, which minimizes choking
- Thickening fluids slow the flow of the swallow = more cohesive bolus
- Least restrictive diet modifications allow for an improved QoL

Experiential Findings

- Rational approach to reduce aspiration
- Not all who aspirate develop pneumonia
- Diminished appetite could lead to dehydration, UTI, falls, etc…

O'Keeffe, 2018

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Speech Pathology

Treatment for dysphagia has increased in the profession over the past 35 years.

SLPs play a critical role in recovery.

SLPs have had traditional indirect and direct treatment:

- Mendelsohn Maneuver, Shaker exercise, sEMG, thermal stim and oral motor exercises.

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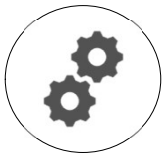

Therapy Innovations

- Designed to change swallow physiology (in contrast to compensatory strategies)
- Improve range of motion of oropharyngeal structures
- Improve sensory integration
- Take voluntary control of timing/ coordination of oropharyngeal movements

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Mendelsohn Maneuver

Manually lifts the larynx

Prolongs laryngeal elevation

Improves epiglottic retroversion

Limited benefit with those with severe cognitive deficits

ESP with proper submental placement can produce hyolaryngeal excursion similar to the Mendelsohn Maneuver *Carmichael et al., TSHA 2011*

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Shaker Exercise

Neck exercises to strengthen the suprahyoids

Isometric (3 – 60 seconds) and Isotonic (30 consecutive) head lifts 3 times/day, 6 weeks

Improves UES openings and anterior/superior excursion of the larynx *Shaker et al., 1997*

x2

Using Ampcare's posture device (RPD) with an isometric contraction can produce twice the amount of muscle activation compared to the Shaker exercise. *Watts, 2013*

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Surface Electromyography

(sEMG)

Muscle activation creates a signal from the nerve conduction picked up by the sEMG

Activation signal intensity is most pronounced near the surface of the skin

Swallowing musculature lies underneath the platysma and the sternocleidomastoid, making the signal most pronounced from non-swallowing activity

Research has demonstrated less than 40% accuracy of hyolaryngeal movements from this technology.

Azola et al., 2015

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McNeill Dysphagia Therapy Program (MDTP)

Uses the swallow as an exercise

Utilizes bolus size/weight for resistance qualities following exercise principles

Does not incorporate the reverse muscle fiber recruitment phenomenon as with NMES

Difficult to utilize with severe dysphagia patients

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Rationale

Range and motion of the hyoid and larynx during the act of swallowing affects:

- Posterior tongue base retraction
- Retroversion of epiglottis
- Movement of the airway out of the path of the bolus
- Contraction of the pharyngeal constrictors and laryngeal vestibule
- Decrease vallecular/pyriform sinus area
- Relaxation of PES/UES

Anatomical Inference – chain reaction

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Ampcare Effective Swallowing Protocol (ESP)

ESP applied to the suprahyoid musculature → 30 minutes QD → Repetitive indirect exercises during stimulation on times → To improve neurovascular coupling and enhance neuroplasticity

Keys to neuroplasticity:

- Task specific exercise or activity
- Repetitive and Resistive

Kleim & Jones, 2008

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Clinical Trials Suggest:

Patients with dysphagia because of decreased hyolaryngeal excursion and or reduced laryngeal vestibule closure times who receive ESP improved at a higher rate than those patients receiving traditional therapy.

After more than 15,000 therapy visits this protocol is a safe adjunct to indirect treatments for pharyngeal dysphagia with impaired hyolaryngeal excursion and or laryngeal vestibule closure times.

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Cochrane Database System Review Conclusions on Swallowing Therapy for Dysphagia

- **Authors' conclusions:**
  - Moderate- and low-quality evidence suggests that swallowing therapy did not have a significant effect on the outcomes of death or dependency/disability, case fatality at the end of the trial, or penetration/aspiration score. *Bath et al., 2018*
- **How does this pertain to Electrical Stimulation Research?**
  - Nearly all of these studies used parameters that are primarily sensory stimulation or TENS. *Suiter et al., 2006, Humbert et al., 2006 · Bulow et al., 2008*
  - Some are looking at the immediate effect electrical stimulation might have, which is not rehabilitation. *Clark et al., 2009, Humbert et al., 2015, Ogura et al., 2022*
  - Some are using electrode placement that would not follow the rules of NMES and do not address any specific mechanical cause. *Ludlow et al., 2007, Bath et al., 2016, Bath et al., 2020*

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Research Utilizing Other Electrical Stimulation Methods

VitalStim over the laryngeal and submental regions was shown to lower the hyoid and larynx reducing airway protection and placing some healthy volunteers and patients at increased risk of aspiration.

Humbert et al., 2006; Ludlow et al., 2007

VitalStim over only the submental region showed no appreciable elevation in healthy volunteers at rest.

Humbert et al., 2006

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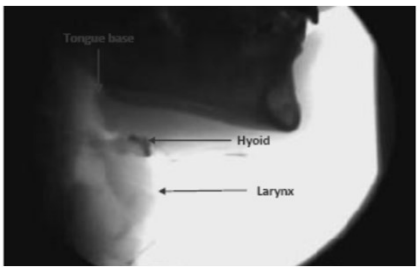
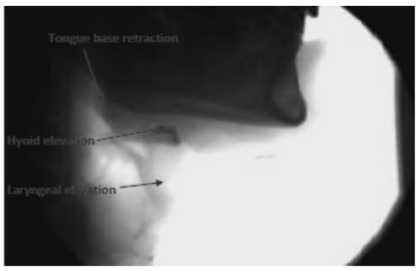
Research Utilizing ESP

Ampcare's ESP over only the submental region at rest produced 17% of the extent of hyoid elevation and 4.5% of laryngeal excursion that normally occurs during swallowing.

Ludlow et al., 2010



Patient at Rest



Patient Receiving ESP

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UK Research Utilizing ESP (2011)
Phase I – Feasibility Study

- 5 patients, all PEG tube dependent
- 3 months to 2 years post treatment
- 20 sessions, 5 times/week for 4 weeks
- 2 of 5 patients weaned off PEG tubes (1 month)
- 1 of 5 patients weaned off PEG tube (3 months)
- All 5 patients reported improved QoL
- All pneumonia free through one-year follow-up

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UK Research Utilizing ESP 2014
Phase II – Pilot Study

- Randomized Controlled Pilot Trial:
  - 30 CVA patients with dysphagia > 1 month
    - Control group (15) – usual dysphagia care
    - Intervention group (15) – ESP for 30 minutes, 5 times/week for 4 weeks
    - Outcome Measures
      - Functional Oral Intake Scale (FOIS) 57% control, 75% ESP
      - Penetration/Aspiration Scale (PAS) 17% control, 58% ESP for Diet
      - SWAL-QOL (Quality of Life) 42% control, 100% ESP

Sproson et al., 2018

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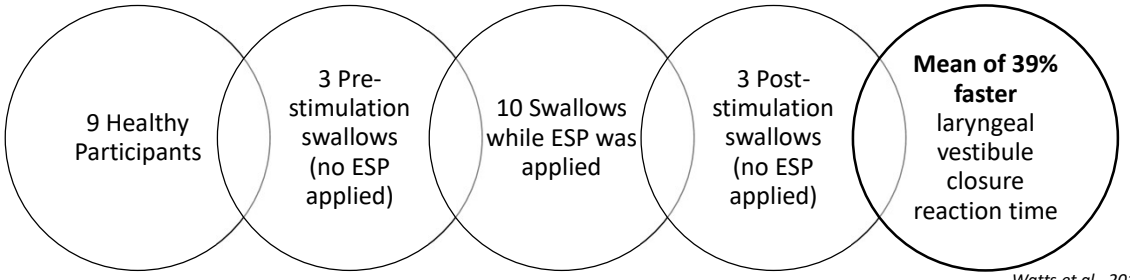
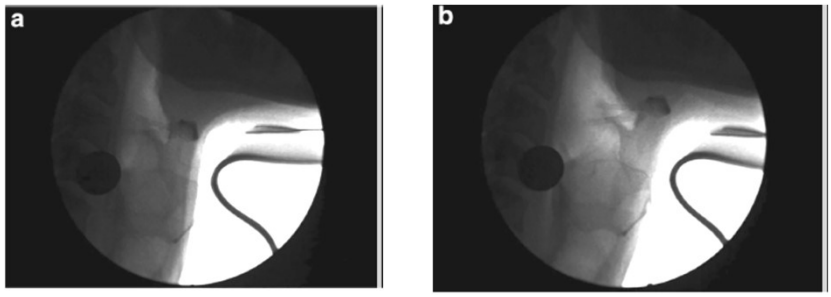
TCU Research Utilizing ESP (2018)



Watts et al., 2018



a – At Rest b - ESP

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UK Research Utilizing ESP 2019
A Single-Arm Trial

- Feasibility Study - 20 sessions of therapy over 6 weeks:
  - 43 patients (29 stroke, 14 non-stroke)
    - Intervention group – ESP for 30 minutes, 3-5 times/week for 6 weeks
    - Outcome Measures
      - Functional Oral Intake Scale (FOIS) 43% non-stroke, 59% stroke
      - Penetration/Aspiration Scale (PAS) 64% non-stroke, 59% stroke for Liquids
      - SWAL-QOL (Quality of Life) 62% non-stroke, 88% stroke

Martindale et al., 2019

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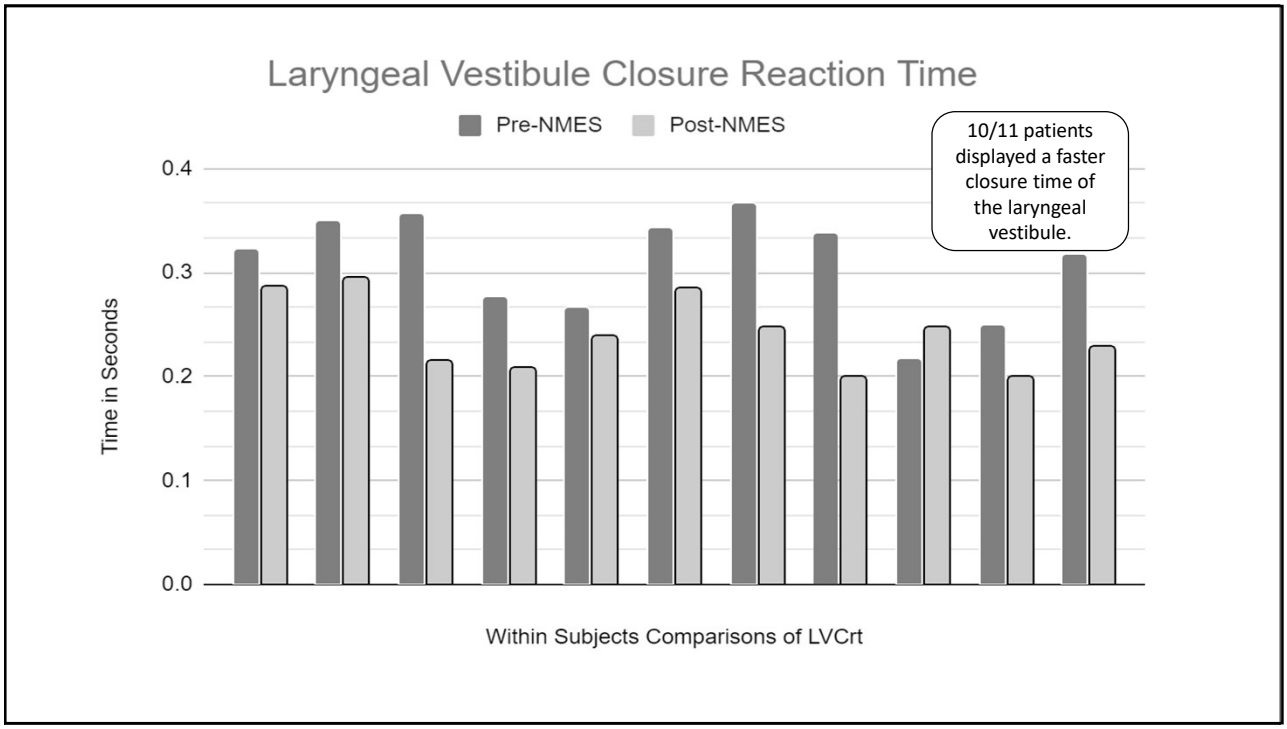
Laryngeal Vestibule Closure Reaction Time
Pre-NMES
Post-NMES
10/11 patients displayed a faster closure time of the laryngeal vestibule.
Time in Seconds
0.4
0.3
0.2
0.1
0.0
Within Subjects Comparisons of LVCrt

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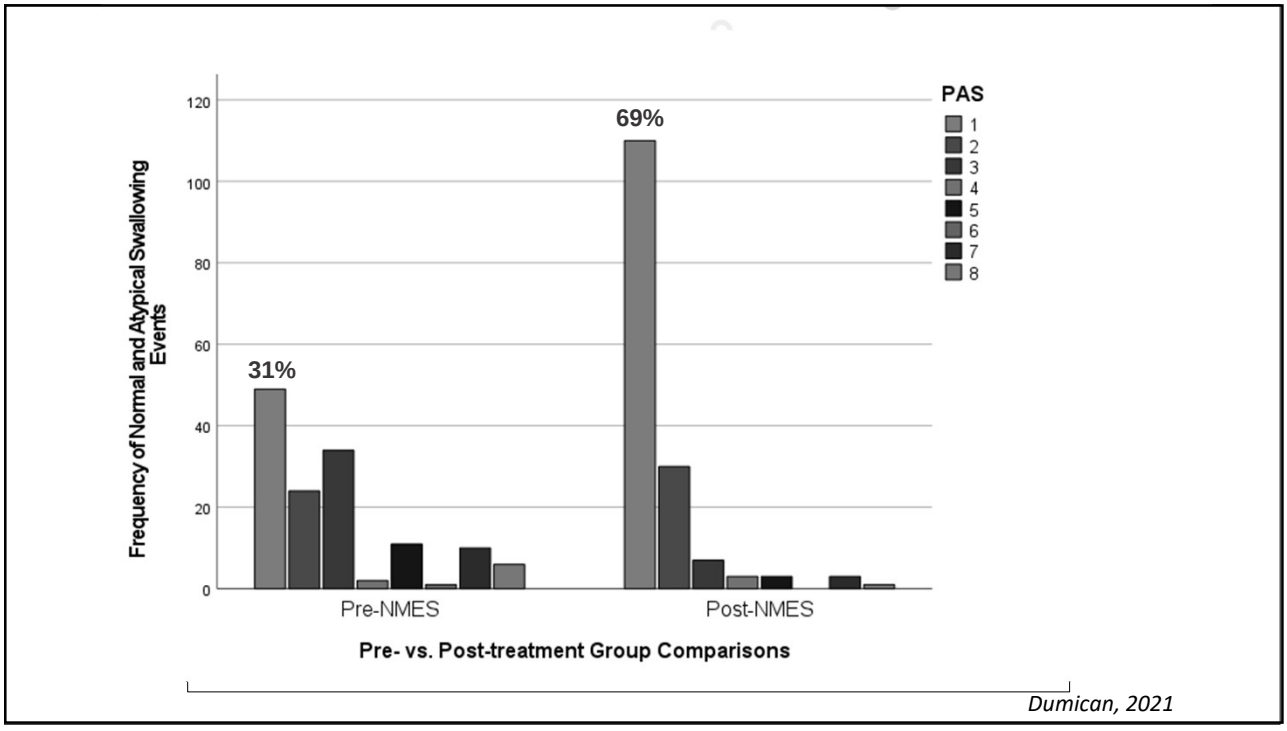
PAS
1
2
3
4
5
6
7
8
69%
31%
Frequency of Normal and Atypical Swallowing Events
120
100
80
60
40
20
0
Pre-NMES
Post-NMES
Pre- vs. Post-treatment Group Comparisons
Dumican, 2021

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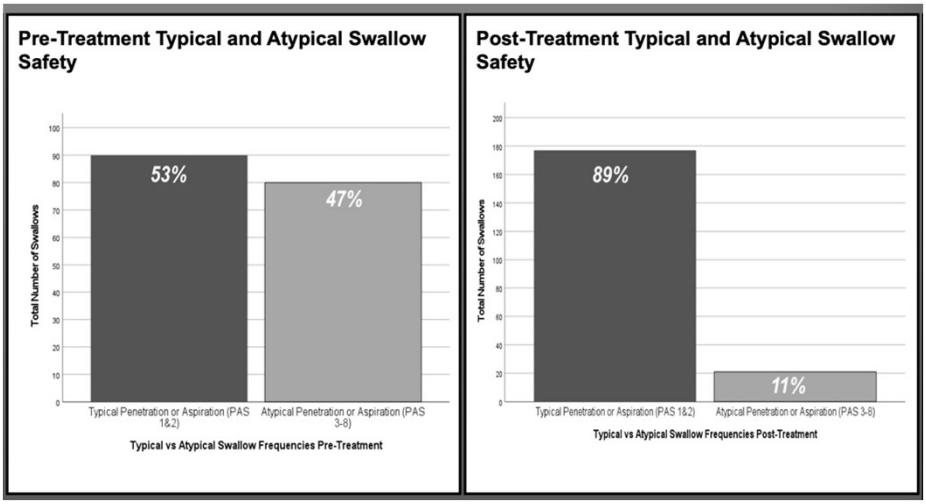
Western Michigan Research (2022)



Dumican et al., ASHA 2022

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Research

Questions

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Anatomy of the Swallow

- Some SLPs have had limited education on the anatomy and physiology specific to a swallow but assess and treat these muscles and cranial nerves.
- Three phases of the swallow work together to produce a functional swallow:
  - Oral - Preparatory/Transport
  - Pharyngeal
  - Esophageal
- Any breakdown in a phase, muscle, or cranial nerve can cause dysphagia.

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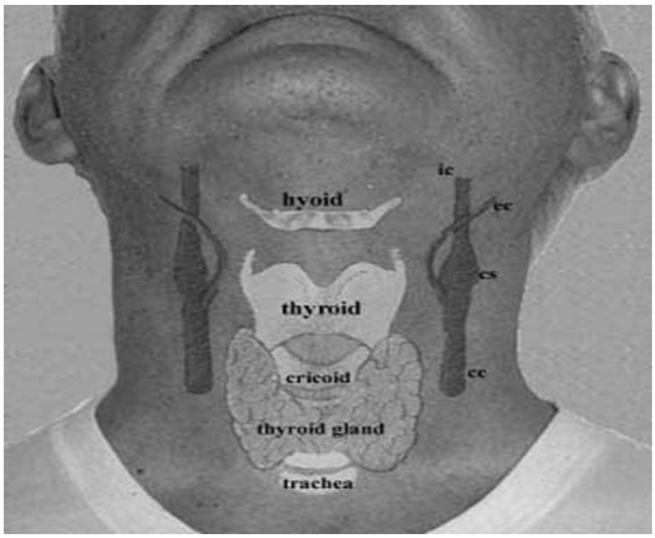
Position of the Hyoid Bone



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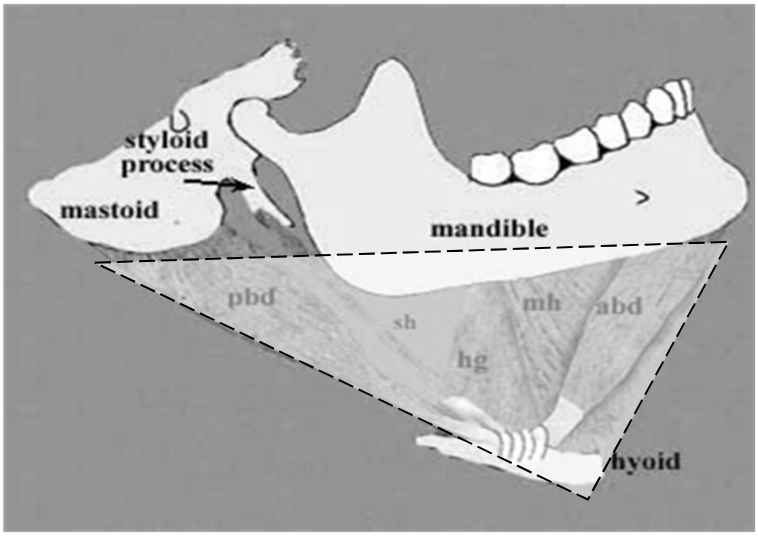
Lateral View
Submandibular Triangle consisting of the Mastoid Process, Mandible and Hyoid



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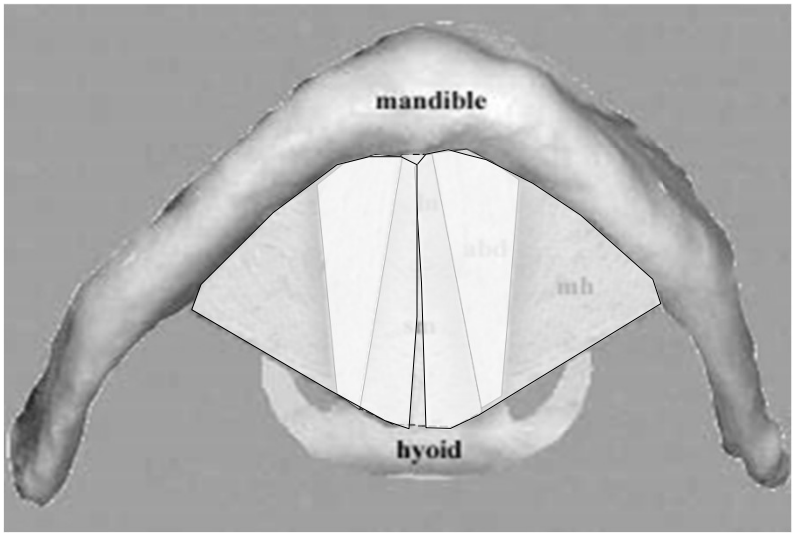
Supine View
Submental Triangle consisting of the Mandible, Hyoid, Anterior Digastric and Mylohyoid



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Anatomy of the Swallow Cranial Nerves

Cranial Nerves:

- V – Trigeminal
- VII – Facial
- IX – Glossopharyngeal
- X – Vagus

Sensory and motor nerve roots

- XI – Accessory
- XII – Hypoglossal

Motor nerve roots

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Oral Prep/Oral Phase

1st phase of the swallow

Begins at the lips and ends at the tongue base

Voluntary act involves conversion of food from a solid to a semi solid, puree state

Affected by dentition and salivary gland function

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Oral Prep Musculature

Zygomaticus major and minor draws the angle of the mouth upward and outward.

Buccinator maintains food between teeth.

Masseter assists in chewing.

Orbicularis oris is in motion when pursing lips to accept liquid bolus from a straw or when closing the lips.

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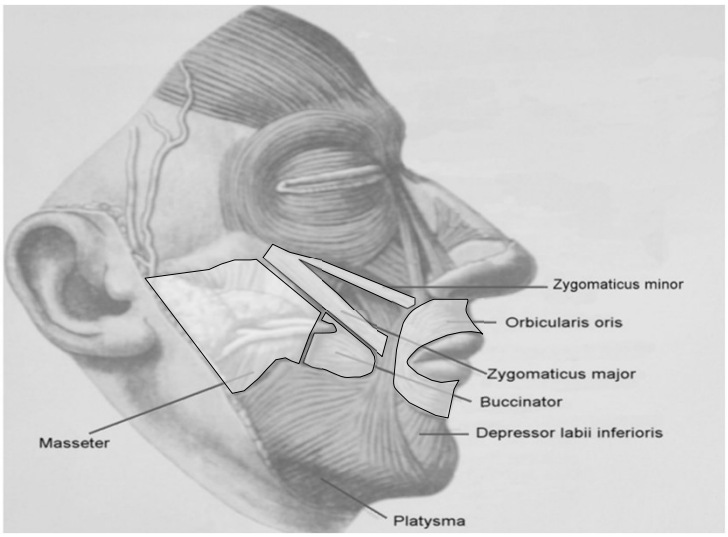
Oral Prep Musculature



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Oral Transport/Oral Phase

A-P propulsion/transit of the bolus

Begins when the tongue contracts against the hard palate.

Normal movement of the tongue is essential for carrying out the tasks of the oral phase of a swallow.

The tongue provides anchoring during hyoid bone elevation and UES opening. It connects to the hyoid bone, pharynx, and epiglottis.

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Lingual Musculature

Tongue Muscles – Intrinsic

4 Intrinsic Tongue Muscles

Superior Longitudinal	Transverse	Vertical	Inferior Longitudinal

Their primary action is to produce changes in the shape of the tongue during articulation and deglutition (cradling the bolus).

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Lingual Musculature

Tongue Muscles – Extrinsic

4 Extrinsic Tongue Muscles

Genioglossus – protracts and depresses tongue	**Hyoglossus** – depresses tongue	**Styloglossus** – retracts and elevates tongue	**Palatoglossus** – elevates tongue

The Palatoglossus, Styloglossus, and Hyoglossus transport the bolus to the posterior pharyngeal wall.

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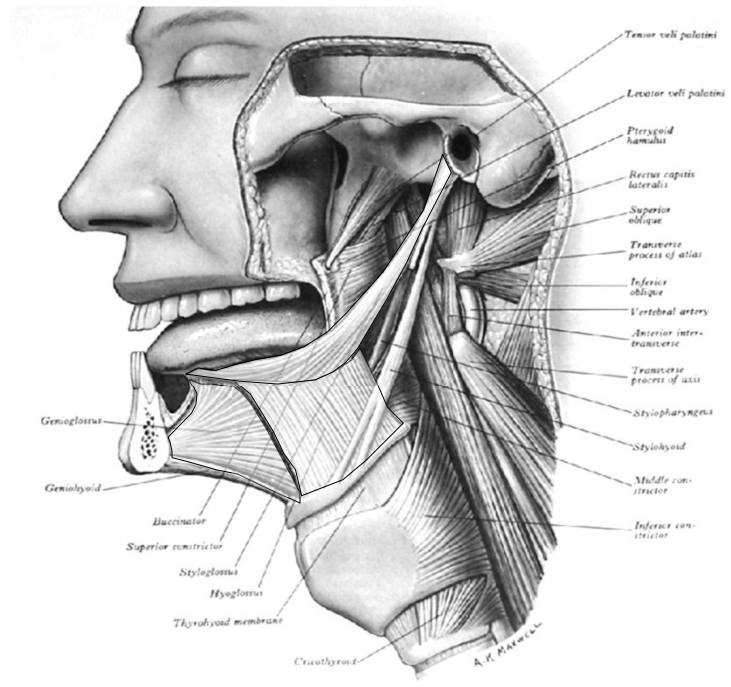

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Oral Phase

Swallow Problem	Muscle Group	Cranial Nerve
Acceptance	Orbicularis Oris, Zygomaticus	CN VII
Anterior Loss	Orbicularis Oris	CN VII
Mastication	Masseter, Pterygoids, and Temporalis	CN V
Oral Pocketing or Scattering	Buccinator and intrinsic and extrinsic lingual muscles	CN VII, XII
Anterior-posterior propulsion	Intrinsic and extrinsic lingual muscles – Genioglossus, Styloglossus	CN XII
Poor lingual pressure to drive the bolus through the PES/UES	Intrinsic and extrinsic lingual muscles – Hyoglossus	CN XII

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Pharyngeal Phase

Shortest but most complex phase.

Requires 1-1.5 seconds to complete; does not vary with consistency of food, age, or gender.

Involves highly cortical centers as well as brainstem centers including CN V, IX, X, XI, and XII.

Special sensory receptors activate the involuntary part of this phase.

Miller, 1994

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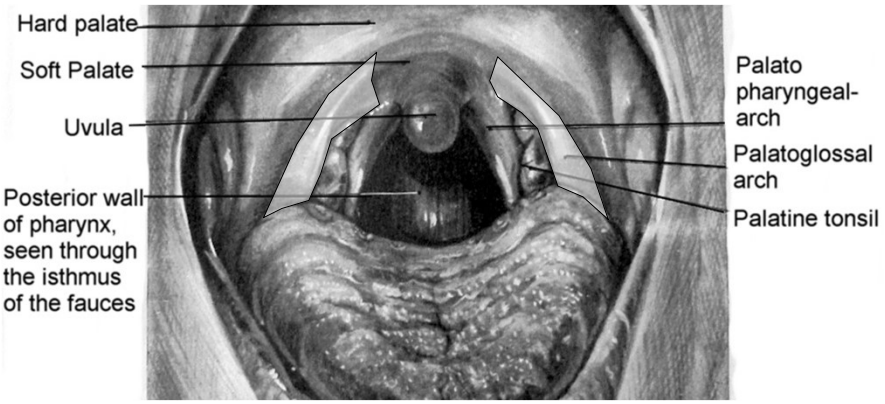
Pharyngeal Phase

Triggered by the glossopharyngeal nerve as bolus encroaches on palatoglossal arch



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Pharyngeal Phase

- Afferent impulses from CN upon reaching brainstem transmit across synapses to efferent fibers completing the reflex arc and affecting the following automatic reactions:
  - Velopharyngeal closure
  - Closure of larynx
  - Pharyngeal peristalsis
  - Elevation and anterior pull of the hyolaryngeal complex
  - Relaxation of UES/PES

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Pharyngeal Phase

Velopharyngeal closure occurs during contraction of the:

- Tensor veli palatini
- Levator veli palatini
- Musculus uvulas

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Pharyngeal Phase

As the true vocal folds adduct a finite period of apnea (i.e. respiratory cessation) occurs during a swallow lasting approximately 0.3 – 2.5 seconds.

Selley et al., 1994

Epiglottis acts to anatomically direct the bolus laterally toward the UES/PES, as well as assisting in airway protection.

Following closure of larynx, pharyngeal peristalsis by contraction of superior, middle and inferior pharyngeal constrictor muscles, then hyolaryngeal elevation takes place.

The larynx elevates because the hyoid bone moves anteriorly and superiorly secondary to contraction of the anterior digastric, mylohyoid, geniohyoid muscles.

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Pharyngeal Phase

Muscles of the laryngeal region can be broken down into 2 groups:

Suprahyoids – HYOLARYNGEAL ELEVATORS

"Sling Muscles" – due to a hammock-like appearance

Infrahyoids - HYOLARYNGEAL DEPRESSORS

"Strap Muscles" – due to a ribbon-like appearance

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Suprahyoids (sling muscles) HYOLARYNGEAL ELEVATORS

Anterior Digastric – elevates/protracts the hyoid assists with mandible depression

Posterior Digastric – elevates/retracts the hyoid

Mylohyoid – elevates/protracts the hyoid assists with mandible depression

Geniohyoid – elevates/protracts the hyoid, depresses mandible

Stylohyoid – elevates/retracts the hyoid

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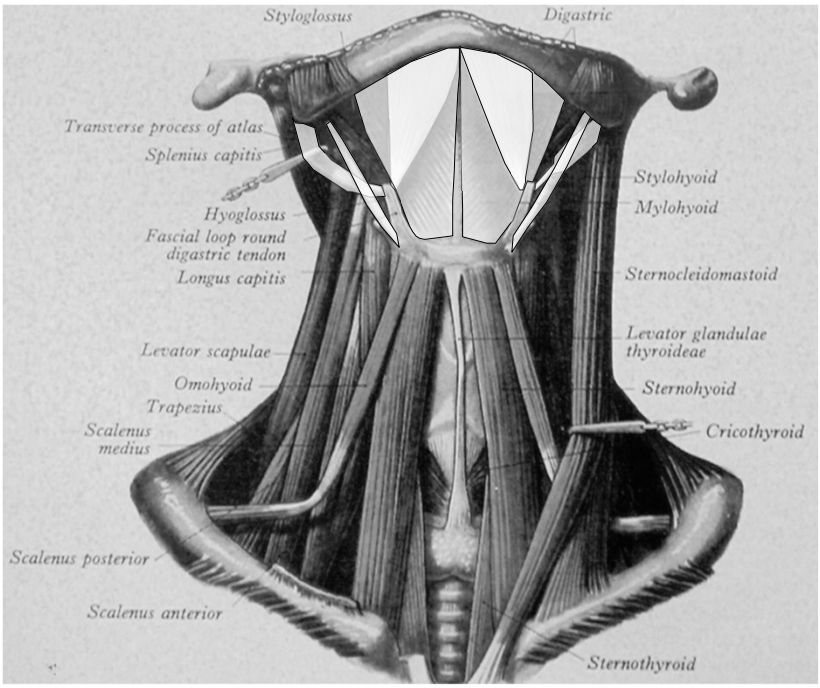

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Infrahyoids (strap muscles)
HYOLARYNGEAL DEPRESSORS

- Omohyoid – depresses hyoid
- Sternohyoid – depresses hyoid
- Sternothyroid – depresses thyroid
- Thyrohyoid – shortens the distance between the thyroid and hyoid bone

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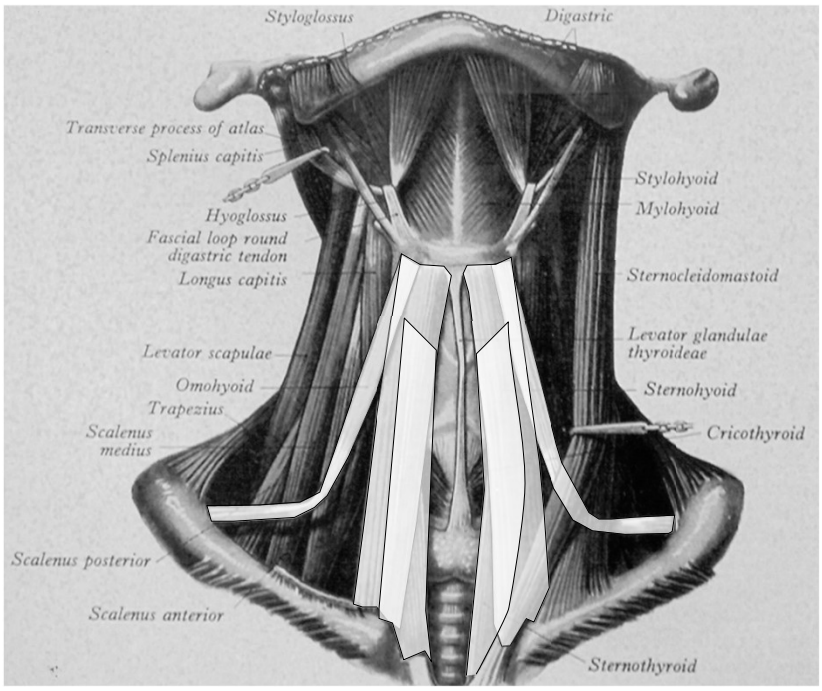

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Pharyngeal Phase

3 muscles contribute to formation of UES/PES:

- Most inferior muscle fibers of inferior pharyngeal constrictor
- Cricopharyngeus
- Most superior portion of longitudinal esophageal muscle fibers

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Pharyngeal Phase

Swallowing Problem	Muscle Group	Cranial Nerve
Poor velopharyngeal seal	Tensor Veli Palatini, Pharyngeal Constrictors, Levator Veli Palatini, Musculus Uvulae	CN V, IX, X, XI
Decreased closure of the larynx	Aryepiglottic, Lat. Cricoarytenoid and Transverse Arytenoid	CN X, XI
Weak pharyngeal constrictor contraction	Superior, Middle, and Inferior Pharyngeal Constrictors	CN IX, X, XI
Decreased anterior superior elevation of the hyolaryngeal complex	Anterior Digastric and Mylohyoid	CN V
Failure of opening the UES/PES	Inferior Pharyngeal Constrictor, Cricopharyngeus, Superior Longitudinal Esophageal muscle	CN IX, X, XI

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Esophageal Phase

Esophagus

- Involuntary action, involves rhythmic contractions.
- Transit time can increase significantly with age.
- Transit time range is from 6 – 18 seconds to clear solids.

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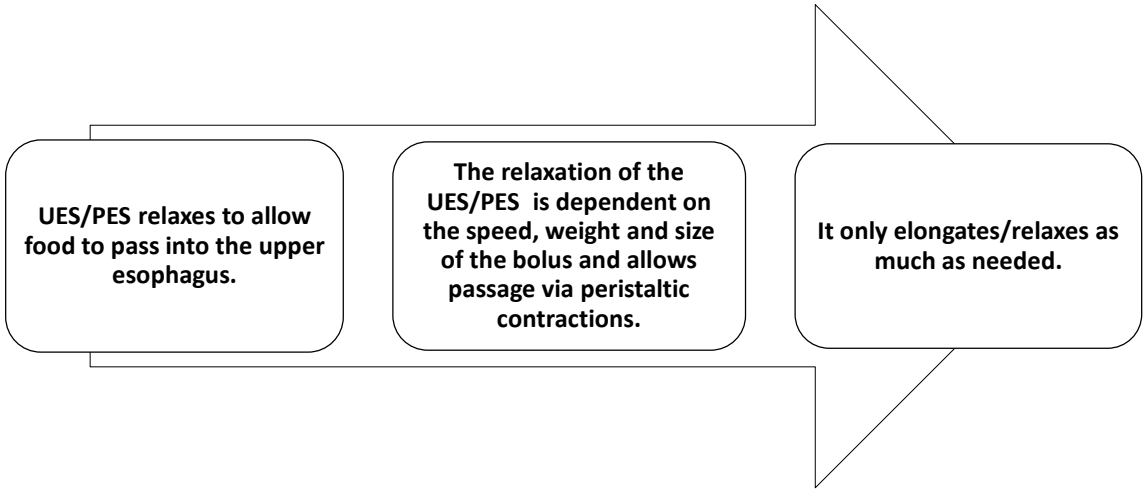
Esophageal Phase



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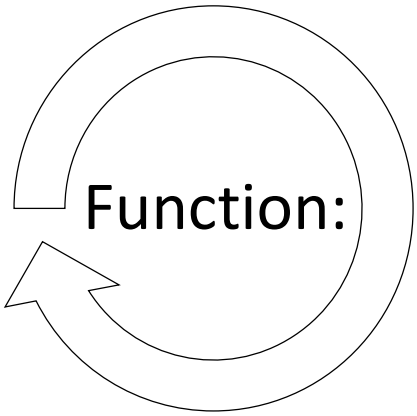
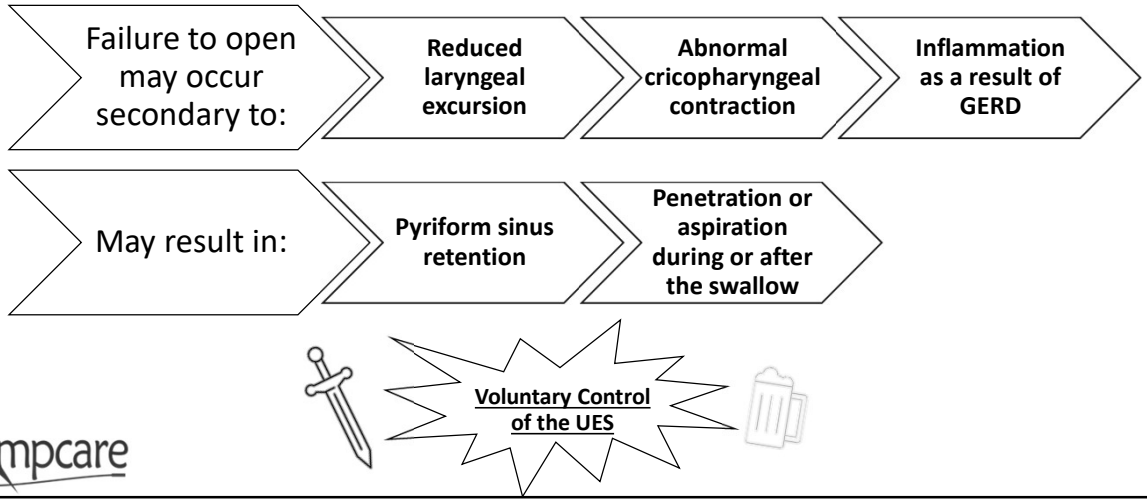
UES/PES



- **Protects pharynx by preventing reflux**
- **Prevents air entering the gastrointestinal tract during normal respirations**
- **Relaxes completely to allow gas to exit or when vomiting occurs**

58

UES/PES Dysfunction



59

Anatomy of the Swallow Questions

60

Evaluation of Dysphagia

Proficient in examination tools

- Modified Barium Swallow Study – MBSS
- Fiberoptic Endoscopic Evaluation of Swallowing – FEES
- Manometry
- Bedside Swallow Evaluation – BSE
  - Cranial Nerve Assessment

61

Cranial Nerve Assessment

CN V (5) – Trigeminal

sensation to the face and motor to the soft palate (tensor veli palatini), hyolaryngeal complex, pharynx, and muscles of mastication.

- Cotton swab wisp to nose
- Teeth clench to assess masseter and temporalis
- Jaw opening – assess jaw deviation
- Assess uvula deviation
- Palpate swallow – assess hyolaryngeal elevation

62

Cranial Nerve Assessment

CN VII (7) – Facial

sensation (taste) to the anterior 2/3 of the tongue, soft palate and motor to the facial muscles.

- Rub a lemon swab on the anterior 2/3 of the tongue
- Inspect facial symmetry
- "Please raise your eyebrows"
- "Please close your eyes tightly against resistance"
- "Pretend to blow out some candles"
- "Puff out your cheeks"

63

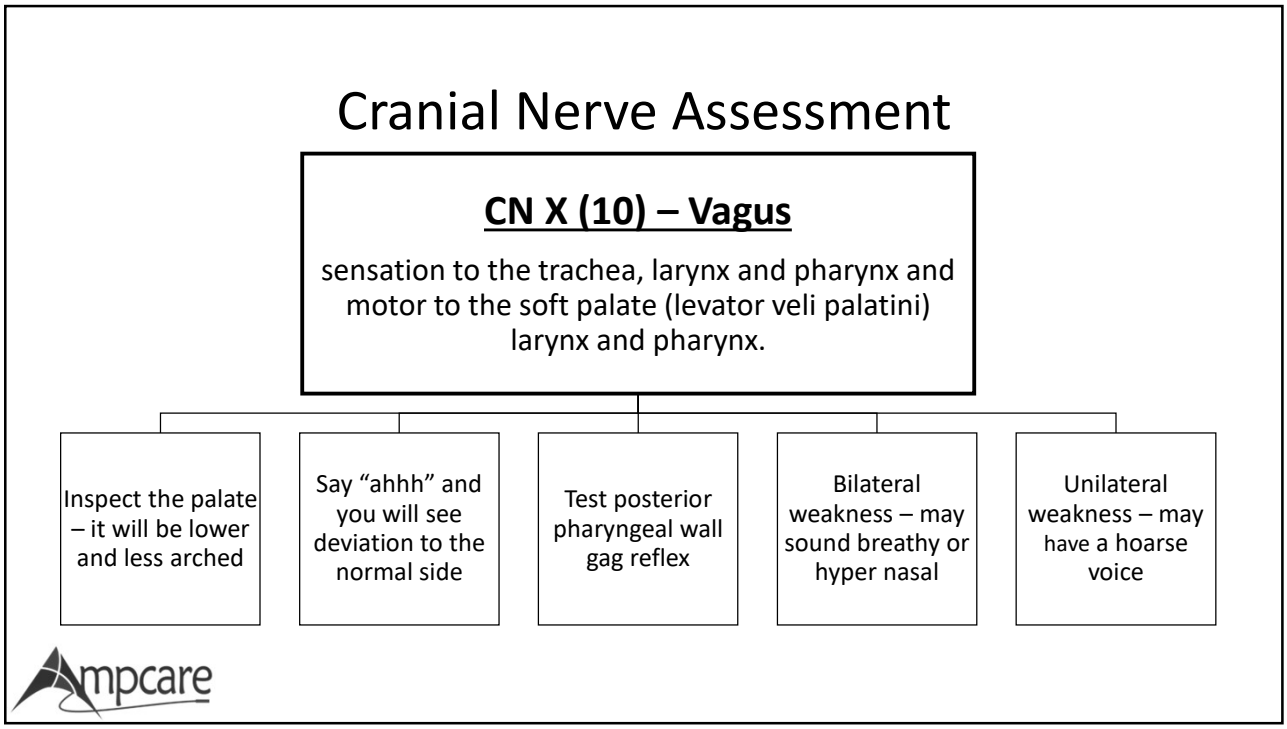
Cranial Nerve Assessment

CN IX (9) – Glossopharyngeal

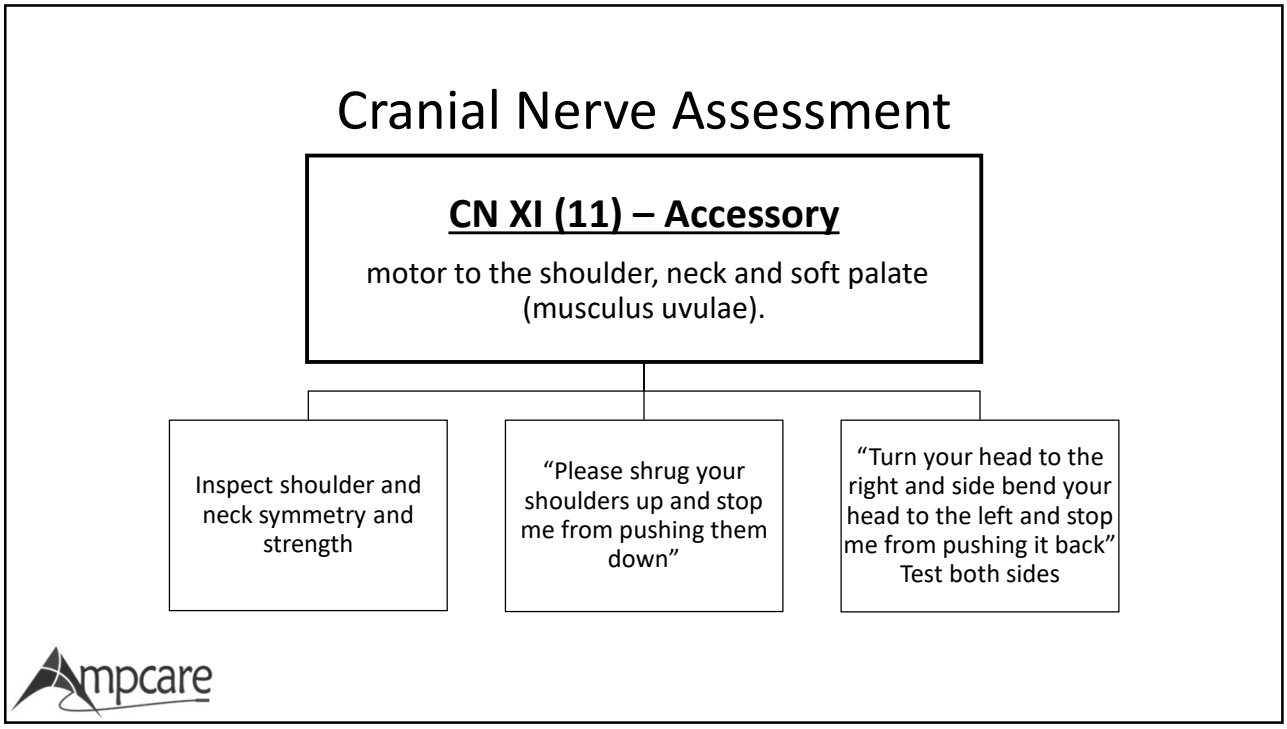
sensation (taste) to the posterior 1/3 of the tongue, soft palate and pharynx and motor to the pharyngeal musculature.

- Test gag reflex
- Lemon swab to the back of the tongue to test for both sensory and motor

64


Cranial Nerve Assessment
CN X (10) – Vagus
sensation to the trachea, larynx and pharynx and motor to the soft palate (levator veli palatini) larynx and pharynx.
Inspect the palate – it will be lower and less arched
Say "ahhh" and you will see deviation to the normal side
Test posterior pharyngeal wall gag reflex
Bilateral weakness – may sound breathy or hyper nasal
Unilateral weakness – may have a hoarse voice

65


Cranial Nerve Assessment
CN XI (11) – Accessory
motor to the shoulder, neck and soft palate (musculus uvulae).
Inspect shoulder and neck symmetry and strength
"Please shrug your shoulders up and stop me from pushing them down"
"Turn your head to the right and side bend your head to the left and stop me from pushing it back" Test both sides

66

Cranial Nerve Assessment

CN XII (12) – Hypoglossal

motor to the tongue muscles.

- Test tongue motor function by protruding tongue, push tongue against cheek
- Check for tongue fasciculations

67

Cranial Nerves Questions

68

Muscle Fiber Types/Recruitment

Muscle tissue – highly specialized fibers that generate a force for contraction.

Nerves connect the spinal cord to the muscle.

Neuromuscular junction or motor point – spot where the nerve meets the muscle.

69

Muscle Fiber Types

Muscle fibers can be grouped according to the kind of tissue they are found in:

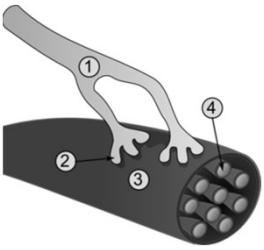
Muscle Type	Location	Contraction Control
Cardiac	In the walls of the heart	Involuntary
Smooth	In the walls of hollow internal structures (e.g., esophagus)	Usually Involuntary
Skeletal	At the attachment to bones	Voluntary

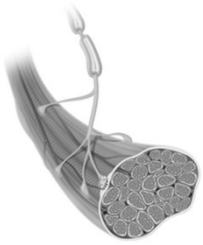
70

Skeletal Muscle Fiber

Global view of a neuromuscular junction:

1. **Nerve**
2. **Neuromuscular junction/motor point**
3. **Muscle fiber**
4. **Myofibril with myofilaments inside**





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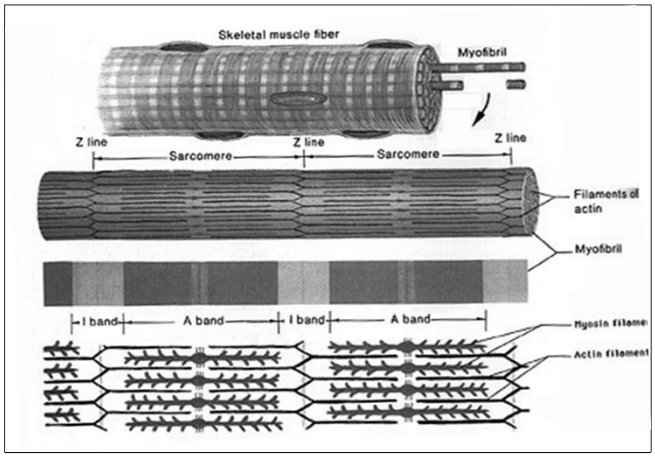
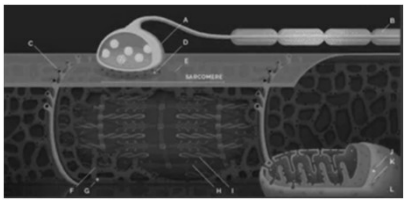
Skeletal Muscle Fiber/Recruitment



Billions of myofilaments in a muscle shorten all at once to cause contraction of entire muscle fiber.



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Muscle Fiber Types

Skeletal muscle - 2 basic types:

Type I (slow-twitch fibers)

Primarily use cellular respiration, relatively high endurance – contain high levels of mitochondria (powerhouse of the cell) and myoglobin (oxygen storage) – responsible for red color of tissue.

73

Muscle Fiber Types

Skeletal muscle - 2 basic types:

Type II (fast-twitch fibers)

relatively low endurance – typically used for short bursts of strength – cannot sustain contractions for significant lengths of time.

Type IIa – intermediate endurance and high power, appear pink due to high content of myoglobin and mitochondria.

Type IIb – fastest firing, most powerful, but fatigue the fastest – appear white due to low oxygen demand.

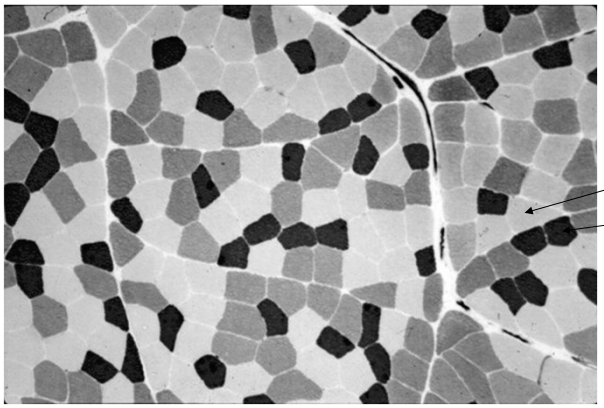
74

Muscle Fiber Types/Recruitment

Fiber Type	Type I	Type IIa	Type IIb
Contraction time	Slow	Fast	**Very Fast**
Endurance	High	Intermediate	**Low**
Fatigue	Slow	Intermediate	**Fast**
Power	Low	High	**Very High**
Motor neuron size	Small, Narrow	Large	**Very Large**
Function	Static, Postural	Dynamic	**Dynamic, Explosive**
Energy Source	Oxygen	Oxygen, Glycogen	**Glycogen**
Color	Red	Pink	**White**

75

Muscle Fiber Types



Normal muscle – size of Type IIb is approximately twice the size of Type I

76

Muscle Fiber Types/Recruitment

Most skeletal muscles contain a mixture of all 3 types of fibers – proportion depends on "usual" action of the muscle:

- Posterior neck/back – postural muscles – higher proportion of type I.
- Anterior/lateral neck – rotating, flexing, nodding – higher proportion of type II.

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Muscle Fiber Types/Recruitment

Several swallowing muscles have:

- Higher proportion of type II fibers -
  - Anterior Digastric
  - Mylohyoid
  - Pharyngeal constrictors
- Higher proportion of type I fibers –
  - Cricopharyngeus

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Muscle Fiber Types/Recruitment

During a normal muscle contraction muscle fibers are recruited according to the 'size principle'.

Henneman, 1965

During contraction muscle fibers relay messages to each other

- If a weak contraction is needed, primarily type I fibers are activated.
- If a maximal contraction is needed, then type II fibers are activated as well.

79

Muscle Fiber Types/Recruitment

Consequently, type I fibers receive the primary benefit from low intensity exercises found early in rehabilitation.

The larger, type II fibers can only be exercised when dynamic activity calls on their recruitment – missed early on in rehab, this quickly leads to disuse atrophy of these fibers/muscles.

80

Disuse Atrophy

Refers to change in muscle after a period of reduced activity.

Many conditions have a degree of disuse atrophy.

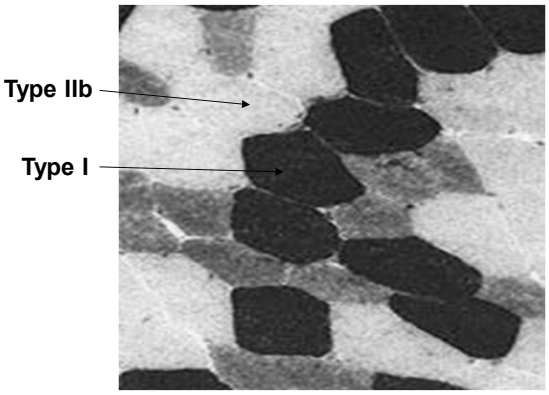
Most obvious change is a decrease in bulk of type II muscle fibers.

This preventable and reversible muscle weakness due to aging, chronic illness and/or decreased physical activity is called sarcopenia.

Muscle can lose up to 40% of its ability to generate force over a 4-6 week period of immobilization. *Mueller, Maluf, 2002*

81

Disuse Atrophy



Atrophied muscle – note that size of Type IIb are the same size or smaller than the Type I

82

Muscle Fiber Types/Recruitment

Recruitment patterns with NMES are the reverse of that through exercise.

Type IIb fibers are first to contract as the motor neuron for these fibers is larger and has a lower depolarization threshold.

Type IIb fibers, therefore, respond sooner to electrical current when exposed.

83

Maximize Treatment

- **Using NMES at the same time as performing voluntary exercise is an ideal way to maximize our therapeutic impact by taking advantage of this recruitment phenomenon seeing that swallowing musculature has a high overall percentage of type II fibers.**

If it doesn't challenge you, it doesn't change you.

FRED DEVITO

84

Evidence-Based Research

Majority of strength augmentation studies use subjects S/P ACL repair.

- At 6 weeks group treated with NMES and post op exercise showed 70% recovery in quad strength, and group treated with post op exercise showed only a 57% recovery in quad strength.

  Snyder-Mackler et al., 1995

- At 12 weeks quad recovery in NMES/exercise group showed 75.9% compared to 67.0% in exercise only group.

  Fitzgerald et al., 2003

85

Muscle Fiber Types/Recruitment Questions

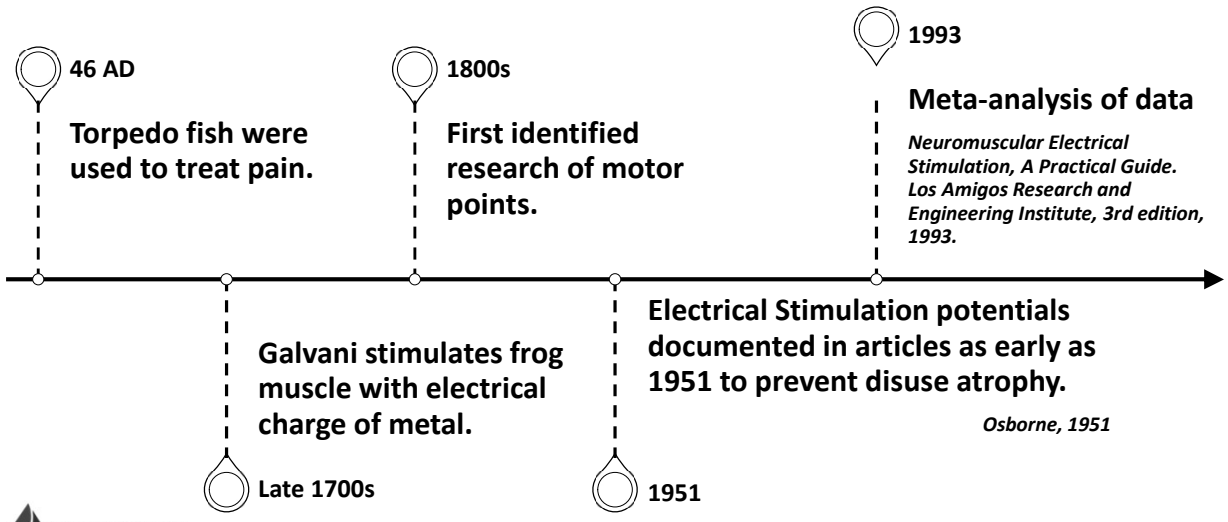
86

86

Fundamental Principles of Neuromuscular Electrical Stimulation (NMES)

87

History of NMES



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History of NMES

Currently an FDA-cleared modality used primarily by Physical/Occupational Therapists and now entering the field of Speech Pathology.

Stimulation requires an intact peripheral nerve.

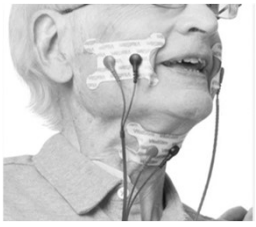
Use requires extended education in the area of electrotherapy.

Treatment goals: strengthening and recovery of motor control.

89

History of E-STIM

Current practices



90

Electrical Stimulation for Muscle Re-education

Process by which electrical stimulation works has been well documented and studied.

Extrinsic muscles of the swallowing mechanism bear no histological difference to any other skeletal muscles typically treated by PT and OT.

91

Indications

Prevent	Prevent disuse atrophy
Increase	Increase range of motion
Re-educate	Re-educate muscle function
Decrease	Temporarily decrease spasticity
Serve	Serve as an electrical orthosis
Increase	Increase local blood circulation

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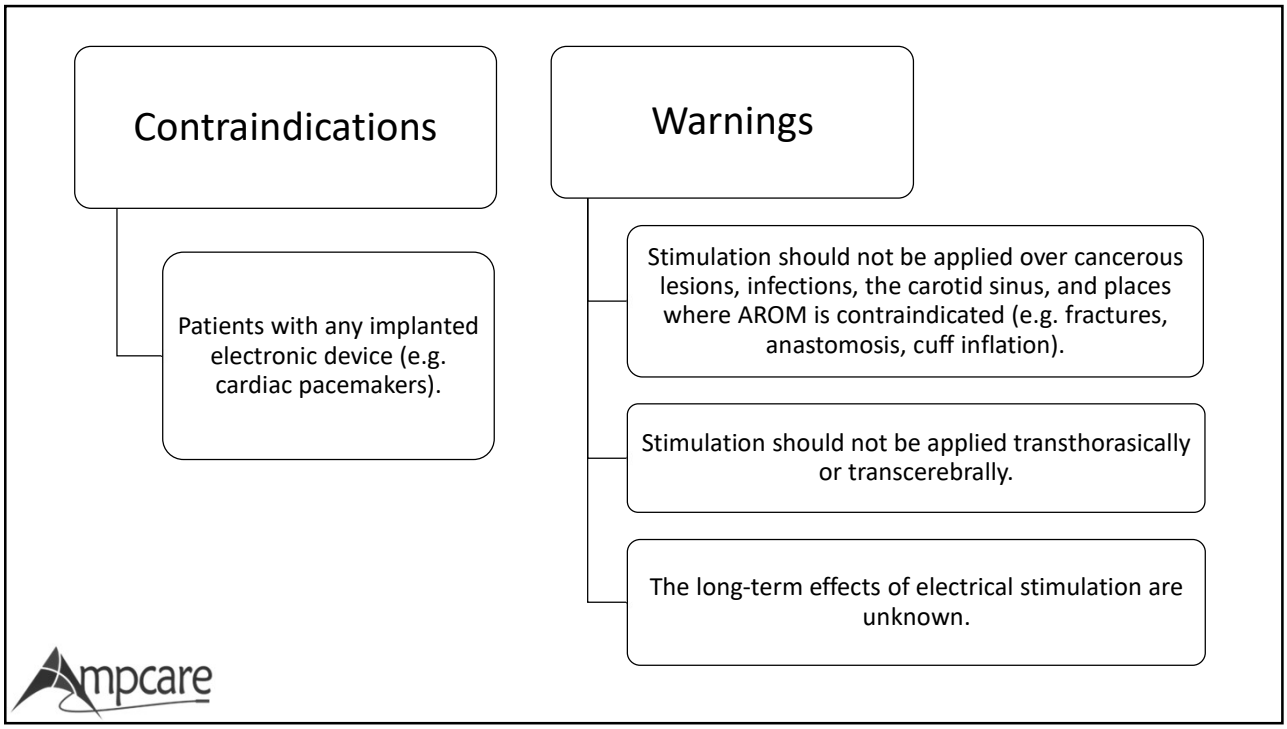
Contraindications
Patients with any implanted electronic device (e.g. cardiac pacemakers).
Warnings
Stimulation should not be applied over cancerous lesions, infections, the carotid sinus, and places where AROM is contraindicated (e.g. fractures, anastomosis, cuff inflation).
Stimulation should not be applied transthorasically or transcerebrally.
The long-term effects of electrical stimulation are unknown.

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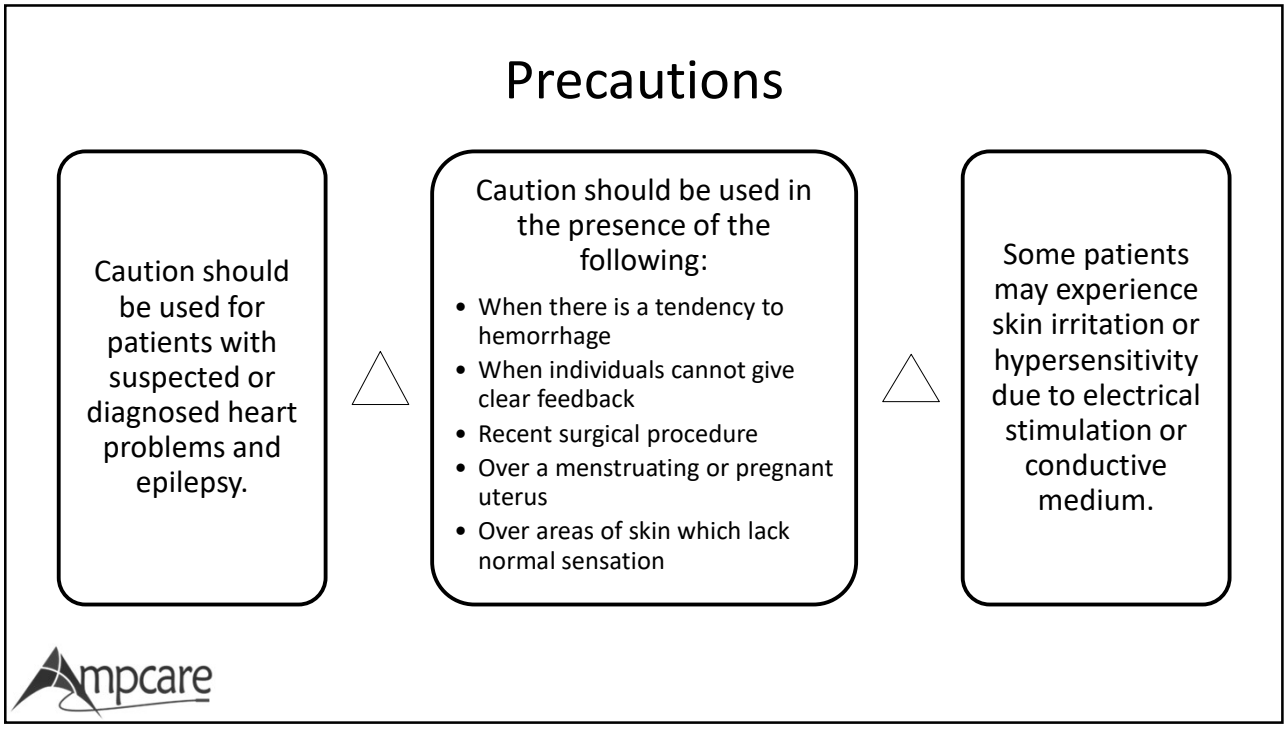
Precautions
Caution should be used for patients with suspected or diagnosed heart problems and epilepsy.
Caution should be used in the presence of the following:
• When there is a tendency to hemorrhage
• When individuals cannot give clear feedback
• Recent surgical procedure
• Over a menstruating or pregnant uterus
• Over areas of skin which lack normal sensation
Some patients may experience skin irritation or hypersensitivity due to electrical stimulation or conductive medium.

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Types of Electrical Stimulation

TENS
Transcutaneous Electrical Nerve Stimulation

- Stimulation to afferent sensory nerve fibers
- Primarily used for decreasing pain

NMES
Neuromuscular Electrical Stimulation

- Stimulation to efferent motor nerve fibers
- Goal: elicit a muscle contraction for a sustained period of time to increase strength

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Electrotherapy Currents

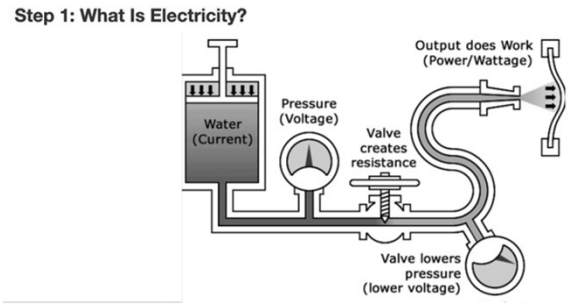
	Alternating Current	Pulsed Current			Direct Current
	IFC Premod Russian	HVG	Neuromuscular Electrical Stimulation (NMES)	TENS	Ionto-phoresis
Indication	Pain Edema	Edema, Wound Care	**Prevent disuse atrophy, increase ROM muscle re-education**	Pain	Edema, Pain
Frequency	Carrier Freq 4000Hz, Modulated Freq 4001-4160Hz	1-120Hz adj	**1-160Hz adj**	1-120Hz adj	10Hz-50kHz
Phase Duration	125μs	100μs	**50-250μs**	50-450μs	Continuous or pulsed
Channels	1-4	1-2	**1-4**	1-2	1-2
Set-up	Bi or Quadripolar	Bipolar	**Bipolar or Quadripolar**	Bipolar or Quadripolar	Bipolar
Waveform	Symmetrical balanced sine wave	Mono-phasic Dual Spiked Wave	**Asymmetrical or Symmetrical Biphasic Square Wave**	Modified Asymmetrical Biphasic Square Wave	Mono- or biphasic, or quadratic
Intensity	1-60mA into 500Ω	1-300V	**1-100mA into 500Ω**	1mA-70mA into 500Ω	1-4mA

96

Definitions

- Voltage - electrical potential (force) which causes current to flow through the conductor measured in volts.
- **Resistance** - the opposition offered by the body to the passage of electric current measured in ohms.
- Ohm's Law:

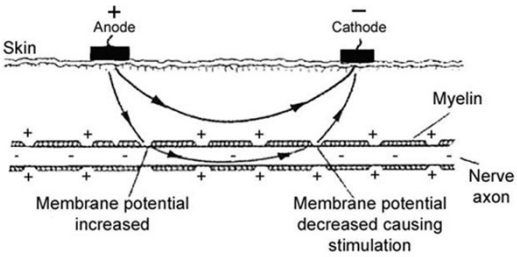
$$\text{Current (I)} = \frac{\text{Voltage}}{\text{Resistance}}$$

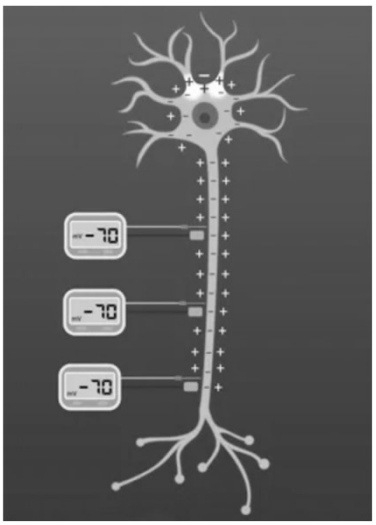


97

Definitions

- NMES is the flow of charged particles between transcutaneous electrodes for therapeutic benefit (i.e., movement).
- Neurons in the path of current depolarize when critical threshold is reached.



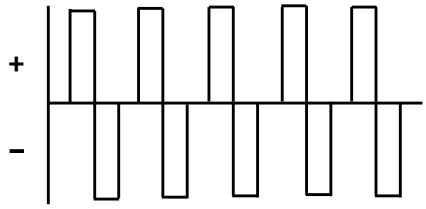


98

Definitions

Waveform: A graphical representation of the shape, direction, intensity, frequency and duration of the electrical current being produced. *Prentice, 1994*

Biphasic- 2 phases, Pulsed current.

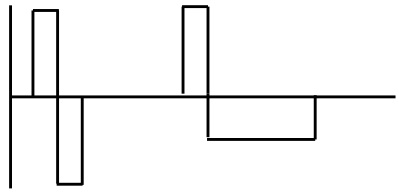


99

Definitions

Waveforms (cont.):

- Symmetrical- Having symmetry, identical phases
- Asymmetrical- Having no symmetry, different phases

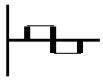


Symmetrical **Asymmetrical**

100

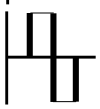
Definitions

- **Intensity:** also known as amplitude is the current generated by the stimulation device.
  - Rate of current flow (height of waveform):



Weak current = (low intensity or lazy river)

vs.



Strong current = (high intensity or raging river)

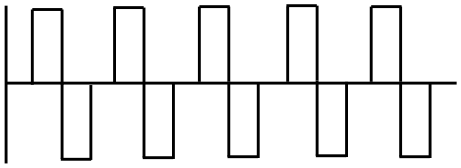
- Electrical current is measured in amperes or amps.
- When applied to NMES the current is typically delivered in small units called milliamps (mA).

101

Definitions

- **Frequency:** Pulses per second (pps), pulse rate measured in Hertz (Hz). 30Hz is sufficient to produce a sustained contraction in most muscles. Higher frequencies (e.g. 50-100Hz) are more fatiguing.

Luschei et al., 1999



5 pps = 5 Hz

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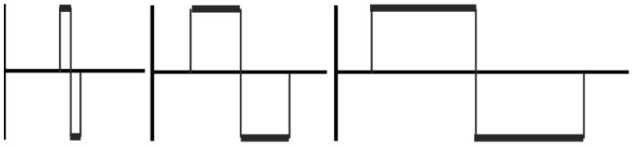
Definitions

- **Phase Duration:** is the measurement of either the + or – phase of the pulse measured in microseconds (µsec).
  - Traditionally, longer phase durations yield deeper penetration, which may create a deep pain/discomfort that may counteract the benefit of the NMES.
  - Traditional NMES uses fixed phase durations between 200-400µsec.



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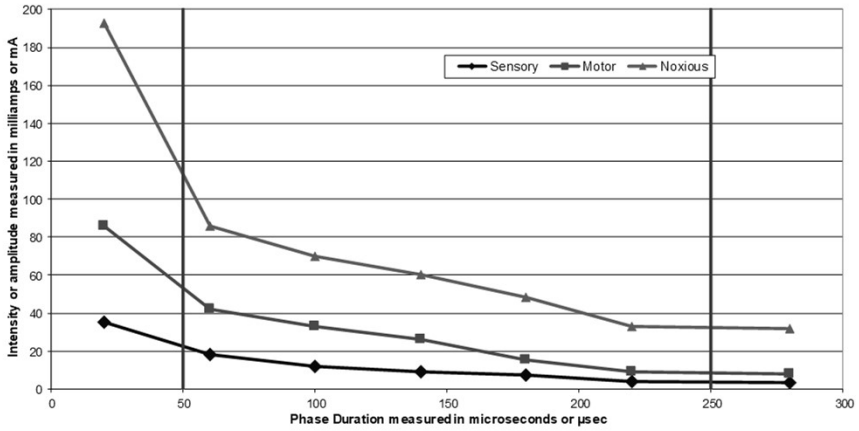
Strength Duration Curve



ESP 1
1 ~ 5mA

ESP 2
1 ~ 2.5mA

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Depth of Current Penetration

Increasing the intensity (current flow), phase duration, or distance between the electrodes will:

- Increase the depth of penetration
- Increase the number of neurons depolarized both superficially and deeper

VS

105

Definitions

- **<u>Ramp Up</u>**: The length of time it takes for the intensity to reach its maximum.
- **<u>Ramp Down</u>:** The length of time it takes for the intensity to drop from its maximum back to zero.

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Definitions

Duty Cycle: Parameters used for NMES to determine the on time and off time of the stimulation

- 1:5 Duty Cycle (less fatiguing)
  - 5 sec on
    25 sec off
    60 stimulations
    48/60 = 80%
- 1:4 Duty Cycle
  - 5 sec on
    20 sec off
    72 stimulations
    58/72 = 80%
- 1:3 Duty Cycle (more fatiguing)
  - 5 sec on
    15 sec off
    90 stimulations

Enoka et al., 2008

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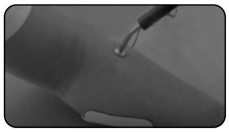
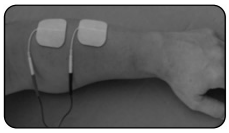
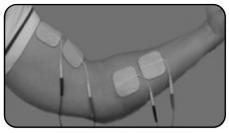
Definitions



Monopolar - 1 pole, usually a probe with a dispersive pad set up - used to stimulate motor or trigger points.



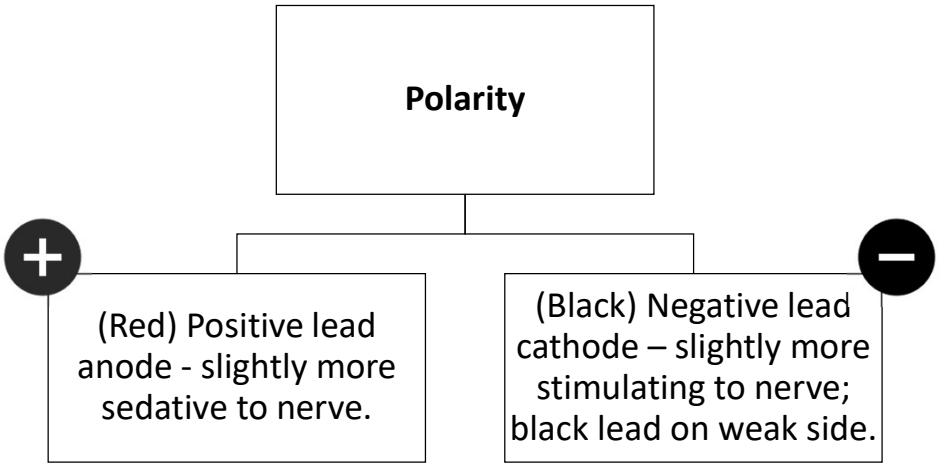
Bi-Polar- 2 poles, single-channel set-up, 2 electrodes - used for muscle stimulation or pain control.



Quad-Polar- 4 poles, dual-channel set-up, 4 electrodes - used primarily for pain control and reciprocating or co-contraction muscle stimulation.

108

Definitions



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Definitions

<u>Accommodation</u>: A phenomenon in which a nerve fiber that has been subjected to a constant level of depolarization will become unexcitable at that same intensity.

Prentice, 1994

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Ampcare's ESP Effective Swallowing Protocol

- Symmetrical Biphasic **waveform.**
- **Frequency** of 30 pulses per second.
- **Phase Duration** of 50 microseconds but if the patient can tolerate maximum intensity we recommend 250 microseconds.
- **Ramp up** of 1 second; **Ramp down** of 0 seconds.
- **Duty cycle** of 5 seconds on, 25 seconds off initially, but progress to 5 seconds on, 20 seconds off and finally 5 seconds on and 15 seconds off.
- **Treatment time** for 30 minutes.
- **Intensity** or amplitude to tolerance, but preferably high enough for a sustained motor contraction.
- Patient to perform **indirect exercise** while electrical stimulation is on.

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Using Ampcare's ESP

Demonstration

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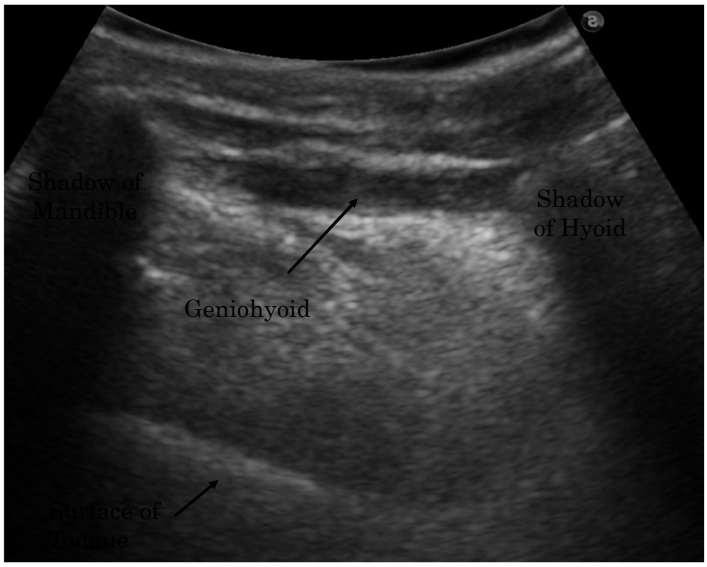
Geniohyoid muscle contraction during stim

Device: ITO postim
Mode: NMES
Frequency: 30pps
Phase duration: 50µs
Ramp up time: 1s
Stim control: Foot switch



Dr. Tatsuyuki Fukuoka (Hiroshima International University)

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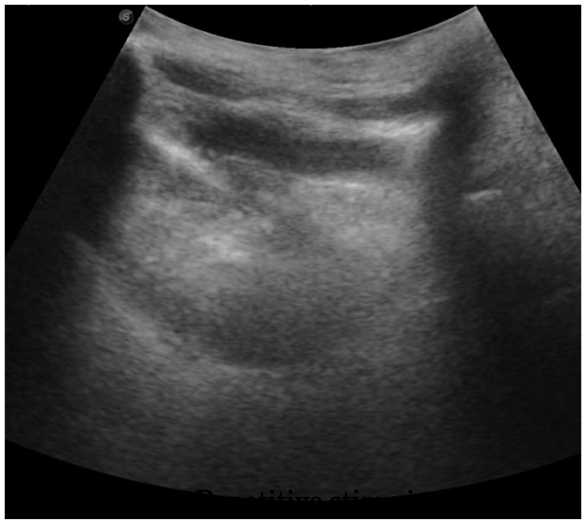
Ultrasonographic view of the Geniohyoid muscle



Male in his 40s. NMES mode (Amplitude:46mA)

Dr. Tatsuyuki Fukuoka (Hiroshima International University)

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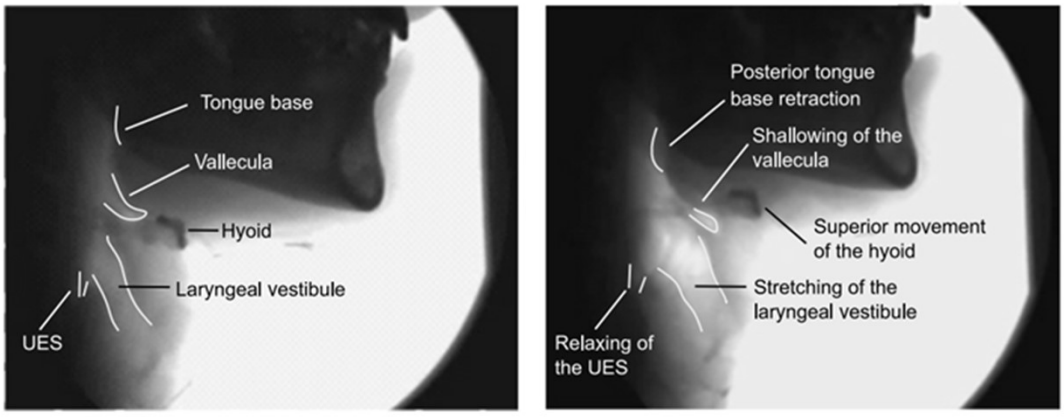
Video Example



At Rest | During ESP

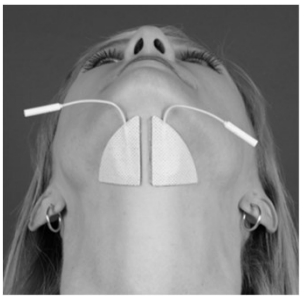
Perturbation: a disruption to a movement goal, requiring a system to overcome the effects created by a change or deviation.

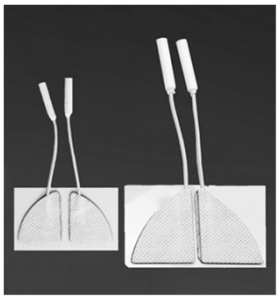
115

Questions?

116

E Series Electrodes





FDA 510(k) cleared for neck muscle stimulation to re-educate the muscles necessary for pharyngeal contraction (K121483) and are:

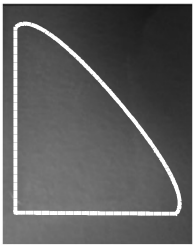
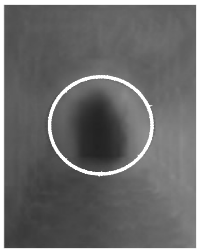
- Designed to match the curvature of the jaw line
- Made with a unique composition
- Reusable, pre –gelled, self-adhering
- Single patient use electrodes
- Latex free, made in the USA
- Multiple sizes

117

E Series Electrodes

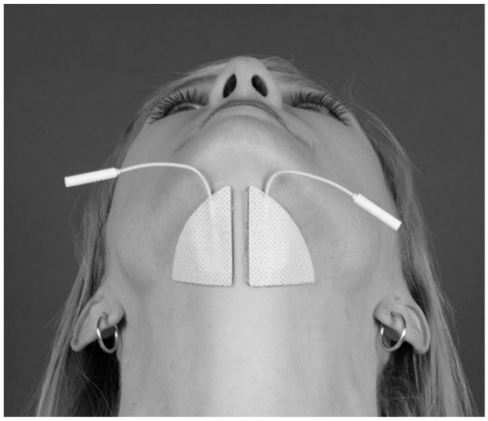
- Extremely low impedance
- Even surface dispersion
- Elicits a comfortable motor contraction

Dispersion test to check the uniformity of current distribution using the same parameters

Ampcare's E Series Electrode		Standard Electrode	
Electrical stimulation occurs evenly across surface of electrode resulting in a more comfortable treatment.		Electrical stimulation occurs primarily in the blue "Hot-Spot" area resulting in a painful stimulus.	

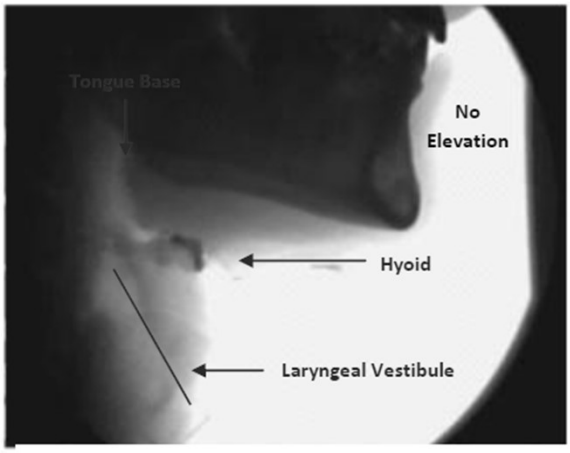
118

Submental Placement



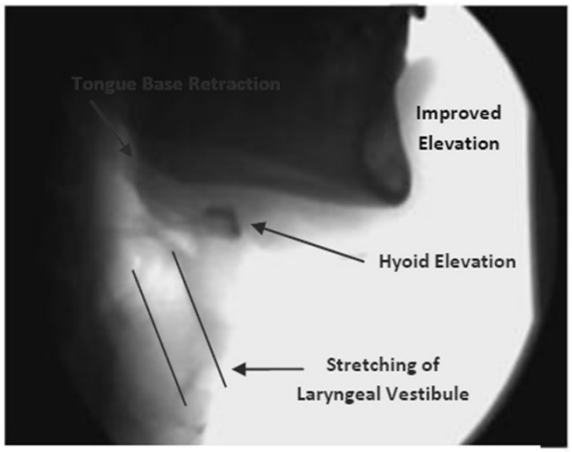
119

Patient at Rest



Patient at rest

Patient with ESP



Patient receiving Ampcare's ESP

120

E Series Electrode Use

1. **Wash** the treatment area with soap and water, rinse, and dry well.
2. **Skin prep wipe may also be used.** Allow the skin to dry for at least 45 seconds.
3. **Remove electrodes from the liner** by lifting a corner and pulling gently.
4. **Place electrodes** on the correct body part to be stimulated.
5. A **strap** or **Restorative Posture Device (RPD)** can be used to hold electrodes in place to increase conduction.
6. **Attach electrodes** to the lead wires.
7. **Make sure the unit is off** and **attach the lead wire** to the stimulator.
8. **Turn on the stimulator** and **increase the intensity to tolerance** but preferably high enough for a tetanic contraction.

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Restorative Posture Device (RPD)

Patented product

Component of ESP

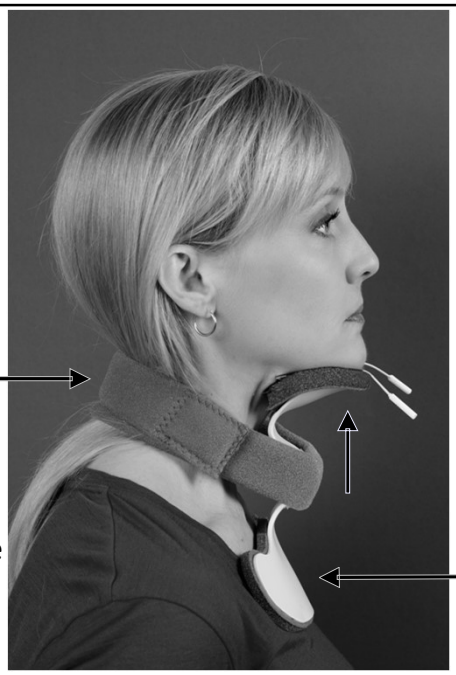
- Maintains electrode placement/ improves conduction
- Assists with proper cervical alignment
- Protects electrodes from coming in contact with saliva
- Can be customized to fit the patient
- Builds strength through a resistive exercise program

122

Application of the ESP

3 Points of Pressure

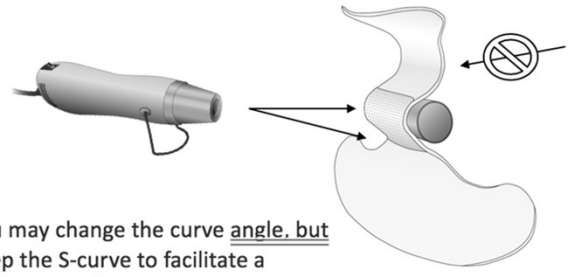
5 pounds of pressure
17 kilopascals
2.5 psi



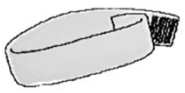
RestorativeMedical.com

123

Heat Molding the RPD



NO heat to the upper S-curve.



You may change the curve angle, but keep the S-curve to facilitate a cushioning effect.

Spot mold only at the middle of the S-curve to adjust the height or the bottom of the S-curve to adjust the chest plate.

124

RPD

Before

After

125

Modifications to the RPD

- Consider preexisting conditions (e.g. surgeries, stenosis, osteophytes, etc.) when fitting the Restorative Posture Device.

126

Modifications to the RPD

- Proper fit will depend on preexisting conditions, comfort and therapeutic goals.

127

CMS Orthotic Billing Code

CPT – Current Procedural Terminology

97760 – Orthotic(s) management & training (including assessment & fitting when not otherwise reported) upper extremity(s), lower extremity(s) and/or trunk, each 15 minutes

97762 – Checkout for orthotic/prosthetic use, established patient, each 15 minutes

128

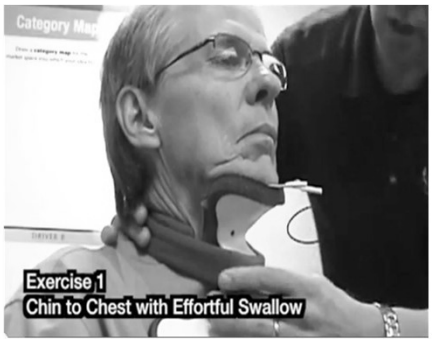
HCPCS Code for Medicare Part B

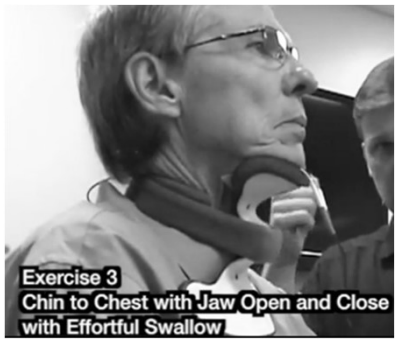
Restorative Posture Device code: L0140

Covers one device per patient for reimbursement rates per state; refer to back of manual.

129

ESP- Exercises





Watts CR. (2013) Measurement of Hyolaryngeal Muscle Activation Using Surface Electromyography for Comparison of Two Rehabilitation Dysphagia Exercises. Arch of Phys. Med. and Rehab, 94:2542-8.

130

ESP Neuromuscular Electrical Stimulation

- **Ampcare ES™ is the only hand-held 2-channel electrical stimulation unit with adjustable parameters cleared by the FDA for the treatment of dysphagia.**
- **Ampcare ESP Therapy System is FDA cleared for muscle re-education by application of external stimulation to the muscles necessary for pharyngeal contraction (K131222).**

131

Ampcare ES Program Table

Program	ESP1	ESP2	Manual 3
Frequency (Hz)	30 (fixed)		5-50 adjustable in 1 Hz increments
Phase Duration (µsec)	50 (fixed)	250 (fixed)	50-250 adjustable in 50 µsec increments
Ramp Up (sec)	1 (fixed)		
Ramp Down (sec)	0 (fixed)		
Cycle ON Time (sec)	5 (fixed)		
Cycle OFF Time (sec)	Selectable values of 25, 20, or 15		
Program Duration (min)	30 (fixed)		5 – 30 adjustable in 5 min increments
Intensity	0 – 20 adjustable in increments of 1*		

** Intensity setting controls output amperage, which is limited based on phase duration.*

132

Ampcare ES Programming Summary

Power

ESP 1 or ESP 2

To modify press the "Menu up" or "Menu down" button once to program the cycle off time

Press the "+" or "-" button to program the cycle off time to either 25, 20 or 15 seconds

Once a change is made, press "enter"

Treat; set intensity

Pause

133

Care and Storage of the E Series Electrodes

Clean the gel surface of the electrode after each use by holding under dripping water and gently rubbing for 5 sec. ⇨ Allow 5 seconds to dry and become tacky. ⇨ Replace electrodes on the liner and seal the package at room temperature. ⇨ Write the patient's name and start date on the outside of the electrode package. ⇨ Life of electrodes depends on skin condition, preparation, and storage.

134

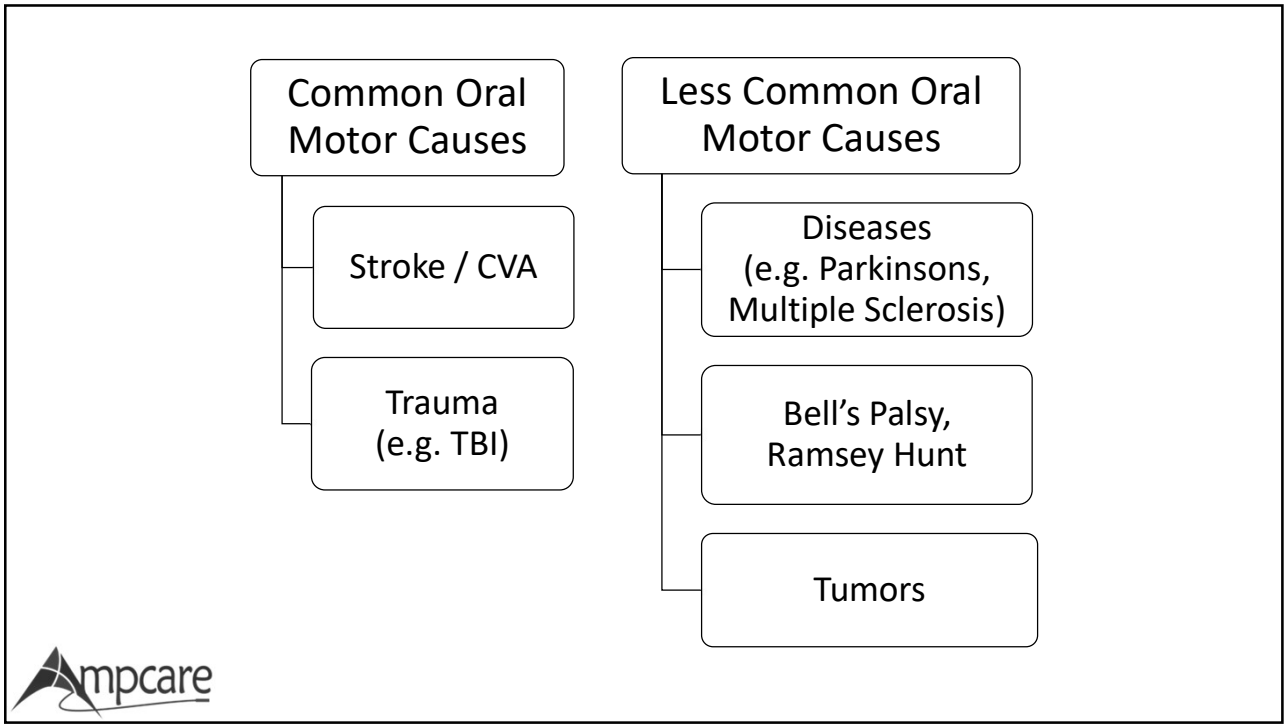
Oral Motor Management

Example of oral motor impairments:

- Facial drooping
- Drooling
- Incomplete mastication
- Oral pocketing
- Swallowing and speaking

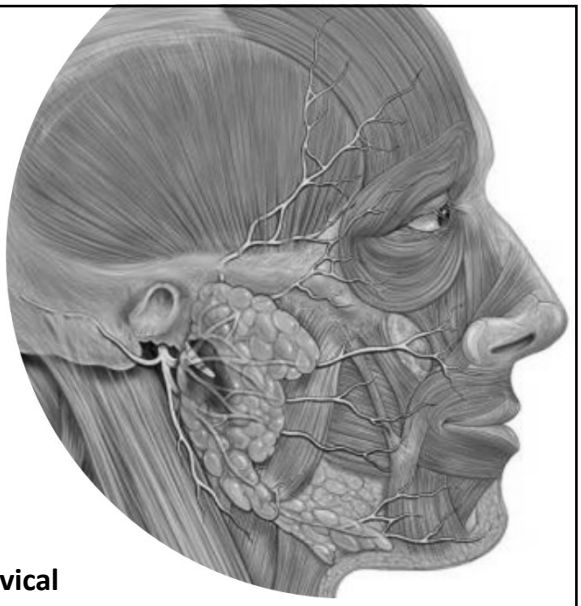
This can be due to facial weakness or abnormal muscle tone.

135



136

Facial Nerve (VII)



5 Nerve Branches Responsible for:

- **motor to the facial muscles**
- **sensory (taste) to the anterior 2/3 of the tongue**
- **parasympathetic functions of the salivary and lachrymal (tear) glands**

Temporal, Zygomatic, Buccal, Mandibular and Cervical

137

Facial Nerve (VII)

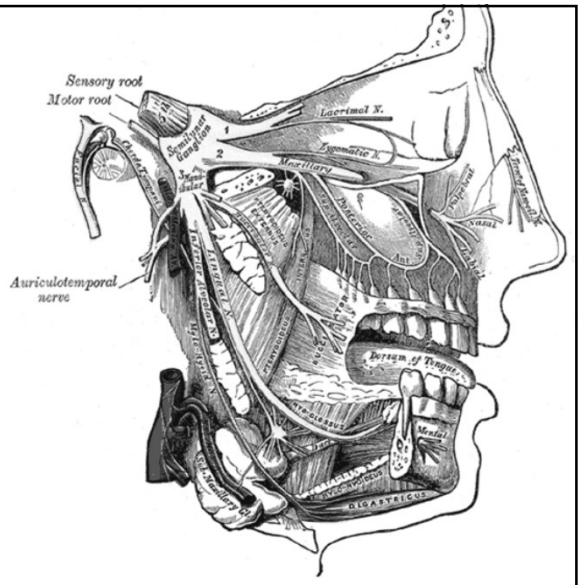
Muscle	Function
Orbicularis Oris	**Controls lip closure, pursing movements – intake through a straw or kiss someone. Allows you to say "puh", "MMM", /w/ or "ooo" sounds.**
Buccinator	**Compresses the cheeks against the teeth to prevent oral pocketing of food, also used in the act of blowing air between the lips as in whistling or to increase oral pressure, speech intelligibility and volume.**
Zygomaticus Major	Draws the angle of the mouth upward and outward as in smiling and for oral acceptance. Allows you to say "eee" sounds.

138

Trigeminal Nerve (V)

- **3 Nerve Branches Responsible for:**
  - **sensation to the face**
  - **motor to the palate (tensor veli palatini), pharynx and the muscles of mastication**

V_1 – Ophthalmic, V_2 – Maxillary, V_3 - Mandibular



139

Trigeminal Nerve (V)

Muscle	Function
Masseter	**Provides jaw closure and range of motion to masticate solids and assist with articulation.**
Anterior Digastric, Mylohyoid	Hyolaryngeal elevation and protraction and may affect voice pitch. Assists with mandibular depression.

140

Oral Motor Treatment

- **NMES is recommended to promote a faster recovery for appropriate patient types (e.g., CVA, TBI)**
- **Controversial for peripheral nerve damage (e.g., Bell's Palsy, Ramsey Hunt)**
  - **Less treatment required due to spontaneous recovery**
  - **Medications (antiviral, anti-inflammatory, antibiotics)**

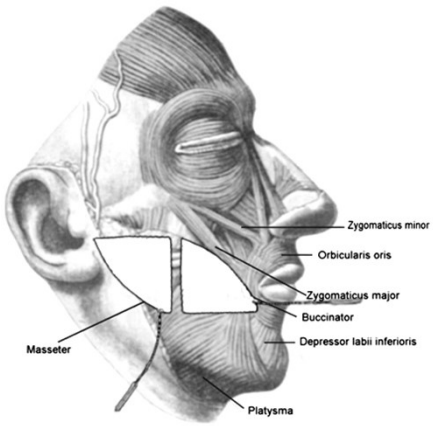
141

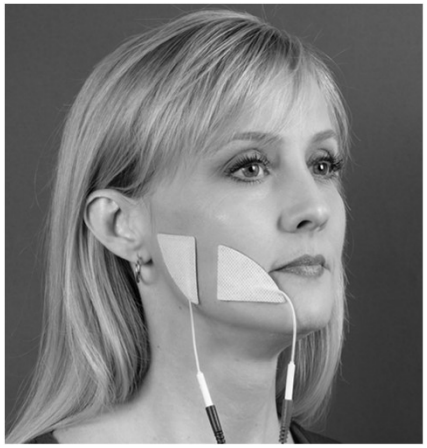
Facial Placement

- **Facial** - Stimulates the Masseter, Buccinator and Orbicularis Oris.
- **Rationale for dysphagia** - To assist chewing, decreasing oral pocketing and preventing anterior loss of a bolus/drooling.
- **Rationale for dysarthria** - To articulate words with "ooo", "mmm", /w/ and "puh" sounds as well as increasing oral pressure, speech intelligibility and volume.

142

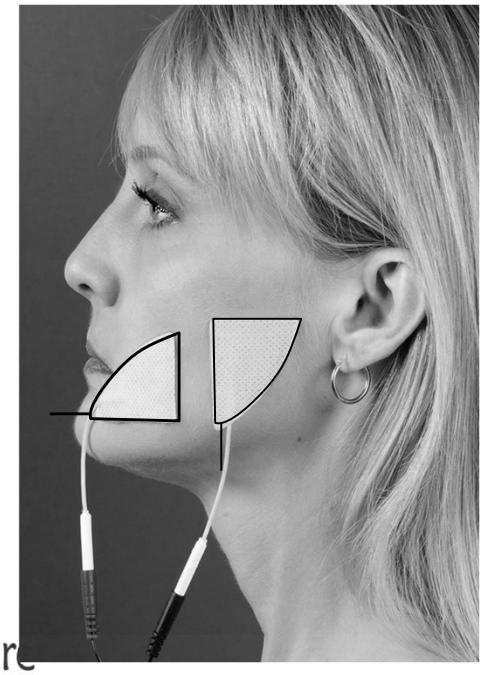
Facial Placement



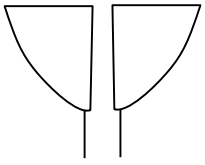


143

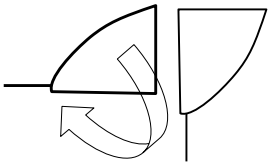
Facial Placement Left Side



1) Starting Position:



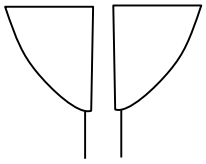
2) Rotate Left Electrode:



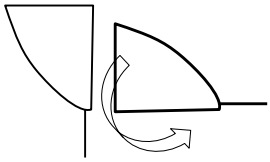
144

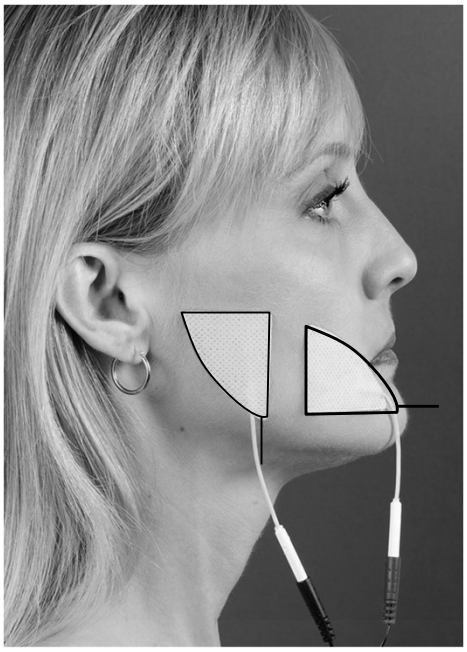
Facial Placement
Right Side

1) Starting Position:



2) Rotate Right Electrode:





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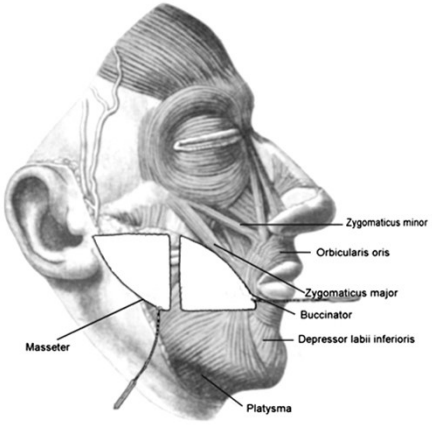
Facial Placement
Video



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Treatment Guidelines

Voluntary exercise should occur simultaneously with the electrical stimulation (e.g., Resistive Chin-to-Chest, Mendelsohn maneuver, Effortful swallow, and oral motor exercises)

Maximal evoked contractions as tolerated to facilitate explosive strength (type II muscle fibers)

As patient fatigues attempt to modify the activity to continue to evoke contractions

147

Billing: PDPM/PDGM

- **Recognize the ICD-10-CM to Clinical Category Mapping**
  - **Example:**
    - **Medical Dx - e.g. Nontraumatic Subarachnoid Hemorrhage (I61.9)**
    - **Treatment Dx:**
      - **Dysphagia following Nontraumatic Subarachnoid Hemorrhage (I69.091)**
      - **Oropharyngeal Dysphagia (R13.12)**

148

Documentation and Billing

- **What are you doing?**
  - **DYSPHAGIA TREATMENT – 92526**
  - **TREATMENT OF SPEECH – 92507**
    - **CMS stipulates SLPs should bill these for treatment of speech, swallowing dysfunction, and/or oral function of feeding.**
  - **Denials for 97110 and 97112**
    - **G0283 - Electrical Stim (unattended), 97032 (attended)**
    - **CMS does not support the use of these codes by SLPs.**

149

Plan of Care

ESP Example order:

Speech Language Pathology (SLP) to add to Dysphagia Plan of Care (POC) Effective Swallowing Protocol (ESP) to the suprahyoid musculature ___ times a week for 30 days to increase laryngeal vestibule closure times and/or hyolaryngeal excursion.

RPD Example order:

Speech Language Pathology (SLP) to add to Dysphagia Plan of Care (POC) Restorative Posture Device (RPD) to assist with resistive exercise protocol and posture ___ times a week for 30 days to increase oropharyngeal strength and/or cervical posture.

150

Daily Treatment Note

Example:

Patient received ESP1 to the suprahyoid musculature x 30 minutes, 5 sec on/(25) sec off duty cycle with intensity setting of 11 while performing 10 minutes each of chin-to-chest with effortful swallows (18/20), Mendelsohn (16/20), and jaw open/jaw closed with effortful swallows (14/20).

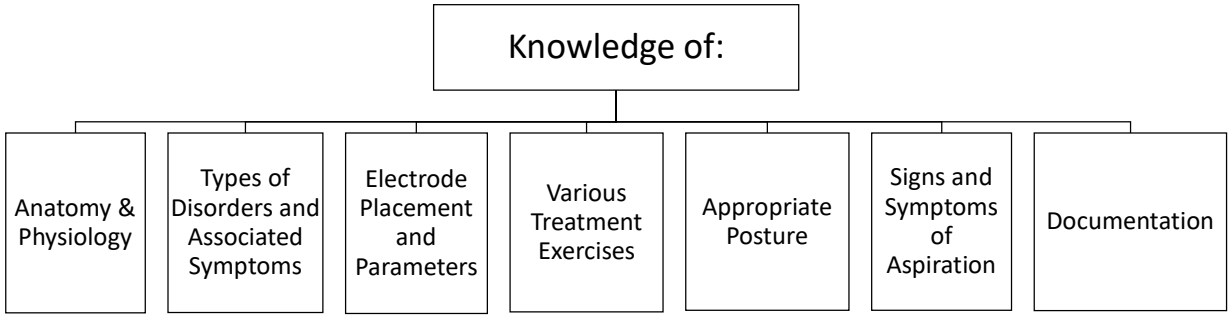
151

Documentation

- You are doing dysphagia treatment to improve oropharyngeal contraction to aid swallowing and/or speech treatment for articulation precision.
- You are looking to achieve hyolaryngeal elevation, improved timing of the swallow, increasing PO, decreasing s/s of aspiration/penetration, improved ROM, etc.
- No modality should be used in isolation.
- Techniques utilized (resistive chin-to-chest, Mendelsohn, effortful swallow, etc.) may be considered appropriate.
- See appendix of this manual for sample orders, goals and exercises.

152

SLP Competency in ESP



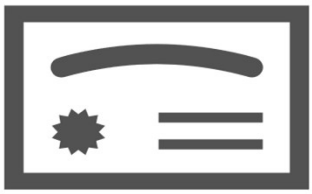
153

Competence

Individuals shall honor their responsibility to achieve and maintain the highest level of professional competence and performance (Principle of Ethics II).

- **Rule A.** Individuals who hold the Certificate of Clinical Competence shall engage in only those aspects of the professions that are within the scope of their professional practice and competence, considering their certification status, education, training, and experience.
- **Rule E.** Individuals in administrative or supervisory roles shall not require or permit their professional staff to provide services or conduct research activities that exceed the staff member's certification status, competence, education, training, and experience.

154



Certificates and Certification

- A CE certificate neither guarantees or confirms competence in a particular technique or device covered by a course.
- ASHA CE does not imply endorsement, only that is related to the field.
- The only certificate that implies competence is your Certificate of Clinical Competence.

155

Post Test

1. Which of these is NOT a laryngeal elevator muscle:
   a) Anterior Digastric
   b) Mylohyoid
   c) Geniohyoid
   d) Sternohyoid

156

Post Test

2. The indications for NMES include the following EXCEPT:
   a) Prevent disuse atrophy
   b) Increase range of motion
   c) Re-educate muscle function
   d) Decrease blood circulation

157

Post Test

3. By placing electrodes over the neuromuscular junction in the muscle, your goal is to:
   a) Allow for the most efficient muscle contraction using the highest intensity with increased pain.
   b) Allow for the most efficient muscle contraction using the least amount of intensity with the least amount of pain.
   c) Allow for the least efficient muscle contraction with increased intensity but with increased pain.
   d) Allow for the least efficient muscle contraction with the least amount of intensity but with increased pain.

158

Post Test

4. Which cranial nerve is most likely involved when a patient presents with silent aspiration?
   a) Hypoglossal
   b) Trigeminal
   c) Vagus
   d) Facial

159

Post Test

5. The _____ muscle fiber is slow twitch, for high endurance and is slow to fatigue.
   a) Type I
   b) Type IIa
   c) Type IIb
   d) Type O-

160

Post Test

6. The _____ muscle fiber is fast twitch, for intermediate endurance and is known for high power.
   a) Type I
   b) Type IIa
   c) Type IIb
   d) Type O-

161

Post Test

7. The _____ muscle fiber is used for maximum contraction and responds first to electrical stimulation.
   a) Type I
   b) Type IIa
   c) Type IIb
   d) Type O-

162

Post Test

8. Electrical stimulation applied to the skin at these levels will penetrate deeper and depolarize nerve endings.
   a) Increased intensity, increased phase duration.
   b) Decreased intensity, decreased phase duration.
   c) Intensity or phase duration do not factor in the depth of penetration of the current.
   d) Works best when applied to cartilage.

163

Post Test

9. _____ affects the fatigue rate, related to the ratio of stimulation on-to-off time.
   a) Frequency
   b) Phase Duration
   c) Duty Cycle
   d) Intensity

164

Post Test

10. _____ is the pulse rate measured in Hertz; 30 pps are sufficient to produce a smooth tetanic contraction, 50-100 pps are associated with more fatigue.
    a) Frequency
    b) Phase Duration
    c) Duty Cycle
    d) Intensity

165

Post Test

11. _____ is the measurement of either the + or – phase of the pulse measured in microseconds (µsec); ESP uses either 50 or 250µsec.
    a) Frequency
    b) Phase Duration
    c) Duty Cycle
    d) Intensity

166

Post Test

12. _____ is the flow of current, measured in milliamps (mA). The higher it is the greater the increase in motor units activated.
    a) Frequency
    b) Phase Duration
    c) Duty Cycle
    d) Intensity

167

Post Test

13. According to the strength duration curve, all the following are true EXCEPT:
    a) The higher the phase duration, the lower the intensity needed to make a contraction.
    b) The lower the phase duration, the higher the intensity needed to make a contraction.
    c) At a higher phase duration, it is more likely to achieve a noxious stimulus with a higher intensity.
    d) At a lower phase duration, it is more likely to achieve a noxious stimulus with a lower intensity.

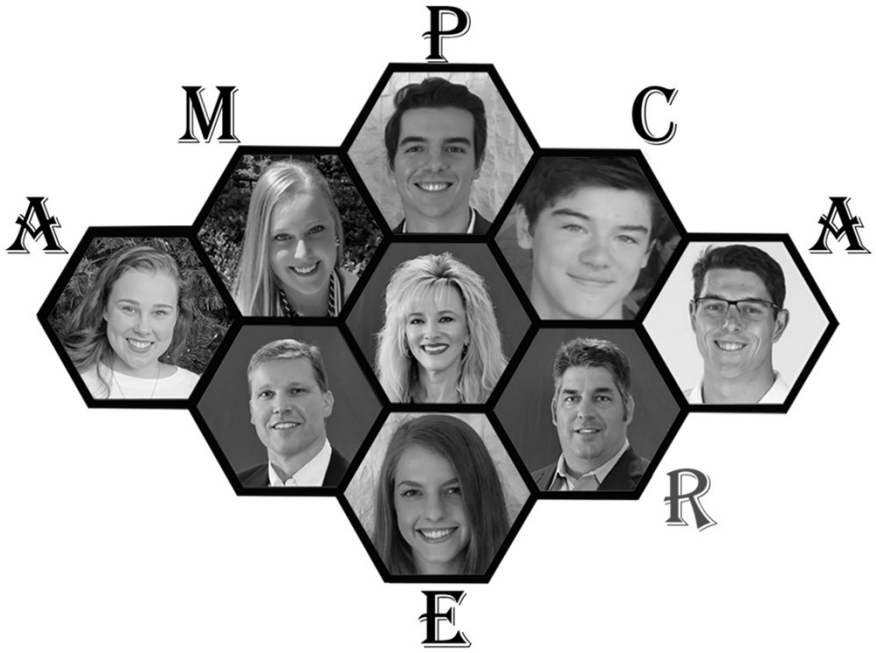
168

Post Test

14. This module's primary discussion point involved the use of ESP for:
    a) The rehabilitation of pharyngeal muscle groups involved in elevation of the hyoid and larynx through muscle re-education and treatment in disuse atrophy.
    b) Achieving a safe swallow only while using appropriate electrical stimulation parameters.
    c) Treating all dysphagia patients.
    d) Improving gait patterns in the elderly.

169

Ampcare Namesakes



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Ampcare Information

Ampcare Certification Number

Ampcare Website

- **ampcarellc.com**
- **swallowtherapy.com**
- Log In Information

171

Acknowledgements

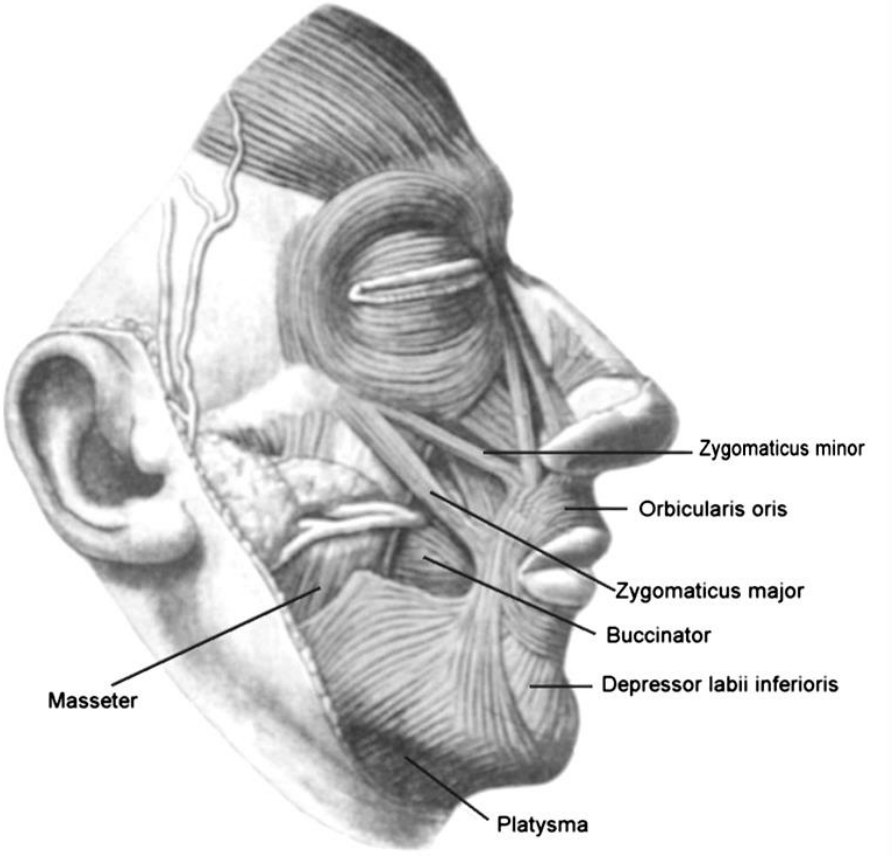
Thank you for spending the day with us!

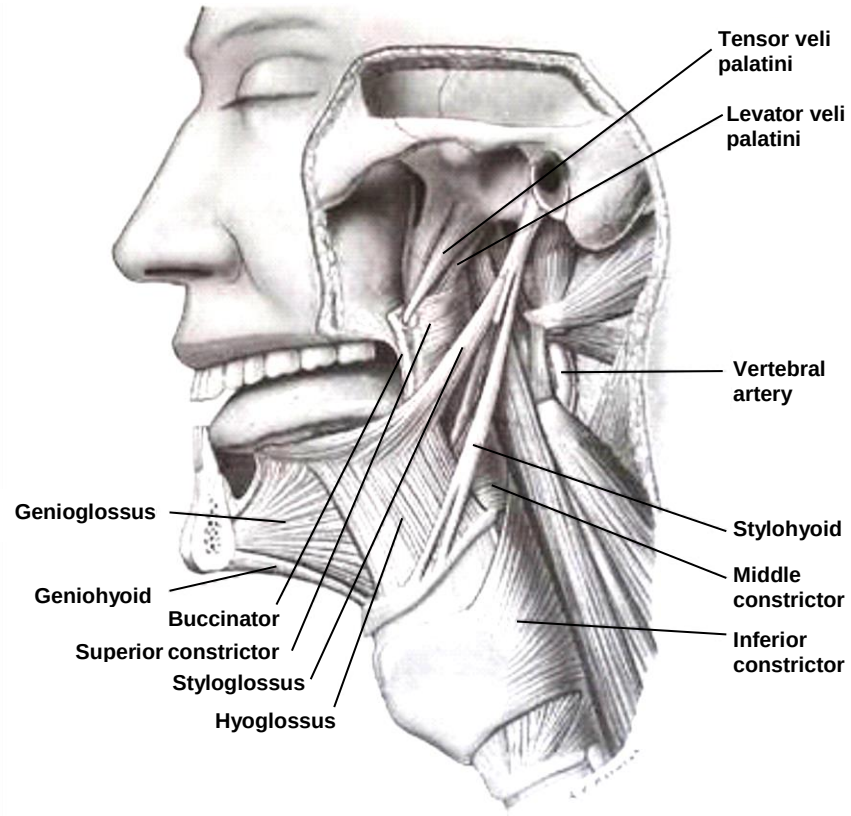
Questions ? ? ?

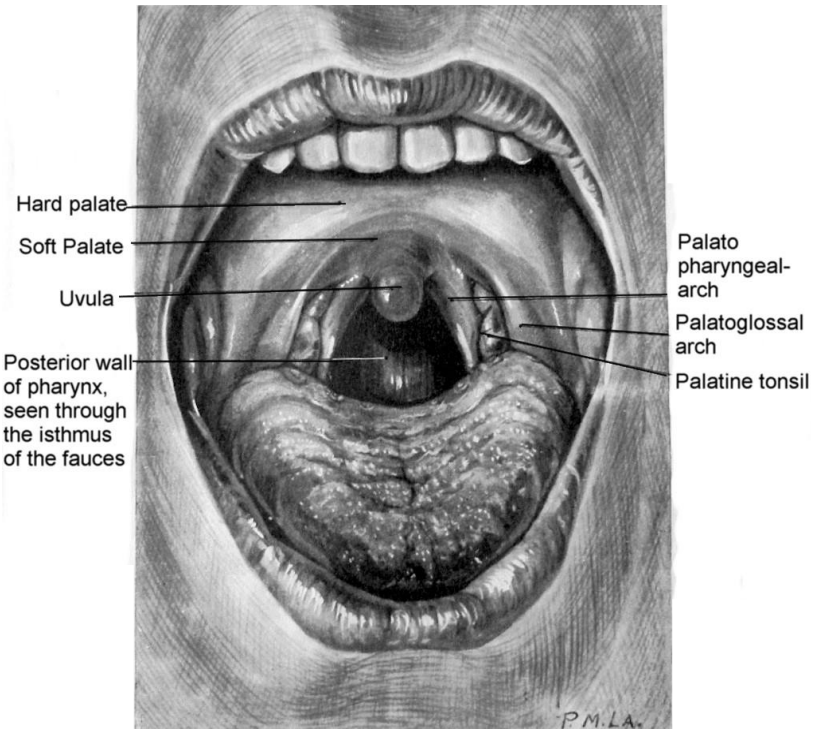
Rick, Ronda and Russ

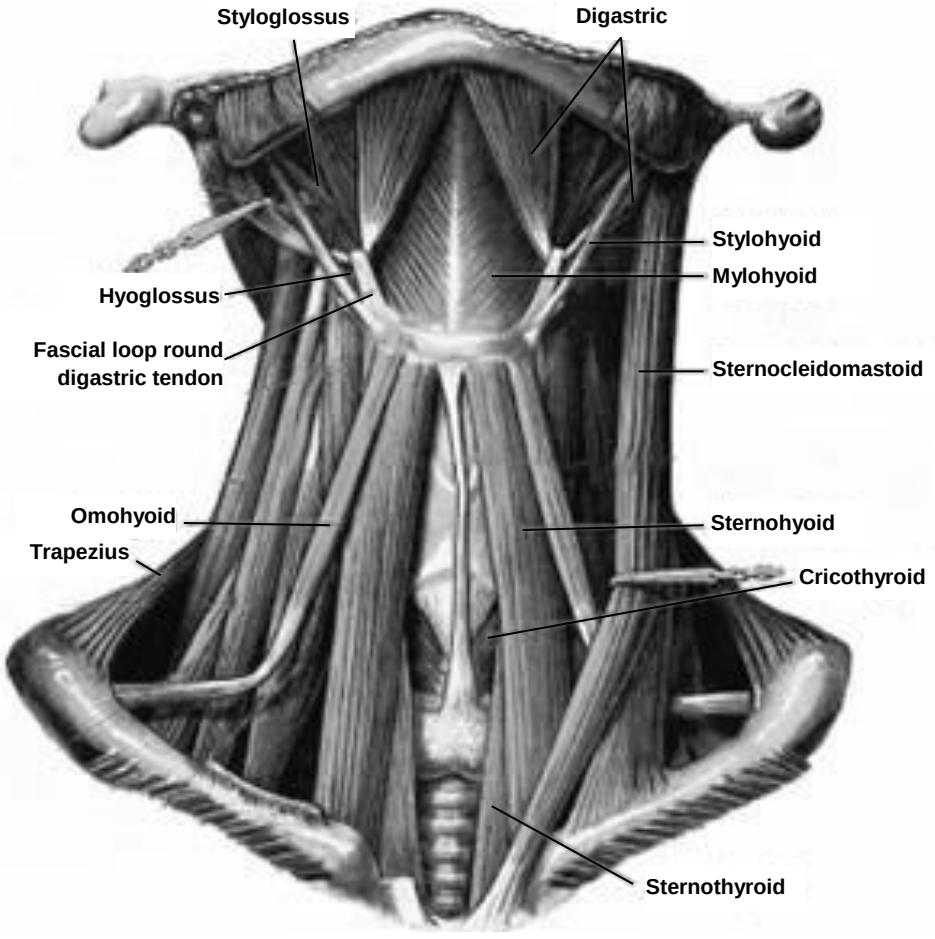
Ampcare, LLC

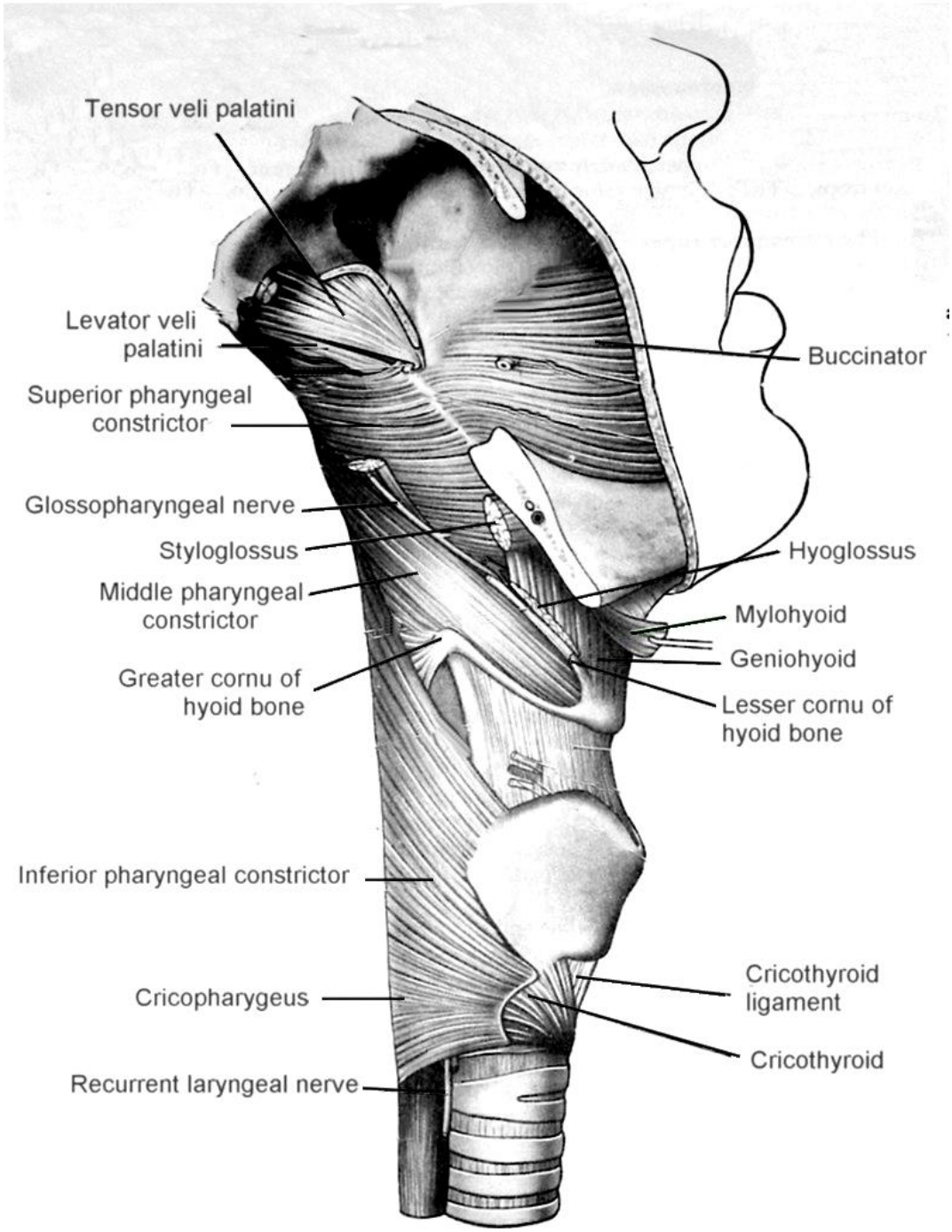
172

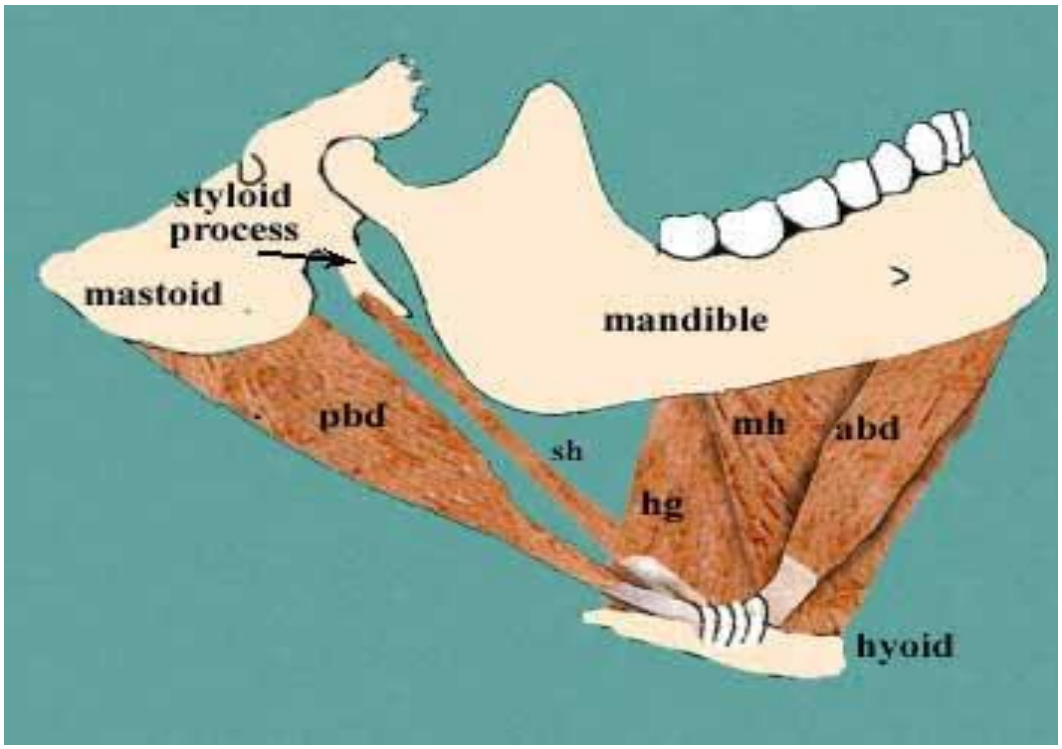

Zygomaticus minor
Orbicularis oris
Zygomaticus major
Buccinator
Depressor labii inferioris
Masseter
Platysma

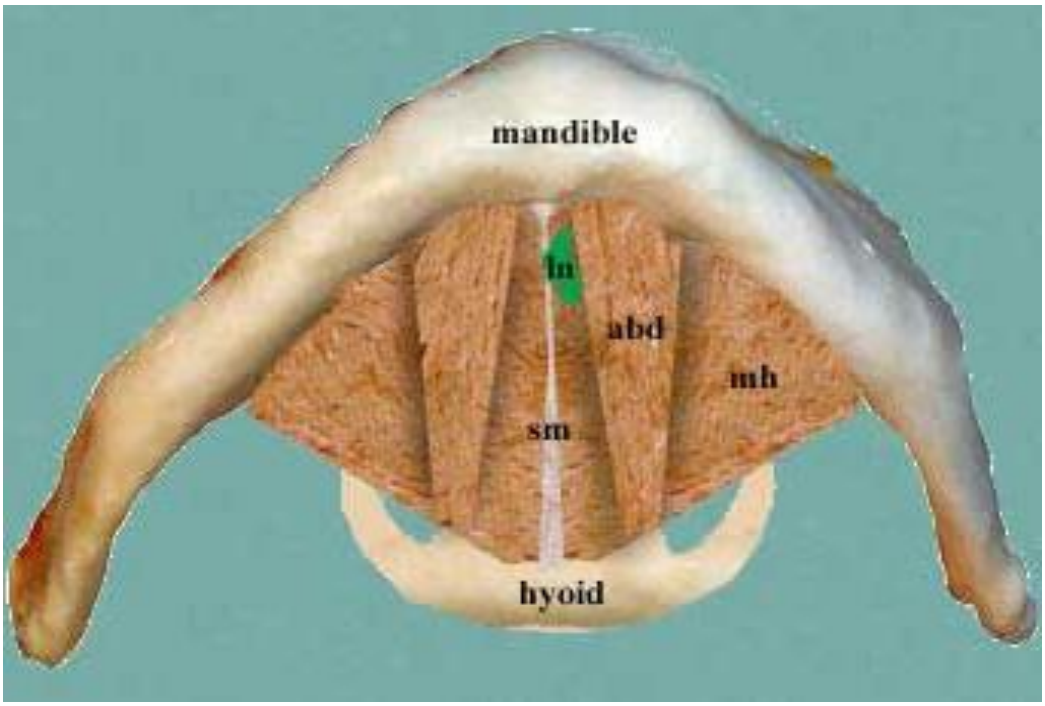

Tensor veli palatini
Levator veli palatini
Vertebral artery
Stylohyoid
Middle constrictor
Inferior constrictor
Genioglossus
Geniohyoid
Buccinator
Superior constrictor
Styloglossus
Hyoglossus


Hard palate
Soft Palate
Uvula
Posterior wall of pharynx, seen through the isthmus of the fauces
Palato pharyngeal-arch
Palatoglossal arch
Palatine tonsil
P.M.L.A.

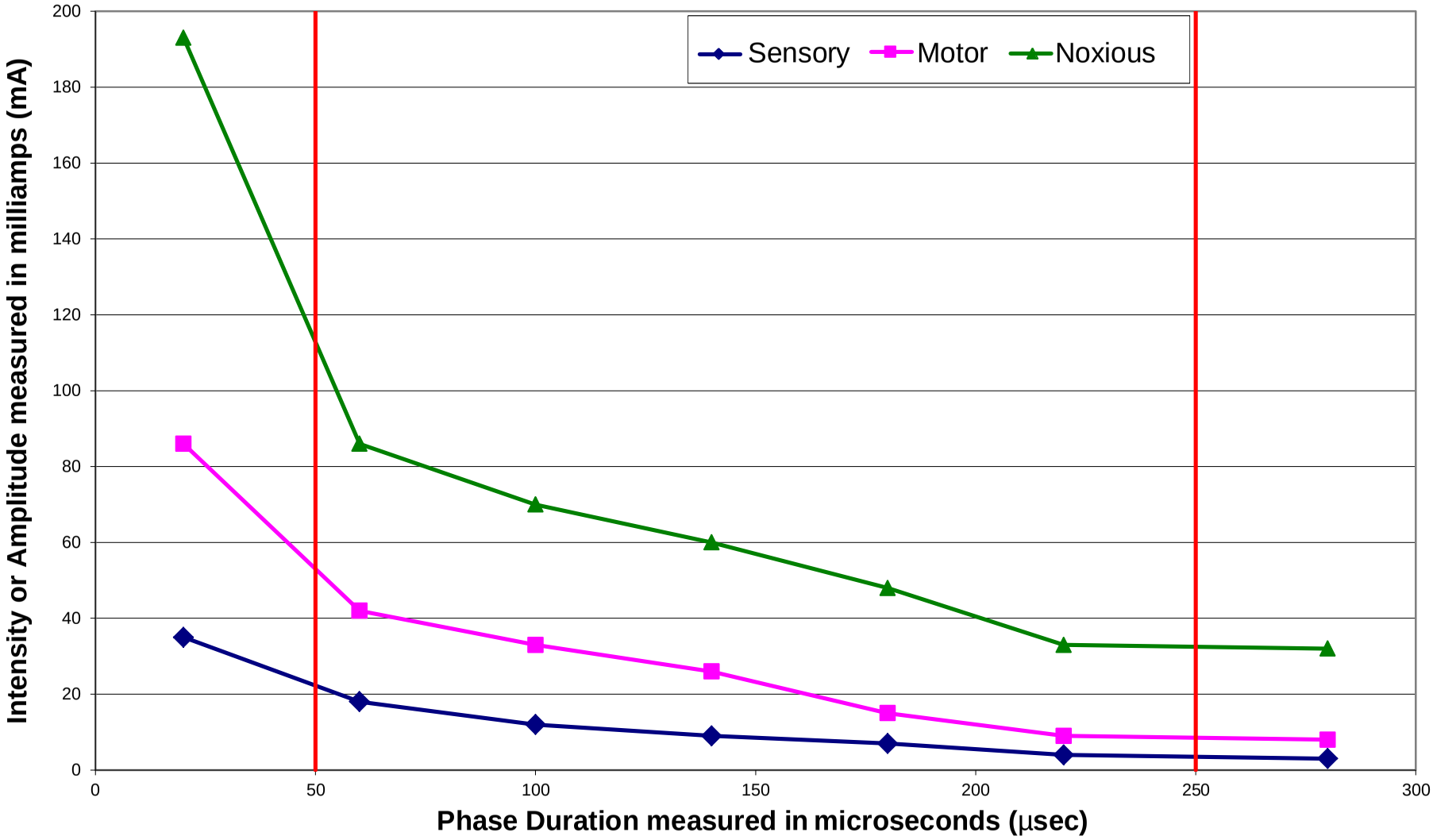

Styloglossus
Digastric
Stylohyoid
Mylohyoid
Hyoglossus
Fascial loop round digastric tendon
Sternocleidomastoid
Omohyoid
Sternohyoid
Trapezius
Cricothyroid
Sternothyroid







Strength Duration Curve



ESP 1

1 ~ 5mA

ESP 2

1 ~ 2.5mA

Pacemaker/Defibrillator Protocol

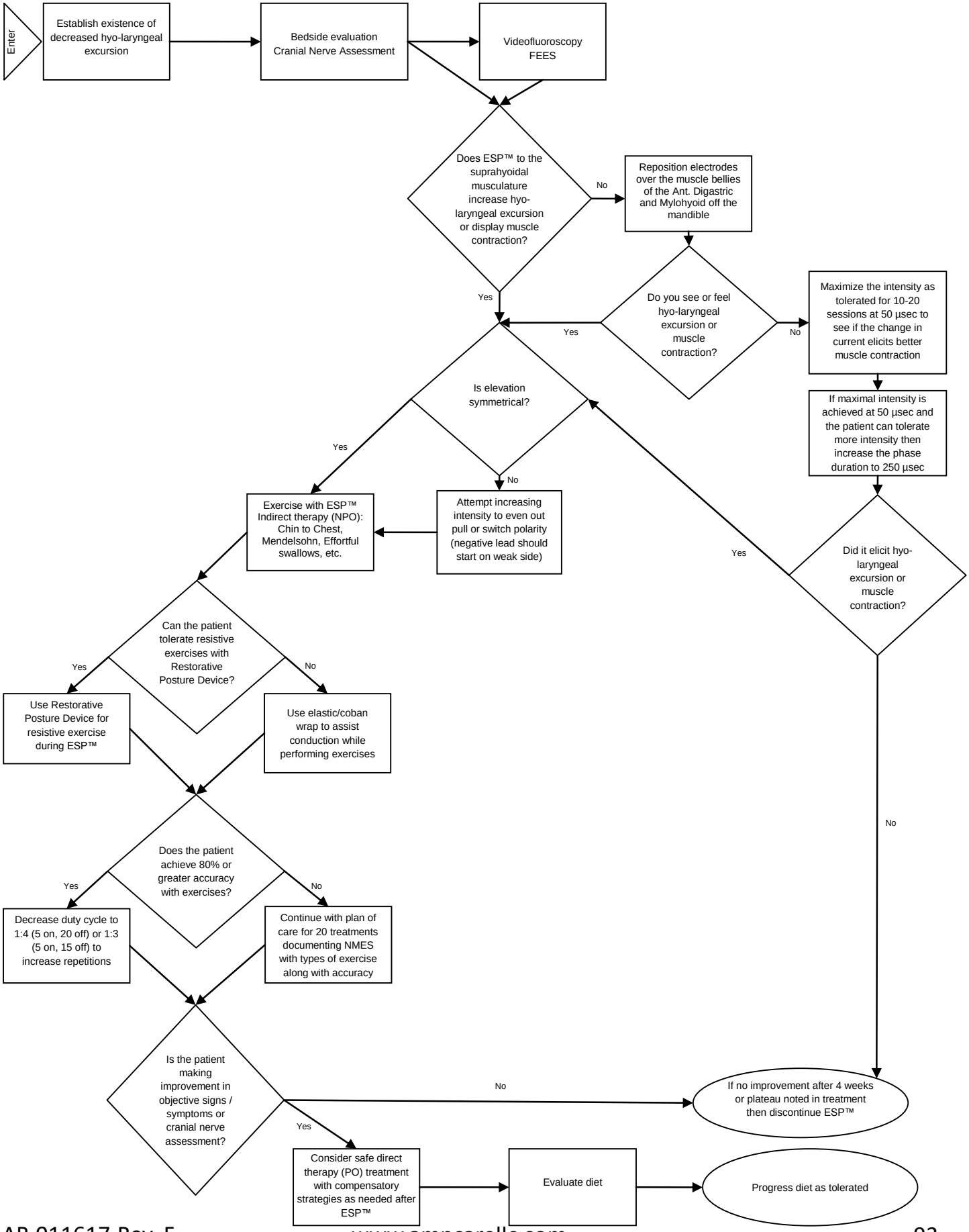
It is always best practice to notify the patient's cardiologist or cardiac clinic (if the cardiologist is no longer seeing this patient) on a patient by patient basis, to clarify if using NMES would be appropriate. Depending on the type of cardiac device the patient may or may not be appropriate for NMES.

If it is approved by the physician you should consider taking the appropriate steps as discussed in the CE Training. Certain pacemaker companies manufacture specific types of pacemakers/defibrillators that can utilize an external magnet to lock the pacemaker signal in place and temporarily prevent the defibrillator from firing. You will need to ask the physician to provide you with the serial number of the device, the company representative's name and phone number in your area to set up an appointment, if the physician agrees on the NMES plan of care on a patient with a pacemaker. The pacemaker company representative may monitor the patient with portable ECG/telemetry during treatment, and instruct you on the process of using the magnet with ESP. If this process is completed and there is no change in the ECG, the company representative may give you a magnet for continued use. It may be that the the company representative just provides you with a magnet without this ECG/Telemetry step. For a step by step process of the Pacemaker/Defibrillator protocol, see below.

<u>Pacemaker/Defibrillator Protocol:</u>

1. Contact Cardiologist or Physician at the cardiac clinic that cares for the patient:
    - Explain that you are treating his/her patient for dysphagia and would like to use NMES.
    - Discuss placement of electrodes over the chin in the submental region using a frequency of 30 Hz and phase duration of 50 µsec to 250 µsec.
    - Request that you would like to set up an appointment with the pacemaker representative to see if an external magnet would be appropriate to prevent electromagnetic inference (EMI).
    - If physician indicates that this is unnecessary, ask for documentation, such as a prescription that indicates "Appropriate to proceed with NMES."
2. Contact Pacemaker Company
    - Call number on back of patient's pacemaker card and ask to speak with a representative in your area.
    - Request an appointment for electromagnetic interference (EMI) testing.
    - Give requested information, such as reason, location, etc.
3. Discussion with Pacemaker Representative
    - Explain that you want to use NMES with the patient and that you have spoken with cardiologist.
    - Schedule time with representative to allow both of you to be present with the patient.
    - The EMI testing should be a free service.
4. Schedule the Appointment
    - Company representative will set the patient up to test the pacemaker/defibrillator for EMI.
    - Place the electrodes submentally and be ready to begin the treatment.
    - The representative will place a magnet over the pacemaker/defibrillator to prevent the defibrillator from firing, but still allows the pacemaker to function.
    - Explain to the patient that you need to increase the intensity as high as you can to ensure there will not be a problem during later treatments.
    - Set the device with standard parameters indicated for treating that particular patient.
    - Turn on and progress the intensity as high as they can tolerate; the representative will have a digital display to tell if there is any EMI; if so discontinue and do not proceed with use. If not, you can proceed.
5. Documentation
    - Ask representative for a printout of the ECG.
    - Sign it, along with signature from the representative.
    - Write the date and the parameters used and document in the chart as well
    - Example: "Medtronic representative John Smith provided pacemaker/defibrillator EMI testing for NMES in the submental region for potential treatment of dysphagia. Equipment tested at frequency of 30 Hz, phase duration of 50 µsec, intensity of 55 milliamps with placement in submental region. No EMI noted."
    - Send a copy of findings to cardiologist or physician at the cardiac clinic that cares for the patient.

Treatment Algorithm for ESP™



Types of Electrical Stimulation

Electrotherapy Currents

	Alternating Current	Pulsed Current			Direct Current
	IFC Premod Russian	HVG	Neuromuscular Electrical Stimulation (NMES)	TENS	Ionto-phoresis
Indication	Pain Edema	Edema, Wound Care	**Prevent disuse atrophy, increase ROM muscle re-education**	Pain	Edema, Pain
Frequency	Carrier Freq 4000Hz, Modulated Freq 4001-4160Hz	1-120Hz adj	**1-160Hz adj**	1-120Hz adj	10Hz-50kHz
Phase Duration	125μs	100μs	**50-250μs**	50-450μs	Continuous or pulsed
Channels	1-4	1-2	**1-4**	1-2	1-2
Set-up	Bi or Quadripolar	Bipolar	**Bipolar or Quadripolar**	Bipolar or Quadripolar	Bipolar
Waveform	Symmetrical balanced sine wave	Mono-phasic Dual Spiked Wave	**Asymmetrical or Symmetrical Biphasic Square Wave**	Modified Asymmetrical Biphasic Square Wave	Mono- or biphasic, or quadratic
Intensity	1-60mA into 500Ω	1-300V	**1-100mA into 500Ω**	1mA-70mA into 500Ω	1-4mA

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]

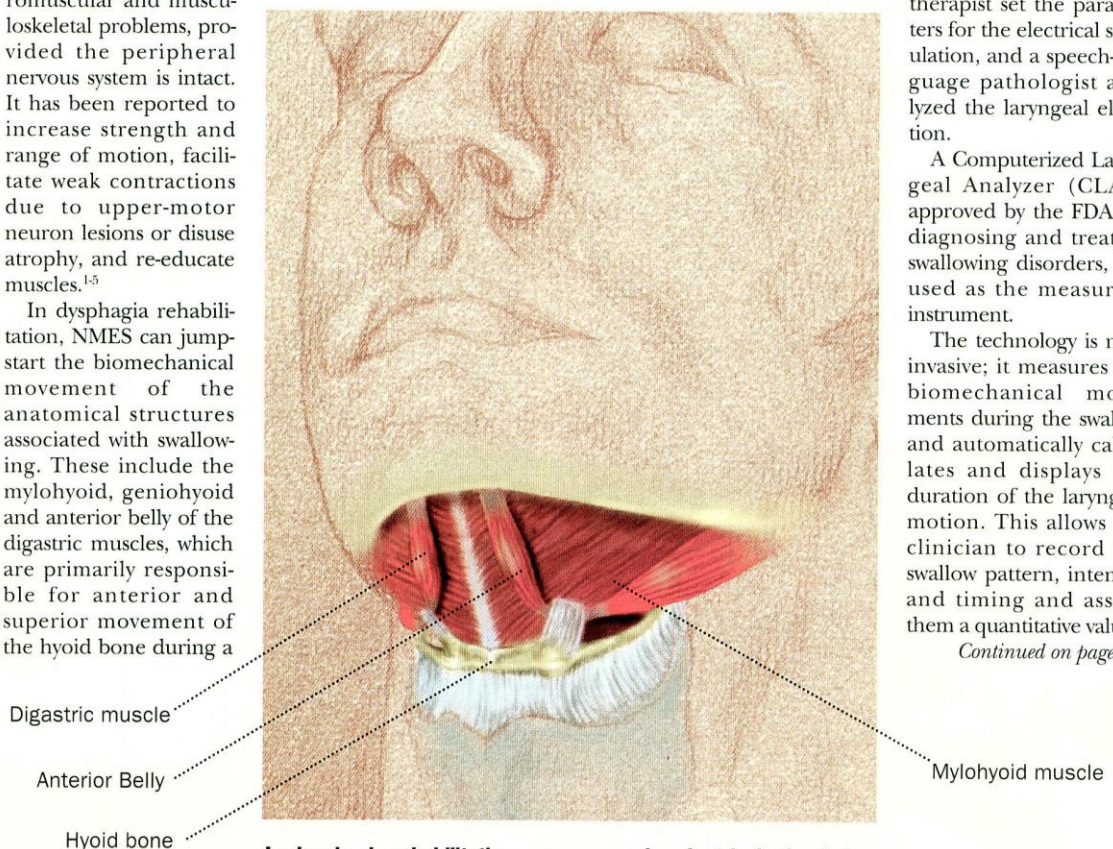
In dysphagia rehabilitation, NMES can jump-start the biomechanical movement of the anatomical structures associated with swallowing. These include the mylohyoid, geniohyoid and anterior belly of the digastric muscles, which are primarily responsible for anterior and superior movement of the hyoid bone 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.

Continued on page 67



In dysphagia rehabilitation, neuromuscular electrical stimulation can jump-start the biomechanical movement of the anatomical structures associated with swallowing.

DYSPHAGIA

Continued from page 64

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 BIOMVE 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.

surable movement of the larynx.

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 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. ■

Electrical stimulation can promote laryngeal elevation without a volitional response from the subjects . . .One day, this research could yield the final clue to deciphering dysphagia.

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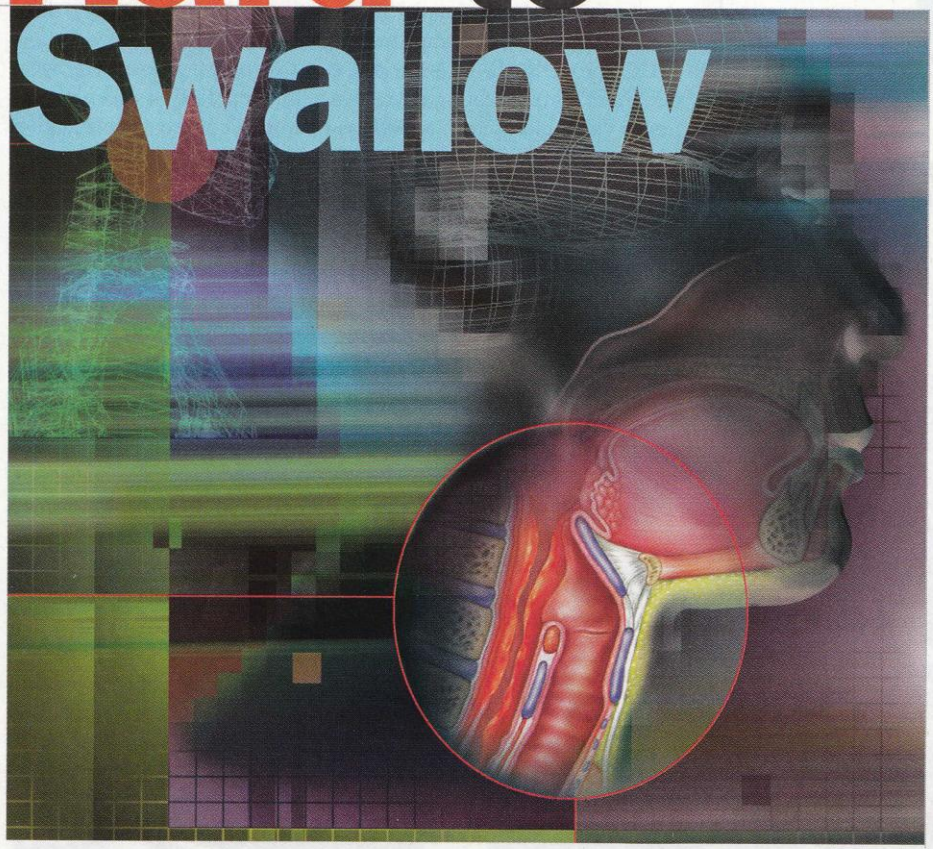
Hard to Swallow



ADVANCE

Neuromuscular e-stim offers another option to treat decreased laryngeal elevation.

BY RONDA POLANSKY, MS, CCC-SLP, RUSS CAMPBELL, PT, & RICK MCADOO, MS, CCC-SLP

With age comes a range of problems, from diminished sight and poor hearing to altered mobility and balance difficulties. In addition to those issues, as many as 70 percent to 90 percent of elderly patients have some degree of swallowing dysfunction.[1]

Dysphagia affects 15 million people in the United States and 45 percent to 87 percent of residents in long-term care.[2-4] Aspiration pneumonia is the fifth leading cause of death in the United States.[5] The cost to treat dysphagia that results in pneumonia is estimated to exceed $3 billion each year. Approximately 150,000 nursing home patients require hospitalization for pneumonia each year.[1]

The amount of time a speech-language pathologist spends caring for patients with dysphagia has increased over the past 20 years due to more referrals and better awareness among health professionals. Speech-language pathologists should play a critical role during the dysphagia recovery process.

DEALING WITH DYSPHAGIA

The symptoms of dysphagia vary with its cause and can have a devastating effect on quality of life. Direct and indirect treatments include oral-motor exercises, hyolaryngeal and Shaker exercises, the Mendelsohn maneuver and thermal stimulation.

These treatments are often difficult to perform with the geriatric population when there is a comorbidity with Alzheimer's disease, stroke or Parkinson's disease. Decreased laryngeal elevation is a common functional abnormality in pharyngeal dysphagia. Laryngeal elevation is important in airway protection to prevent penetration and aspiration.

Electrical stimulation (e-stim) has been used for years as a physical therapy modality. Although transcutaneous e-stim has received more attention as an adjunct to dysphagia treatment recently, clinicians don't know much about its effect on swallowing physiology. E-stim assists hyolaryngeal elevation and may increase sensory input to the central nervous system to enhance swallowing.[6]

Using neuromuscular electrical stimulation (NMES) to treat laryngeal elevation provides speech-language pathologists with another treatment option to help patients improve swallowing disorders, and enable them to return to feeding and a regular diet. When NMES is applied to the skin at low current levels, it activates sensory nerve endings in the surface layers, which provides sensory feedback to the peripheral and central nervous systems.

With increased intensity or pulse width, the electric field penetrates deeper and depolarizes nerve endings in muscles lying beneath the skin surface. The field also spreads with diminishing density to produce a muscle contraction, provided the peripheral nervous system is intact.

The U.S. Food and Drug Administration has cleared NMES for use for muscle re-education, to prevent or retard disuse atrophy and relax muscle spasms. In addition, NMES is FDA-approved to increase local blood circulation, maintain or increase range of motion and for immediate post-surgical stimulation of calf muscles to prevent deep vein thrombosis.

Speech-language pathologists should play a critical role during the dysphagia recovery process.

Using e-stim for this program is based on a standard muscle re-education protocol for small muscle groups. It's also applied to prevent or retard disuse atrophy of the supra-hyoid musculature due to inactivity.

To treat diminished hyolaryngeal elevation, electrodes are placed

on the submental area of the submandibular triangle, rather than the contraindicated portion of the anterior neck area, such as the carotid sinus or laryngeal region. This location is safer and more physiologically plausible.

By using standard equipment for this purpose, clinicians can modify the parameters to meet a patient's individual needs. This can be done with adequate electrotherapy training.

Used properly, NMES is safe and effective to treat poor hyolaryngeal elevation. Through continued research, this approach has been proven under videofluoroscopy, as well as fiberoptic endoscopic evaluation of swallowing (FEES) supporting laryngeal elevation, tongue base retraction and improved by-mouth intake.[7]

PUTTING IT TO THE TEST

A clinical trial evaluated the efficacy of using e-stim to the anterior digastrics and mylohyoid musculature (submandibular region) to promote improved laryngeal elevation and improved swallow function and safety. The rationale was that range of motion of the larynx during swallowing affects airway protection, and anterior motion of the hyolaryngeal complex is essential to successful function of the cricopharyngeal muscle. The trial focused on using these e-stim parameters with a restorative postural device to promote optimal posture and electrode conduction, combined with electrodes to re-educate and strengthen muscles related to laryngeal elevation.

The trial involved patients at long-term care facilities in Texas. Patients in group 1 received at least 20 therapy days of the NMES protocol, along with traditional therapy (79 patients). Patients in group 2 received traditional dysphagia therapy, which would have been per-

formed prior to NMES modality training or for patients who refused the NMES therapy protocol (46 patients).

Diagnoses included cerebrovascular accidents, Parkinson's, Alzheimer's, dementia, pharyngeal cancers and pneumonia from a pharyngeal dysphagia.

To date, 125 patients evaluated by modified barium swallow study (MBSS) had impaired laryngeal elevation as a primary or secondary dysfunction, causing aspiration or risk of aspiration to the degree that diet changes were necessary. A swallow severity scale was established to determine the diet.

The subset of patients who could tolerate at least 20 days of traditional dysphagia therapy while using the NMES protocol were included in the analysis as successfully completing the protocol. They were compared with 46 patients who received only traditional dysphagia therapy, but whose chart reviews noted they exhibited dysphagia with decreased laryngeal elevation as diagnosed from MBSS under fluoroscopy.

The charts were evaluated as to the number of patients who had an improved swallowing severity scale. The six scale levels are: nothing by mouth (0); therapeutic intake only (1); pleasure feedings only (2); modified diet including thickened liquids and puree or mechanical soft with strategies (3); strategies only, no alternate method of intake (4); and normal swallowing function (5).

The scale level improved from 2.33 to 3.72 in the NMES subgroup that received at least 20 days of the NMES protocol, and from 2.52 to 2.6 in the traditional therapy group. Not all of the patients were able to achieve a period of at least 20 days in the traditional therapy group.

The average number of therapy days was 36.79 in the NMES subgroup and 19 in the traditional study group. Three-fourths of the patients who received at least 20 days of the NMES protocol had a diet upgrade.

The results of this clinical trial suggest that patients who present with dysphagia, due in part to diminished laryngeal elevation, and receive NMES to the laryngeal elevators improve diet upgrades and swallow function at a higher percentage. Throughout the trial, there were more than 5,814 therapy visits using this protocol. This suggests that it's a safe adjunct to treat patients with pharyngeal dysphagia.

As research expands in this area, clinicians will be able to determine more about the physiological effects on the neck muscles and swallowing functions. ■

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An investigation into the effects of neuro-muscular electrical stimulation (NMES) on swallowing function in patients presenting with persistent dysphagia.

Dr Sue Pownall and Professor Pam Enderby

Speech and Language Therapy Department Sheffield Teaching Hospital NHS Foundation Trust.
School of Health and Related Research, University of Sheffield.

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sue.pownall@sth.nhs.uk

1) Background

Decreased laryngeal elevation is common among patients with swallowing difficulties. It has been hypothesised that electrical stimulation can assist hyo-laryngeal elevation (Freed et al 2001; Leelamanit et al 2002). Stimulation of laryngeal elevation musculature via NMES in combination with traditional treatments is suggested to re-educate muscles when suffering from reduced laryngeal elevation. The rationale for the technique and parameters follow the rules of electrophysiology for stimulating small muscle groups. Using NMES to treat decreased laryngeal elevation provides SLTs with another treatment option.

2) Method

Feasibility study using a case series design which included 5 patients with stable and persistent dysphagia who presented with decreased laryngeal elevation diagnosed by Videofluoroscopy (VF).

Participants received 4 weeks of daily intervention (5 days per week for 30 minutes). Participant's swallowing was re-assessed by VF and clinical assessment post intervention. A follow-up assessment was completed two weeks after completion of the intervention.

Data was collected using Rosenbek Penetration/aspiration scale, Waxman dysphagia severity scale and Functional Oral Intake Scale. Participants also completed a questionnaire about acceptability of the intervention.

Data was analysed using descriptive statistics.

3) Results

5 patients were recruited. Two with diagnosis of stroke, two head and neck cancer and one skull base osteomyelitis. Time of dysphagia ranged from 3 months to two years.

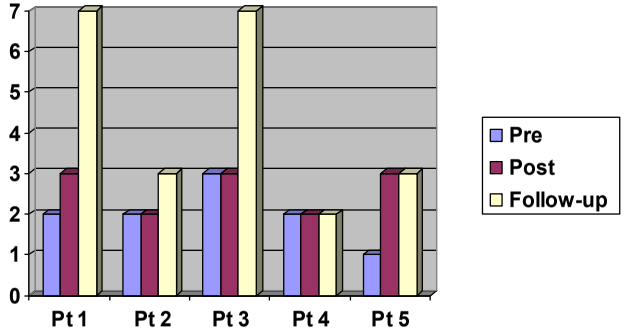
All participants completed 20 sessions, described the intervention as acceptable and would strongly recommend it to others.

All 5 participants showed improvements in their swallowing to varying degrees.

Two returned to full oral diet having been on non-oral feeding for 5 months and over 24 months respectively, although one continued to show aspiration with some intake. Both ceased nutritional intake via PEG reducing costs to the NHS.

Three patients introduced an increased amount and range of food consistencies to their oral intake, although they continue to receive their main nutrition via PEG.

Functional Oral Intake Scale



Level 1: Nothing by mouth.
Level 2: Tube dependent with minimal attempts of food or liquid.
Level 3: Tube dependent with consistent oral intake of food or liquid.
Level 4: Total oral diet of a single consistency.
Level 5: Total oral diet with multiple consistencies, but requiring special preparation or compensations.
Level 6: Total oral diet with multiple consistencies without special preparation, but with specific food limitations.
Level 7: Total oral diet with no restrictions.

4) Results

Patient description of daily oral intake
(All had PEG tubes for nutrition)

Patient 1 Pre- 5 teaspoons fluid or 5 teaspoons soft fork mashed diet
Follow-up- Eating full oral intake. PEG to be removed

Patient 2 Pre- Half pint soup taken in small amounts throughout day
Follow-up- As above plus 4x half cup coffee per day.
Introducing small amount soft fork mashable foods

Patient 3 Pre- small amounts normal diet and fluids
Follow-up- Full oral intake. Flushing PEG only to keep patent

Patient 4 Pre- 2-4 cups tea per day
Follow-up- intermittently eating minimal amounts soft fork mashed diet. First solid food in 3 years

Patient 5 Pre- Water only sucked from mouth sponges
Follow-up- Sips water, plus small amount soft fork mashed diet

5) Conclusion

Results suggest this technique may be an effective intervention for some patients presenting with persistent dysphagia.

A pilot study is now planned to investigate the technique using a randomised design.

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journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2013;94:2542-8

ORIGINAL ARTICLE

Measurement of Hyolaryngeal Muscle Activation Using Surface Electromyography for Comparison of Two Rehabilitative Dysphagia Exercises

Christopher R. Watts, PhD

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Abstract

Objective: To investigate the effects of a resistance-based chin-to-chest (CtC) exercise on measures of hyolaryngeal muscle activation compared with a head-lift exercise.

Design: Within-subject, repeated-measures design.

Setting: Academic research laboratory.

Participants: Healthy young women (N=20) without a history of dysphagia, cervical spine conditions, neurologic disease, or head/neck cancer (mean age, 22.5y).

Interventions: All participants performed an isometric jaw-opening exercise against resistance (CtC) and an isometric head-lift exercise, both targeting activation in the hyolaryngeal (suprahyoid) muscles. The CtC exercise required jaw opening into a chin brace secured against the upper torso for a duration of 10 seconds. The isometric head-lift exercise required lifting and holding the head from a supine position for 10 seconds. The degree to which each exercise activated the suprahyoid muscles was measured using surface electromyography (sEMG).

Main Outcome Measures: Microvolts as measured from sEMG sensors placed on the skin surface above the hyolaryngeal muscles (surface of skin above geniohyoid, mylohyoid, and anterior digastric). Dependent variables included the peak microvolts during 10 seconds of sustained contraction and the difference in microvolts from rest to peak contraction for each exercise.

Results: Activation in the hyolaryngeal musculature as measured via sEMG was significantly greater when participants performed the CtC exercise compared with the head-lift exercise. Measures of peak microvolts during contraction were significantly greater for CtC ($t=10.72$, $P<.001$) compared with the head-lift exercise, and difference measures in microvolts calculated between rest and contraction for each exercise revealed a 2-fold increase in hyolaryngeal muscular activation for CtC ($t=8.27$, $P<.001$).

Conclusions: The isometric CtC exercise resulted in greater activation of the hyolaryngeal muscles compared with an isometric head-lift exercise. Results support the need for further investigations to determine whether the CtC exercise has a positive effect as a rehabilitative exercise for clinical populations with dysphagia secondary to upper esophageal sphincter dysfunction where hyolaryngeal excursion is a physiological impairment.

Archives of Physical Medicine and Rehabilitation 2013;94:2542-8

A reduction in the opening diameter of the upper esophageal sphincter (UES) during the pharyngeal stage of swallowing is a physiological impairment underlying dysphagia in both neurologic and oncologic etiologies. Mechanical and neurologic events that facilitate UES dilation during the pharyngeal swallow include central nervous system–mediated relaxation, bolus pressure at the superior UES, and traction applied to UES tissue via superior and anterior movement of the hyoid and thyroid (hereafter referred to as hyolaryngeal excursion) secondary to activation in the hyolaryngeal (mylohyoid, geniohyoid, anterior digastric, and thyrohyoid) musculature.[1-5] Reduced hyolaryngeal excursion is a common cause of aspiration in dysphagic patients.[6,7] When hyolaryngeal excursion is restricted, the diminished superior and anterior laryngeal movement fails to provide adequate traction on

No commercial party having a direct financial interest in the results of the research supporting this article has conferred or will confer a benefit on the authors or on any organization with which the authors are associated.

Surface electrodes and chin braces used in this study were donated to the Department of Communication Sciences & Disorders by Ampcare, LLC. The author has no financial interest or conflict of interest with this company.

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Research Report

Combined electrical stimulation and exercise for swallow rehabilitation post-stroke: a pilot randomized control trial

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Abstract

Background: Dysphagia is common after stroke, affecting up to 50% of patients initially. It can lead to post-stroke pneumonia, which causes 30% of stroke-related deaths, a longer hospital stay and poorer health outcomes. Dysphagia care post-stroke generally focuses on the management of symptoms, via modified oral intake textures and adapted posture, rather than direct physical rehabilitation of the swallowing function. Transcutaneous neuromuscular electrical stimulation (NMES) is a promising rehabilitation technology that can be used to stimulate swallowing; however, findings regarding efficacy have been conflicting.
Aims: This pilot randomized controlled study involving three UK sites compared the efficacy of the Ampcare Effective Swallowing Protocol (ESP), combining NMES with swallow-strengthening exercises, with usual care in order to clarify evidence on NMES in the treatment of dysphagia post-stroke. A further objective was to pilot recruitment procedures and outcome measures in order to inform the design of a full-scale trial.
Methods & Procedures: Thirty patients were recruited and randomized into either (1) usual speech and language therapy dysphagia care; or (2) Ampcare ESP, receiving treatment 5 days/week for 4 weeks. Outcome measures included: the Functional Oral Intake Scale (FOIS), the Rosenbek Penetration-Aspiration Scale (PAS) and patient-reported outcomes (Swallow Related Quality of Life—SWAL-QOL).
Outcomes & Results: Thirty patients were recruited; 15 were randomized to the Ampcare ESP intervention arm and 15 to usual care. A greater proportion (75%, or 9/12) of patients receiving Ampcare ESP improved compared with 57% (or 8/14) of the usual-care group. Patients receiving Ampcare ESP also made clinically meaningful change (a comparative benefit of 1.5 on the FOIS, and on the PAS: 1.35 for diet and 0.3 for fluids) compared with usual care. The intervention group also reported much better outcome satisfaction.
Conclusions & Implications: The pilot demonstrated successful recruitment, treatment safety and tolerability and clinically meaningful outcome improvements, justifying progression to a fully powered study. It also showed clinically meaningful treatment trends for the Ampcare ESP intervention.

Keywords: dysphagia, stroke, electrical stimulation, randomized controlled trial, rehabilitation.

What this paper adds

What is already known on the subject

There is a growing movement to identify dysphagia interventions that can restore swallow function rather than simply manage symptoms. One method under evaluation is NMES; however, research to date on its efficacy has yielded conflicting results, although there is a growing consensus on its benefit as an adjunct to therapy. Therefore, we conducted a trial to work towards greater clarity to inform clinical practice.

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BMC Ear, Nose and Throat Disorders

RESEARCH ARTICLE Open Access

The effect of transcutaneous neuromuscular electrical stimulation on laryngeal vestibule closure timing in swallowing

Christopher R. Watts* and Matthew J. Dumican

Abstract

Background: The purpose of this study was to investigate the effect of transcutaneous neuromuscular electrical stimulation (NMES) on the timing of laryngeal vestibule closure during the pharyngeal stage of swallowing in healthy adults. The theoretical framework proposed that NMES applied to these muscles would present a perturbation to laryngeal vestibular closure reaction time (the amount of time for the laryngeal vestibule to close once the swallowing reflex has been triggered) by providing an antagonistic force to the direction of vestibule closure.

Methods: Nine healthy adults (2 males, 7 females) received ten consecutive stimulations applied to the submandibular hyolaryngeal muscles while performing dry swallows. Laryngeal vestibule closure reaction time (LVCrt) and the laryngeal vestibule closure duration (LVCd) were measured from videoflouroscopic images pre-stimulation and post-stimulation.

Results: Results indicated a significant effect of stimulation on LVCrt but not LVCd. LVCrt was significantly reduced (timing was faster) during swallows immediately after stimulation compared to pre-stimulation.

Conclusions: Findings from this study support the supposition that laryngeal muscles respond to perturbations via adaptation learning, which might be used for rehabilitation of neuromuscular swallowing impairment. This pilot study supports the need for further research.

Keywords: Swallowing, Deglutition, Deglutition disorders, Neuromuscular electrical stimulation

Background

Neuromuscular electrical stimulation (NMES) is used by allied health professionals as a treatment modality for neuromotor impairments including muscle weakness, muscle atrophy, and decreased range of motion [1–3]. In populations served by speech-language pathologists, these impairments are often associated with dysphagia caused by etiologies such as stroke and degenerative disease. The clinical research literature reporting outcomes for the effects of NMES on swallowing function is growing, as are the stimulation devices and NMES clinical protocol options available to professionals. The physiological adaptations secondary to NMES application for muscles involved during swallowing, specifically muscle activation during the pharyngeal stage, are less clear. If clinicians are to utilize NMES as a valid treatment modality, it is critical that they have knowledge of the physiological principles underlying its application and be able to apply those principles to impaired swallowing physiology.

Clinical goals when utilizing NMES often include strengthening, increasing tone (to reduce atrophy), or increasing range of motion in a target muscle. In order to increase muscular strength and tone, treatments often overload (stress) a muscle by providing a resistance to contraction force. When a resistance is applied against contraction, the muscle is stressed and over time the body will respond by adapting to the stress. One way muscles adapt to the stress of an overload or resistance against contraction is to hypertrophy. Muscle hypertrophy results from the muscle cells gaining volume.

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geriatrics

MDPI

Article

Neuromuscular Electrical Stimulation Plus Rehabilitative Exercise as a Treatment for Dysphagia in Stroke and Non-Stroke Patients in an NHS Setting: Feasibility and Outcomes

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Abstract: Dysphagia is a debilitating condition with significant consequences in terms of physical and mental health. This study demonstrates that it is feasible to provide an intensive therapy program combining neuromuscular electrical stimulation (NMES) with exercise against resistance in the treatment of dysphagia in a public healthcare setting. Thirty-one patients (17 stroke, 14 non-stroke) who experienced dysphagia with reduced laryngeal elevation completed the therapy program. After checking the data sets for comparability, it was deemed appropriate for the outcome data from these patients to be combined with that of 12 stroke patients previously reported to enable statistical analysis on a larger data set (n = 43). A repeated-measures ANOVA revealed a statistically significant increase in amount and variety of food a patient was able to take orally (FOIS) following completion of treatment ($p < 0.001$). There was no significant between-subject effect of stroke status ($p = 0.43$), or interaction between treatment and stroke status ($p = 0.68$). There was a significant improvement in secondary outcome measures of swallow safety with fluids (PAS) ($p < 0.001$) and swallow-related quality of life (Swal-Qol ($p < 0.001$). These findings indicate that the therapy program may be associated with reduced impairment in a subset of patients with dysphagia resulting from stroke and non-stroke aetiologies, and the data will inform the design of future research to address unanswered questions.

Keywords: dysphagia; stroke; rehabilitation; neuromuscular electrical stimulation; NMES; Ampcare ESP

1. Introduction

The use of neuromuscular electrical stimulation (NMES) in the treatment of dysphagia has received considerable research interest (see the National Institute for Clinical Excellence (NICE) guidelines, 2018, for an overview [1]). Dysphagia, or difficulty moving material from the mouth to the stomach, is a debilitating condition with far-reaching consequences in terms of a patient's physical health [2,3], mental wellbeing [4], level of dependency and economic cost to the state [2,5]. Dysphagia can have many causes, including stroke, neurodegenerative conditions, traumatic brain injury and head and neck cancers. Severity of dysphagia also varies widely, from some people having a mild difficulty that may result in the avoidance of certain foods or eating situations; to those with severe cases, rendering a patient unable to safely eat or drink orally at all, thus requiring consideration of clinically assisted artificial nutrition and hydration. Standard management of dysphagia in the UK may involve exercise regimens, but is often restricted to symptom management through modification of oral intake and

Ampcare ESP in Treatment of Post-Stroke Dysphagia
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Neuromuscular electrical stimulation plus intensive exercise against resistance (Ampcare ESP) in the treatment of post-stroke dysphagia: further evidence for positive outcomes

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Dysphagia in respiratory diseases / stroke and brain damage
PB08

Introduction

Dysphagia is a common consequence of stroke. It can result in malnutrition and dehydration, aspiration and pneumonia, and reduced quality of life. There are also significant financial costs incurred in the management of dysphagia and associated consequences post stroke, further motivating the search for effective treatments. There is evidence which indicates that a therapy program combining neuromuscular electrical stimulation (NMES) to the suprahyoid muscles with intensive exercise against resistance (the Ampcare Effective Swallowing Protocol) can be effective in the treatment of post stroke dysphagia[1]. More data is required to further evaluate the effectiveness of the therapy program for this patient group. In accordance with NICE guidelines[2] outcome measures are collected in the UK when Ampcare ESP is used in the treatment of dysphagia. The outcomes from 26 stroke patients who were offered the therapy program across 5 NHS trusts were collated and the findings discussed.

Objective

Collate outcome data from across the UK to determine what proportion of patients experience a functional gain in their swallow in terms of improved quantity and or variety of oral intake following completion of Ampcare ESP.

Methods

26 stroke patients from 5 NHS trusts in the UK, identified by Speech and Language Therapists as having pharyngeal dysphagia including reduced laryngeal elevation (either during bedside swallow assessment or videofluoroscopy) were offered up to 22 thirty minute sessions of Ampcare ESP

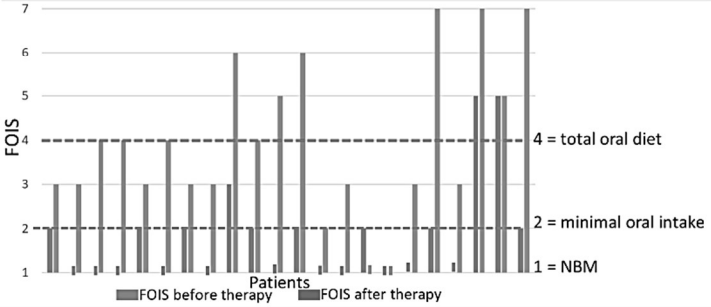
Ampcare ESP = NMES to suprahyoid muscles + exercise against resistance

Functional oral intake scale (FOIS)[3] was recorded before and after completion of the therapy program.

Of the 26 patients offered Ampcare ESP, 3 died and one was too unwell to complete the treatment.

Results

22 patients completed the therapy program (13 male, age range 31-91, mean age 69 years)
19 (86%) were able to safely increase the amount/ variety of food they were eating



10/11 patients who were NBM at the start of therapy were able to introduce some oral intake
9/20 patients who were tube dependent were able to meet their needs orally after therapy

Conclusions

- Speech and language therapists in NHS services across the UK are using Ampcare ESP in the treatment of post stroke dysphagia.
- Outcome data continue to demonstrate that many of these patients are able to eat a more varied diet following completion of the therapy program.
- A large proportion of these patients were able to meet their needs orally after completing the therapy program.
- Further research is required to evaluate the health economics of the therapy program.

References: 1. Martindale et al., 2019 *Geriatrics*, *4*, 53; 2. NICE https://www.nice.org.uk/guidance/ipg634; 3. Crary et al., 2015 *Arch. Phys. Med. Rehabil.* **2005**, *86*, 1516–1520

Is There a Role for Ampcare ESP in the Treatment of Post Covid-19 Dysphagia?

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Is there a role for neuromuscular electrical stimulation therapy programs (e.g. the Ampcare Effective Swallowing Protocol) in the treatment of post covid-19 dysphagia?

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Dysphagia during/ post covid-19
PD08

Introduction

A cohort of four patients with Covid-19 requiring a lengthy critical care stay including intubation, ventilation and tracheostomy presented with severe pharyngeal dysphagia. Following decannulation, videofluoroscopy (VF) analysis showed reduced pressure generation, reduced laryngeal elevation & closure, reduced base of tongue to posterior wall contact & absent epiglottic inversion leading to reduced pharyngeal clearance and penetration/ aspiration. All patients were unsafe to commence oral intake and were artificially fed. Their dysphagia did not improve with standard swallow therapy.
The Ampcare Effective Swallow Protocol (ESP) combines neuromuscular electrical stimulation (NMES) with swallow exercises completed against resistance. Evidence suggests that this may be beneficial in treating some patients with pharyngeal dysphagia[1]. A trial of Ampcare ESP was introduced with these patients to determine whether they were able to tolerate and actively participate with the therapy whilst recovering from Covid-19 and whether they made functional gains to their swallow.

Objectives

- Are post-critical care Covid 19 patients able to tolerate and engage with Ampcare ESP?
- Do patients see an improvement in their functional swallow after engaging with Ampcare ESP?

Methods

The following four covid-19 survivors with severe pharyngeal dysphagia were offered Ampcare ESP

	Age	Gender	Intubation (days)	Tracheostomy (days)	Dysphagia onset – Ampcare ESP (days)
A	73	M	11	41	65
B	56	M	10 + 6 (intubated twice)	25	47
C	66	M	9	37	77
D	67	M	32	20	57

Each patient was offered 20 thirty minute sessions of Ampcare ESP

Ampcare ESP = NMES to suprahyoid muscles + exercise against resistance

Swallow was assessed before and after treatment at bedside and with VF (*not all VF had been completed at time of writing)

Outcome measures were the penetration and aspiration scale (PAS)[2] and Waxman dysphagia severity score[3] as measured at VF and level of oral intake.

Results

	Sessions completed	Average no. of therapy sessions per week	PAS pre PAS post	Waxman pre Waxman post	Oral intake pre Oral intake post
A	20/20	3.3	3-5 5	6 5	NBM Trials of level 5 diet
B	17/20	2.4	3-5 3-5	6 5	NBM Trials of level 5 diet
C	20/20	2.8	7 7	5 5	NBM Trials of level 5 diet
D	15/20	3	5 *	6 *	NBM Trials of level 5 diet

- All four patients tolerated the therapy well & were able to reliably generate swallows in synch with stimulation
- Some improvement in swallow was observed following treatment in terms of reduction in Waxman dysphagia severity score and safe introduction of trials of oral intake (diet) post therapy
- Patients continued to experience ongoing moderately-severe dysphagia despite full engagement with Ampcare ESP
- All patients continued to penetrate/ aspirate fluids.
- **Patient A had a further VF 6 weeks after completion of Ampcare ESP, their swallow had improved further, allowing safe introduction of small sips of level 0 fluids and level 6 diet**

Conclusions

- This cohort of post critical care Covid-19 patients tolerated & were motivated to engage with Ampcare ESP
- Their dysphagia was severe in presentation but improved sufficiently post therapy to allow introduction of trials of level 5 diet. Unfortunately it was not possible for patients to safely commence fluids immediately after completing therapy.
- Pt A was able to further increase oral intake after a period of level 5 diet trials suggesting that the Ampcare ESP may have 'kick started' the swallow and that further progress may be made for these patients longer term.
- The dysphagia presentation was not typical of the disuse atrophy & deconditioning seen in standard post-critical care patients and was more reminiscent of fibrosis seen post radiotherapy in head and neck cancer patients
- This cohort of patients may benefit from more intense and/or more prolonged therapy programs
- Further analysis of VF data is ongoing to allow more detailed analysis of the swallow impairment and improvement or otherwise post therapy. These patient will be followed up longer term.

References: 1. Martindale et al., 2019 *Geriatrics*, *4*, 53; 2. Rosenbek et al., 1996, *Dysphagia*, 11, 93-98. 3. Waxman et al., 1990, *Nutr Clin Pract*, 5:196–199

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ORIGINAL ARTICLE

Immediate Effects of Electrical Stimulation on Oropharyngeal Structure and Laryngeal Vestibular Closure: A Pilot Study in Healthy Subjects

Michihiro Ogura, SLHT [a] Shuji Matsumoto, MD, PhD [b,c] Rintaro Ohama, MD [c] Yumi Ohama, MD [c,d] Haruka Arima, SLHT [a] Keita Takenaka, SLHT [e] Keiichi Toyama, SLHT [f] Toshiyuki Ikegami, SLHT [g] and Megumi Shimodozono, MD, PhD [c]

Objectives: This study examined the immediate effects of neuromuscular electrical stimulation (NMES) on the dynamics of oropharyngeal structure and laryngeal vestibular closure (LVC) in healthy subjects. **Methods:** Ten healthy male volunteers participated in this controlled, before-and-after, videofluoroscopic swallowing pilot study. The study was conducted in four phases (each performed twice): (1) saliva swallow (SS) before evaluation (BEFORE), (2) NMES while at rest with no SS (NMES AT REST), (3) SS during NMES (DURING NMES), and (4) SS to examine the aftereffects of NMES (AFTER). We measured distances that oropharyngeal structures moved in the NMES AT REST phase, and we analyzed the kinematics of saliva swallowing primarily in the BEFORE and AFTER phases. **Results:** Four changes in the morphology of the oropharyngeal structure caused by NMES AT REST were statistically significant: anterior–upward displacement of the hyoid bone and larynx, stretch of the laryngeal vestibule, and posterior ridge of the tongue root. Regarding the kinematics measured during SS, although there was no significant change in LVC reaction times, LVC duration in the AFTER phase was significantly longer than BEFORE. Regarding maximal displacement of the hyoid bone, there was significantly greater movement AFTER than BEFORE. As additional exploratory outcomes, the velocity of hyoid bone movement was significantly slower, and the hyoid-to-larynx approximation was significantly smaller, DURING NMES than AFTER. **Conclusions:** Longer duration of LVC might be caused by adaptive learning with NMES-induced structural changes in the oropharynx. Further clinical studies are warranted to determine whether this approach improves dysphagia, which impairs LVC.

Key Words: Ampcare ESP™; hyoid laryngeal proximity; laryngeal vestibular closure; neuromuscular electrical stimulation; swallowing

INTRODUCTION

Laryngeal vestibule closure (LVC) is the primary mechanism preventing penetration or aspiration during swallowing. Given that impaired LVC causes unsafe swallowing,

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Swallowing Outcomes in Clinically Based Patients Using Neuromuscular Electrical Stimulation (NMES)

Kaitlynn Harper, B.S.

Matthew Dumican, Ph.D. CCC-SLP

Purpose

Neuromuscular electrical stimulation (NMES) has received mixed findings in the literature regarding its effectiveness in treating dysphagia of neurogenic etiology (Speyer et al., 2022). While functional outcomes are often considered, the underlying mechanisms of improvement are often unspecific, examining outcomes such as water swallow tests, "swallowing ability", or only penetration or aspiration (Alamer et al., 2020, Bath et al., 2018).

The aims of this project were to examine the effects of NMES on mechanistic changes to swallow function in:

1. Absolute hyoid movement distance
2. Laryngeal kinematic timings
3. Swallow safety outcomes

Methods

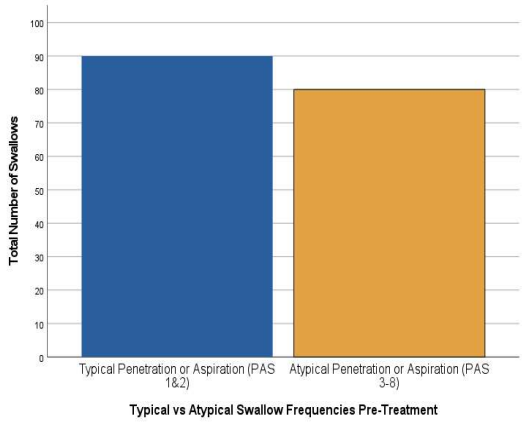
Comparison of baseline and final VFSS of 16 (13 male, 3 female) of clinical patients with post-stroke after a range of 3-5 days a week and a minimum of 30 total days of treatment to obtain:

- Hyoid Kinematics (anterior, superior, excursion)
- Time-To-Laryngeal Vestibule Closure (LVC) & LVC Duration
- Penetration-Aspiration Scale (PAS) scores

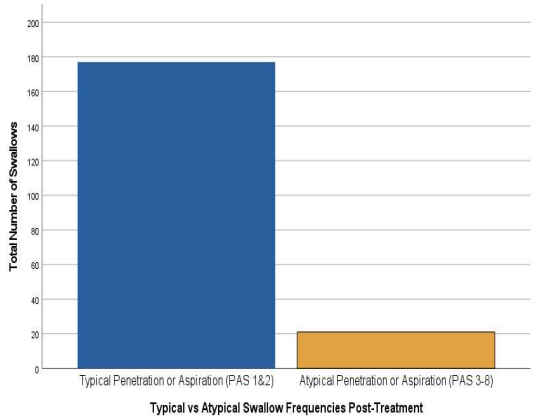
All measurements were obtained using TIMS-DICOM software for VFSS review. All patients included in this study received NMES as a treatment protocol for dysphagia rehabilitation as their primary treatment, in various clinical settings. NMES was implemented with suprahyoid placement, pulse frequency of 30 Hz, phase duration of 50 µs, and variable intensity in mA dependent on patient tolerance and progression.

A one-way repeated measures ANOVA (RM-MANOVA) was performed to examine within-subjects changes of hyoid kinematics and laryngeal vestibule timings pre- and post-treatment. Crosstabulations were performed to examine pre- and post-treatment associations with penetration and/or aspiration.

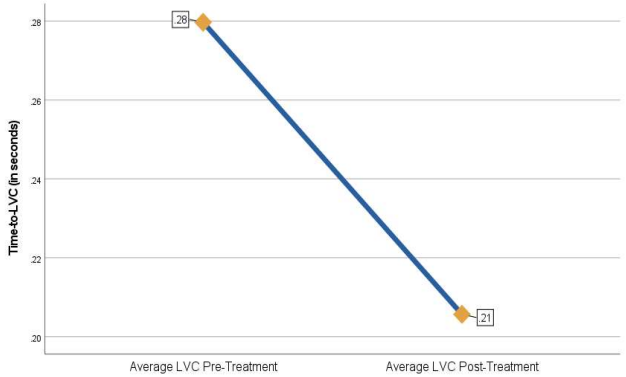
Pre-Treatment Typical and Atypical Swallow Safety (Figure 1)



Post-Treatment Typical and Atypical Swallow Safety (Figure 2)



Time-to-LVC Pre-Treatment vs Post-Treatment (Figure 3)



Results

Crosstabulations displayed a significant association of lower PAS scores post-treatment (χ^2= 60.16, p < 0.001). Pre-treatment PAS scores indicating penetration or aspiration (PAS scores ≥3) occurred on 47% of all swallows (figure 1), yet similar scores post-treatment occurred on only 11% of swallows (figure 2).

RM-MANOVA results indicated a significant effect of treatment on hyoid excursion (F= 9.32, p= 0.008) and time-to-LVC (F= 54.74, p< 0.001) (figure 3).

Effect size calculations of partial eta-squared (η^2_p) indicated that both hyoid excursion (η^2_p = .37) and time-to-LVC (η^2_p = .77) demonstrated large effects.

Conclusions & Clinical Relevance

The results from this project support that NMES may be a viable treatment option for patients experiencing post-stroke dysphagia, in agreement with findings from Speyer et al. (2022), and particularly in dysphagia characterized by reduced laryngeal elevation and events of penetration and/or aspiration (Martindale et al., 2019).

In a small, clinically based cohort of patients with post-stroke dysphagia, NMES with suprahyoid placement and parameters based on muscle and swallow physiology significantly improved hyoid excursion, decreased time-to-LVC, and decreased occurrences of penetration and/or aspiration.

More rigorously controlled pre-post treatment studies are required to support NMES treatment efficacy.

References

Strategies to Increase Swallowing Activities

Good oral care should be maintained before therapy

1. Cold, wet spoon: present spoon with just cold condensation to initiate the autonomic response
2. Lollipops (sugar-free if diabetic) or ice lollies, laryngeal mirrors are good options to stimulate sensory receptors on the mucosa of the mouth, tongue, and pharyngeal regions to trigger a swallow
3. Alterations in bolus volume, taste, temperature
4. Taste Tests, using food coloring or hidden juice cups; appropriate consistencies; & diabetic considerations
5. Smell or taste of lemon, cranberry, apple, or grape juices to increase saliva
6. Coconut oil for dry tongue/xerostomia to assist and lubricate the surface of the tongue
7. Consider a water protocol, with appropriate oral care

Pharyngeal Exercises and Strategies

Valleculae/Tongue Base

1. Tongue slides
2. Yawn
3. Masako (protrude tongue between teeth - hold - swallow hard)
3. Pretend to gargle
4. Pull/hump tongue base posteriorly
5. Head tilt or turn as appropriate
6. Resistive Chin-to-Chest for 5 seconds with RPD and effortful swallow
7. /k/ and /g/ words/sounds (say “kuh” or “guh”)
8. Mouthguard pull

PES/UES/Cricopharyngeal sphincter if related to reduced laryngeal elevation

1. Effortful/dry/hard swallow
2. Alternate solids and liquids if appropriate
3. Head turn, lift, or tilt if appropriate
4. Chin thrust (not chin tuck!)
5. Hyolaryngeal exercises /Mendelsohn Maneuver

Pharyngeal Pyriform

1. Head turn to impaired side if appropriate
2. Tilt head to stronger side if appropriate
3. Alternate solid and liquids if appropriate
4. Push against mandible while swallowing
5. Successive swallow

Pharyngeal Posterior wall

1. Repeat effortful swallows and increase rate of swallow
2. Thermal/Tactile/Chemical stimulation to elicit effortful swallows

Laryngeal or Hyolaryngeal exercises

1. Resistive Chin-to-Chest for 5 seconds with RPD & effortful swallow
2. Resistive Chin-to-Chest with RPD & Mendelsohn Maneuver for 5 seconds
3. Resistive Chin-to-Chest for 5 seconds with RPD & jaw open/close then effortful swallow
4. Shaker exercise: Lie flat - raise head - look at toes/feet - hold for 1 minute then relax for 1 minute, repeat 2 more times, followed by 30 consecutive head raises while keeping shoulders resting flat.
5. EMST
6. Falsetto exercises
7. Pitch glides - gliding up in pitch to reach a high, squeaky voice, then holding it for a minimum of 5 seconds with effort.
8. Adduction exercises while lifting up or pushing down on chair
9. Supraglottic swallow
10. Valsalva maneuver (breath hold) contraindicated with cardiac precautions

Home-exercise program for Head & Neck Cancer patients – 5 sets of 5 reps, 4 times per day

1. Tongue press
2. Effortful swallows
3. Falsettos (effortful “eeeee” pronunciation)
4. Chin-to-Chest with jaw open against resistance (RPD)
5. While sitting, tilt head back with jaw open attempt to close jaw and protrude it toward the ceiling until a stretch is felt on the front of the neck. Hold this for 30 seconds for 5 reps.

Oral Motor Function

5 sets of 5 reps, 4 times per day

Lips – reduced lip sensation, strength, and ROM may result in drooling, lip biting and pocketing, as well as anterior loss.

1. Assess labial musculature by pressing lips tightly around a spoon, mouthguard, or tongue depressor as the SLP tries to remove it.
2. Straw sucking against resistance. Attempt holding stickers, coins or other weighted objects at end of straw.
3. Have patient close eyes. Lightly touch each of the 4 quadrants of the upper and lower lips with a tongue depressor or cotton swab. This will assess lip sensitivity.
4. Smile/Pucker. Have them say "ee", Have them say "oo" / Alternate between "ee" and "oo".
5. Say the syllable "puh" as quickly as possible to determine ability to obtain closure of lips.
6. Open mouth but try to hold a pucker.
7. Blowing Bubbles/Blowing out a Candle; Horn/Harmonica/Party Favor; Straw– controlled pursing of the lips.
8. Close lips around the tongue blade/Press lips together "MMMMMMM".

Cheeks –reduced cheek sensation, strength, and range of motion may result in pocketing of food or biting cheek. Before beginning exercises, observe patient's facial asymmetry. Check buccal musculature by:

1. Have them puff their cheeks up with air. Be sure to check velum function before this exercise because reduced velopharyngeal seal can result in decreased oral pressure and may contribute to the patient's inability to puff cheeks.
2. Assess the sensitivity of cheeks by touching random locations with a cotton swab.
3. Pretend to "swish mouthwash around in the mouth".
4. Push cheeks out with spoon while the patient attempts to suck cheeks in.

Tongue – reduced tongue sensation, strength, and ROM can result in the inability to manipulate bolus in the oral cavity, it can also result in residue on hard palate and pocketing.

1. Assess sensitivity by touching various areas of the tongue.
2. Stick out tongue – check for deviation, fatigue, and fasciculations
3. Move tongue from left to right – check for ROM, speed, and coordination.
4. Elevate tip of tongue – maintain for 5 seconds. Can also elevate tip to alveolar ridge and move it anteriorly to posteriorly along palate (tongue slide).
5. Using Peanut Butter on lips to increase side-to-side ROM.
6. Stick out tongue and point down to chin - maintain for 5 seconds, left to right cheek, maintain 5 seconds.
7. Tongue retraction – humping it posteriorly and hold for 5 seconds, /g/ and /k/ words/sounds/soundless "guh.".
8. Lingual resistance – Extend tongue forward and push against top row of teeth/palate, tongue depressor, lollipop, or finger. Hold for 5 seconds.
9. Diadochokinetic rate: "Buttercup".

Soft Palate – reduced sensation, strength, and ROM can result in reduced gag reflex, hypernasality, nasal reflux, and premature spillage

1. Phonate "ah" in isolation and repetitive pattern – observe elevation.
2. Assess for hypernasality.
3. Assess gag reflex – contraindicated with cardiac precautions.

Velar Exercises

1. Thermal Tactile Stimulation to help elicit effortful swallowing exercise.
2. Suck/swallow; Straw attempts with Thick Liquid to increase effort; Can also suck through pinched straw.
3. Effortful "guh".
4. High pitch "eeee" for 5 seconds.
5. Snore for 5 seconds.

Jaw strength and ROM – Necessary for rotary movements involved in mastication. This can be used with patients exhibiting reduced oral ROM or masseter weakness.

Mandible – mastication/ side-to-side and rotary action is required for cohesive boluses

1. Open mouth wide, hold for 5 seconds.
2. Open and close 5 times quickly.
3. Mouthguard pulls.
4. Jaw grading (bite and hold for 5 seconds) using chewy tubes.
5. Move jaw from left to right and in a circular motion as though rotary chewing.

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PDAC
Medicare Pricing, Data Analysis and Coding

February 24, 2009

LERKINS BILLING & CONSULTING PROFESSIONALS INC
ATTN: CHRYSTAL ZELLER
407 E MARKET ST STE 105B
CRAWFORDSVILLE IN 47933

Re: Restorative Medical's RPD (Restorative Posture Device) Model #50707

Xref #: 7493545

Dear Ms. Zeller:

This letter is in response to your recent inquiry for coding verification of the above listed product(s) manufactured and/or distributed by your company.

It is our determination that the Medicare HCPCS code(s) to bill the four DME Medicare Administrative Contractors (DME MACs) is/are:

L0140 - CERVICAL, SEMI-RIGID, ADJUSTABLE (PLASTIC COLLAR)

This HCPCS coding decision applies to the submitted product(s) as presented to and reviewed by the Pricing, Data Analysis and Coding (PDAC). Any modifications to the product(s) could change the HCPCS code and would need to be reviewed for coding verification. The assignment of a HCPCS code to the product(s) should in no way be construed as an approval or endorsement of the product(s) by PDAC or Medicare, nor does it imply or guarantee claim reimbursement or coverage. For questions regarding claim coverage or reimbursement, please contact your DME MAC jurisdiction.

Should you disagree with this coding decision, a reconsideration can be requested. The reconsideration form is located on the PDAC website (www.dmepdac.com) under the HCPCS Review tab. The PDAC will reconsider the request if made within 45 days of the date of this letter and additional supporting documentation is provided. If a request for reconsideration is made after 45 days, the request is treated as a new Coding Verification Review and a complete application must be submitted, along with the additional documentation supporting the request.

CMS
CENTERS for MEDICARE & MEDICAID SERVICES

HCPCS Code: L0140
Short Description: Cervical semi-rigid adjustab
Long Description: CERVICAL, SEMI-RIGID, ADJUSTABLE (PLASTIC COLLAR)
https://www4.palmettogba.com/pdac_dmecs/hcpcsdetailsFeeScheduleSearch.do?hcpcsCode=L0140

Beneficiary State of Residence	Non-Rural Fee	Effective From	Effective To
AL	$82.58	1/1/2024	3/31/2024
AK	$61.46	1/1/2024	3/31/2024
AZ	$70.43	1/1/2024	3/31/2024
AR	$71.86	1/1/2024	3/31/2024
CA	$70.43	1/1/2024	3/31/2024
CO	$79.52	1/1/2024	3/31/2024
CT	$91.05	1/1/2024	3/31/2024
DE	$71.91	1/1/2024	3/31/2024
DC	$71.91	1/1/2024	3/31/2024
FL	$82.58	1/1/2024	3/31/2024
GA	$82.58	1/1/2024	3/31/2024
HI	$65.74	1/1/2024	3/31/2024
ID	$93.91	1/1/2024	3/31/2024
IL	$70.43	1/1/2024	3/31/2024
IN	$70.43	1/1/2024	3/31/2024
IA	$93.91	1/1/2024	3/31/2024
KS	$93.91	1/1/2024	3/31/2024
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MA	$91.05	1/1/2024	3/31/2024
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NM	$71.86	1/1/2024	3/31/2024
NY	$70.43	1/1/2024	3/31/2024
NC	$82.58	1/1/2024	3/31/2024
ND	$79.52	1/1/2024	3/31/2024
OH	$70.43	1/1/2024	3/31/2024
OK	$71.86	1/1/2024	3/31/2024
OR	$93.91	1/1/2024	3/31/2024
PA	$71.91	1/1/2024	3/31/2024
PR	$136.68	1/1/2024	3/31/2024
RI	$91.05	1/1/2024	3/31/2024
SC	$82.58	1/1/2024	3/31/2024
SD	$79.52	1/1/2024	3/31/2024
TN	$82.58	1/1/2024	3/31/2024
TX	$71.86	1/1/2024	3/31/2024
UT	$79.52	1/1/2024	3/31/2024
VT	$91.05	1/1/2024	3/31/2024
VI	$70.43	1/1/2024	3/31/2024
VA	$71.91	1/1/2024	3/31/2024
WA	$93.91	1/1/2024	3/31/2024
WV	$71.91	1/1/2024	3/31/2024
WI	$70.43	1/1/2024	3/31/2024
WY	$79.52	1/1/2024	3/31/2024

Restorative Posture Device

SINGLE PATIENT USE ONLY

Addresses anatomical alignment, posture, and strength that allows for optimal laryngeal and pharyngeal function during swallowing.

Indications:

The Restorative Posture Device (RPD) is indicated for patients that present with poor positioning including forward head and neck posture resulting in decreased range of motion (ROM) and increased dysphagia risk as a result of posture as determined on an instrumental exam. This patient may be **flaccid** (can be passively ranged to an upright position but cannot sustain the position), may present with **shortened adaptive tissue** (unable to be passively or actively ranged to upright position), or may present with **neurological tone** with or without shortened adaptive tissue.

Intended Uses:

Patients with impaired ability to swallow and lost cervical range of motion - with or without neurological tone – can improve function and gradually increase flexibility by reeducating muscles in the submandibular region to promote the ideal head positioning for anatomical alignment that allows for optimal hyolaryngeal excursion. Patients may also benefit from:

1. Enhanced swallowing treatment when used in conjunction with Ampcare's Effective Swallowing Protocol (ESP™); assists with proper position of head and neck, maintains placement and improves electrical conduction of E Series Electrodes, and provides a resistive exercise protocol.
2. Improved respiratory function, coordination of respiration and swallowing and increased O_2 and CO_2 exchange.
3. Improved pharyngeal space for adequate laryngeal movement and passage of the bolus through the pharyngeal phase.
4. Increased ability to orally accept food taken by mouth (PO) and improve oral ROM, manipulation of the bolus for improved safety of the swallow.
5. Increased healing of any skin breakdown related to pressure, skin-on-skin contact, and lack of air to involved tissue.
6. Decreased neck pain and discomfort; be able to improve the ability to take in nutrition and hydration.
7. Improved ability to receive the stimuli of their environment which could increase their quality of life as they are able to take part in activities which may also improve their degree of orientation/cognition and PO intake.

Application:

1. Apply and remove per physician's order and patient's overall plan of care.
2. Explain to patient in understandable terms what you are about to do.
3. Determine the degree of comfortable range of motion of head/neck. Try to keep the cervical spine in good alignment (erect) for more appropriate vallecular space with a mild dorsal glide (chin retraction) to allow for better epiglottic closure and airway protection.
4. If needed this device can be remolded. Refer to the Instructions on Heat Molding section.
5. Adjust the blue strap around patient's neck and secure with hook-and-loop fasteners to form the most comfortable and therapeutic angle. Assure moldable chin cup is comfortable and no plastic is touching the patient's throat.
6. Begin wearing schedule with short duration according to the patient's tolerance levels and their individual conditions. Gradually buildup 30 minutes per day to typically no more than 6 hours per 8-hour shift (6 hours on 2 hours off). Attempt to build muscle strength and prevent weakening. Consider initiating use during ESP dysphagia treatment and/or liquid PO trials.
7. Check all areas of skin where the device touched each time it is removed. If any red areas appear that do not resolve within 30 minutes, remove the device and inform the caregiver or call **Ampcare at 682-561-2444**. Shortening the wearing period or adding more padding may resolve the issue.
8. Chart all pertinent information.

Laundering:

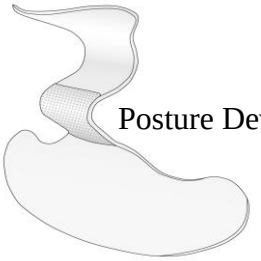
Cleaning instructions: Remove padding. Hand wash, lay flat and blot with a towel, then air dry. Wipe plastic clean with mild cleanser, protecting the hook-and-loop fasteners. Rinse with water, and allow to dry thoroughly while protecting the hook-and-loop fasteners. Replace padding, making sure all plastic edges where patient's skin might touch is covered.

Restorative Posture Device

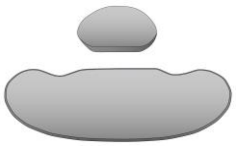
SINGLE PATIENT USE ONLY

Instructions on Heat Molding

CAUTION: To ensure safety while remolding, wear heavy gloves. Plastic may be hot after heat molding.



Posture Device



Padding

Strap

Heat Gun

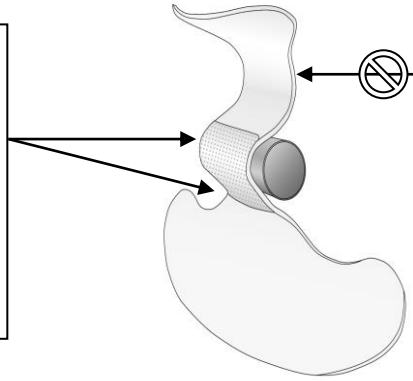
1. Before heat-molding the brace, place the chin plate under the patient's chin to see where modifications are needed. Patient's chin should remain slightly behind the end of the chin plate.
2. **Before applying heat with a heat gun, remove chin and chest padding, strap, and hook-and-loop fastener on S-curve.**
3. Spot mold the device only at the middle or bottom of the S-curve. Only mold to 10-15 degrees of stretch.
4. Move the heat gun in a small circular motion approximately 3" away from the plastic, for approximately 30 seconds on each side, only to the area to be remolded. Heat the middle of the S-curve to adjust the height and the bottom of the S-curve to adjust the depth of the chest plate.
5. Replace hook-and-loop fastener, padding, and strap to appropriate areas after plastic cools.
6. Place the brace on the patient to ensure that desired modifications are complete.

**** Not for prolonged use ****

You may change the curve angle, but keep the S-curve to facilitate a cushioning effect.

Spot mold only at the middle of the S-curve to adjust the height or the bottom of the S-curve to adjust the chest plate.

Avoid heating the top of the S-curve as the angle is set to the appropriate amount of resistance.



NO heat to the upper S-curve.

The use of a small can or PVC is recommended to form the curve.

Warranty: Ampcare agrees that if any defect in materials or workmanship appears in this product within six months after the original date of consumer purchase, it will replace the product in question free of charge. This applies only if the product has been used as directed and has not been damaged through misuse, accident, or neglect.

If a defect appears, please check that the product is being used in accordance with instructions. If so, return it with this warranty and proof of purchase to your nearest Ampcare Dealer.

If you are not a certified user of ESP, contact Ampcare to receive video instructions on how to perform ESP exercises.

U.S. Patent: 7,885,713

CE

MD

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RPD-121316 Rev.C

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Orders:

- Should indicate the type of modality (ESP™)
- The area of the body where the modality will be used
- The reason/purpose for the treatment and the frequency and duration

Example: Speech and Language Pathology (SLP) to add to Dysphagia Plan of Care (POC) Effective Swallowing Protocol (ESP) to the suprahyoidal and facial musculature to increase oropharyngeal contraction and improve facial muscle tone 5 times a week for 30 days.

Goal writing should address impairments that limit function and prevent complications. Goals should be:

- Measurable
  - Percentages are not always necessary, but when used indicate the number of stimuli, i.e., 80% accuracy (8/10)
- Lead to functional outcomes
  - Increased independence for ADL's
  - Less burden on caregiver and less cost to insurer
- Related to functional skills
- Patient specific – customized to each patient's prior level of function

Sample Long-Term Goals:
Pt will be able to tolerate PO intake of choice without choking or aspirating.

Pt to display a safe and efficient swallow of (insert specific diet consistency) with/without compensatory strategies to meet nutrition and hydration needs.

Sample Short-Term goals:
(References)
1 tsp (teaspoon) = 5 ml or 5 cc 1ml = 1 cc
3 tsp (teaspoons)/1 tablespoon = 15 ml or 15 cc

Pt to perform ___ (e.g. 48) out of 60 effortful swallowing exercises using ESP to suprahyoidal musculature to improve hyolaryngeal excursion and secretion management, increase UES opening, improve laryngeal vestibule closure, reduce pharyngeal residue and decrease risk of penetration and aspiration during oral intake.

Daily note idea: Depending on the patient you might want to modify the exercises per 10-minute intervals based on the repetitions from the duty cycle (e.g. 5 seconds on/ 25 seconds off = 60 reps):
Ex: Pt performed 17 out of 20 Mendelsohn Maneuvers.
Pt performed 16 out of 20 Chin to chest with RPD with an effortful swallow.
Pt performed 15 out of 20 Chin to chest with RPD, jaw open/closed with an effortful swallow.
-Pt. achieved 48 out of 60 exercises, will progress to a 5/20 duty cycle next treatment due to patient achieving 80% accuracy with effortful swallows.

Increase accuracy of the Mendelsohn Maneuver from 50% (5/10) to 70% (7/10) to improve airway protection.

Pt will improve hyolaryngeal excursion by performing hyolaryngeal exercises [(Mendelsohn, Shaker, Masaka, Falsetto, etc. (insert percentage 80%, accuracy 4/5)] in combination with the SLP using ESP to the suprahyoidal musculature to facilitate muscle reeducation and strength to establish a more effective swallow.

Pt will tolerate ____ (15 or 30) minutes of ESP to suprahyoidal musculature to improve (hyolaryngeal excursion, manage secretions) and increase UES elongation and laryngeal excursion to reduce pyriform retention and decrease the risk of penetration and aspiration during oral intake.

Resident will be able to perform Mendelsohn Maneuver on command 80% (4/5) of the time in 5-10 minutes, with or without PO, to facilitate hyolaryngeal excursion, increase UES elongation and laryngeal vestibule closure to reduce pyriform retention and decrease the risk of penetration and aspiration during oral intake.

Pt will demonstrate the ability to manage oral secretions better by initiating cued volitional swallows every 2 minutes (15 swallows per session) during treatment of dysphagia with clear vocal quality.

Pt. will demonstrate the ability of AP propulsion and tongue base retraction with 1-2 tsp bolus (liquids, puree) during (meal, trial feedings, 4/5 attempts or bites).

Pt will increase initiation of swallow with presentation of 15cc/tablespoon size bolus from ____ (5) seconds to ____ (3) seconds or less to (reduce pharyngeal delay, reduce posterior bolus leakage) decreasing the risk of aspiration.

Pt will demonstrate a (therapeutic technique) for safe and efficient swallow of 15 cc/tablespoon or cup sip of _____ (thin) liquid with 90% effectiveness (9/10). (Therapeutic technique could include: Supraglottic swallow, Mendelsohn)

May need to work with other disciplines (OT/PT) to assess/modify/adapt Restorative Postural Device in order to:

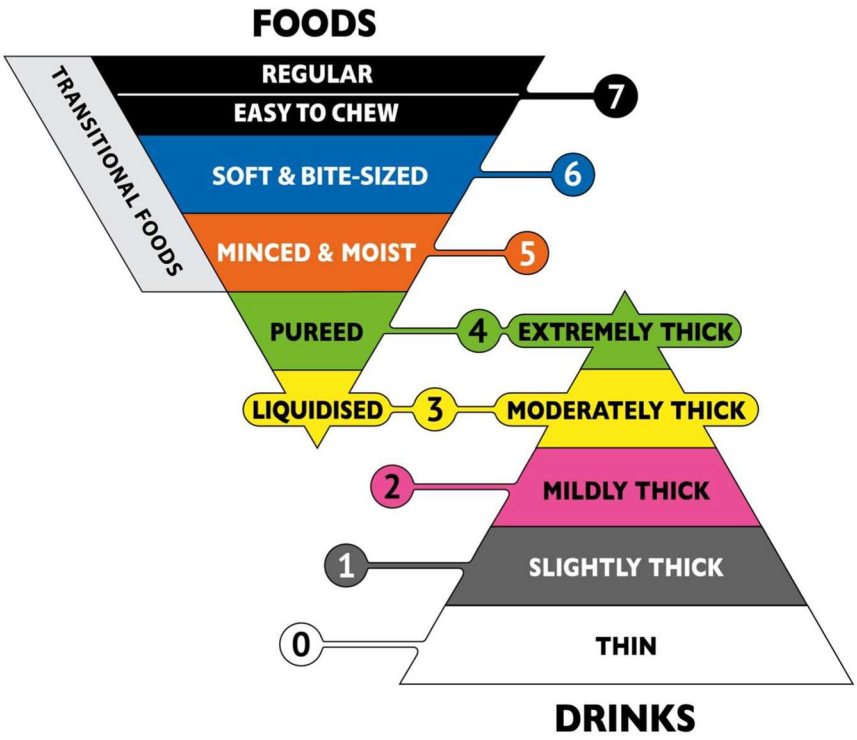
Achieve appropriate neck posture by (___ degrees extension) to promote (increased/adequate) pharyngeal space for functional epiglottic closure to decrease the risk of penetration and aspiration.

Facilitate upright head control by modifying a restorative posture device to decrease signs and symptoms of aspiration.

Pt will achieve appropriate head and neck posture to manage their secretions (anterior bolus loss) by wearing a restorative posture device for ___ (2) hours while sitting in chair or participating in direct or indirect dysphagia treatment.

Pt and/or caregiver to be instructed in restorative posture device application and be able to give correct return demonstration ____ (100%) of the time.

IDDSI (International Dysphagia Diet Standardisation Initiative)[1]



8-Point Penetration-Aspiration Scale[2]

Score	Description of Events
1	Material does not enter airway.
2	Material enters the airway, remains above the vocal folds, and is ejected from the airway.
3	Material enters the airway, remains above the vocal folds, and is not ejected from the airway.
4	Material enters the airway, contacts the vocal folds, and is ejected from the airway.
5	Material enters the airway, contacts the vocal folds, and is not ejected from the airway.
6	Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway.
7	Material enters the airway, passes below the vocal folds, and is not ejected from the trachea despite effort.
8	Material enters the airway, passes below the vocal folds, and no effort is made to eject.

[1] © The International Dysphagia Diet Standardisation Initiative 2019 @ https://iddsi.org/framework. Licensed under the CreativeCommons Attribution Sharealike 4.0 License. Derivative works extending beyond language translation are NOT PERMITTED.

[2] Rosenbek, JC, Robbins, J, Roecker EV, Coyle, JL, & Woods, JL. A Penetration-Aspiration Scale. Dysphagia 11:93-98, 1996.

Functional Oral Intake Scale[3]

TUBE DEPENDENT (levels 1-3)

1 No oral intake
2 Tube dependent with minimal/inconsistent oral intake
3 Tube supplements with consistent oral intake

TOTAL ORAL INTAKE (levels 4-7)

4 Total oral intake of a single consistency
5 Total oral intake of multiple consistencies requiring special preparation
6 Total oral intake with no special preparation, but must avoid specific foods or liquid items
7 Total oral intake with no restrictions

Waxman Dysphagia Severity Scale[4]

Rating	Explanation
0	Normal swallowing mechanism.
1	Minimal dysphagia—video swallow shows slight deviance from a normal swallow. Patient may report a change in sensation during swallow. No change in diet is required.
2	Mild dysphagia—oropharyngeal dysphagia present, which can be managed by specific swallow suggestions. Slight modification in consistency of diet may be indicated.
3	Mild-moderate dysphagia—potential for aspiration exists but is diminished by specific swallow techniques and a modified diet. Time for eating is significantly increased; thus supplemental nutrition may be indicated.
4	Moderate dysphagia—significant potential for aspiration exists. Trace aspiration of one or more consistencies may be seen under videofluoroscopy. Patient may eat certain consistencies by using specific techniques to minimize potential for aspiration and/or to facilitate swallowing. Supervision at mealtimes required. May require supplemental nutrition orally or via feeding tube.
5	Moderately severe dysphagia—patient aspirates 5% to 10% on one or more consistencies, with potential for aspiration on all consistencies. Potential for aspiration minimized by specific swallow instructions. Cough reflex absent or nonprotective. Alternative mode of feeding required to maintain patient's nutritional needs. If pulmonary status is compromised, "nothing by mouth" may be indicated.
6	Severe dysphagia—more than 10% aspiration for all consistencies. "Nothing by mouth" recommended.

[3] Crary MA, Carnaby-Mann GD, Groher ME. Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. *Arch Phys Med Rehabil* 2005;86:1516-1520.

[4] Waxman, Michael J., et al. "Nutritional aspects and swallowing function of patients with Parkinson's disease." *Nutrition in clinical practice* 5.5 (1990): 196-199.

Sunnybrook Facial Grading System

Resting Symmetry

Compared to normal side

Eye (choose one only)	
normal	0
narrow	1
wide	1
eyelid surgery	1
Cheek (naso-lablal fild)	
normal	0
absent	2
less pronounced	1
more pronounced	1
Mouth	
normal	0
corner dropped	1
corner pulled up/out	1

Total ☐

Resting symmetry score **Total** × 5 ☐

Patient's name

Dx

Date

Symmetry of Voluntary Movement

Degree of muscle EXCURSION compared to normal side

Standard Expressions	Unable to initiate movement/no movement	Initiates slight movement	Initiated movement with mild excursion	Movement almost complete	Movement complete	
Forehead Wrinkle (FRO)	1	2	3	4	5	☐
Gentle eye closure (OCS)	1	2	3	4	5	☐
Open mouth smile (ZYG/RIS)	1	2	3	4	5	☐
Snarl (LLA/LLS)	1	2	3	4	5	☐
Lip Pucker (OOS/OOI)	1	2	3	4	5	☐

Gross Asymmetry	Severe Asymmetry	Moderate Asymmetry	Mild Asymmetry	Normal Symmetry	
				Total	☐

Voluntary movement score: **Total** × 4 ☐

Synkinesis

Rate the degree of INVOLUNTARY MUSCLE CONTRACTION associated with each expression

	NONE: No synkinesis or mass movement	MILD: Slight synkinesis	MODERATE: Obvious but not disfiguring synkinesis	SEVERE: Disfiguring synkinesis/ Gross mass movement of several muscles	
Forehead Wrinkle (FRO)	0	1	2	3	☐
Gentle eye closure (OCS)	0	1	2	3	☐
Open mouth smile (ZYG/RIS)	0	1	2	3	☐
Snarl (LLA/LLS)	0	1	2	3	☐
Lip Pucker (OOS/OOI)	0	1	2	3	☐

Synkinesis score: **Total** ☐

Vol mov't score ☐ − **Resting symmetry score** ☐ − **Synk score** ☐ = **Composite score** ☐

1

Ross, Fradet, Nedzelski 1992

Scale range is from 0 (total paralysis) to 100 (normal).

House-Brackmann Facial Nerve Grading System[2]

Grade I - Normal

Normal facial function in all areas

Grade II - Slight Dysfunction

Gross: slight weakness noticeable on close inspection; may have very slight synkinesis

At rest: normal symmetry and tone

Motion: forehead - moderate to good function; eye - complete closure with minimum effort; mouth - slight asymmetry.

Grade III - Moderate Dysfunction

Gross: obvious but not disfiguring difference between two sides; noticeable but not severe synkinesis, contracture, and/or hemi-facial spasm.

At rest: normal symmetry and tone

Motion: forehead - slight to moderate movement; eye - complete closure with effort; mouth - slightly weak with maximum effort.

Grade IV - Moderate Severe Dysfunction

Gross: obvious weakness and/or disfiguring asymmetry

At rest: normal symmetry and tone

Motion: forehead - none; eye - incomplete closure; mouth - asymmetric with maximum effort.

Grade V - Severe Dysfunction

Gross: only barely perceptible motion

At rest: asymmetry

Motion: forehead - none; eye - incomplete closure; mouth - slight movement

Grade VI - Total Paralysis

No movement

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[1] *Sunnybrook Health Sciences Centre (2019). https://sunnybrook.ca/uploads/FacialGradingSystem.pdf*

[2] *House JW, Brackmann DE (1985). Facial nerve grading system. Otolaryngol. Head Neck Surg, [93] 146–147.*

EATING ASSESSMENT TOOL (EAT-10)

Name: _____ EMR# _____

Birthdate/Age: _____ Todays Date: _____

The purpose of the EAT-10 questions is to help measure swallowing problems. Answer each question by circling the number that matches how bad you feel the problem is for you.

To what degree to you experience the following problems? **Circle an answer between 0 and 4**	0 = No problem 4 = Severe problem				
1. My swallowing problem has caused me to lose weight.	0	1	2	3	4
2. My swallowing problem interferes with my ability to go out for meals.	0	1	2	3	4
3. Swallowing liquids takes extra effort.	0	1	2	3	4
4. Swallowing solids takes extra effort.	0	1	2	3	4
5. Swallowing pills takes extra effort.	0	1	2	3	4
6. Swallowing is painful.	0	1	2	3	4
7. The pleasure of eating is affected by my swallowing.	0	1	2	3	4
8. When I swallow food sticks in my throat.	0	1	2	3	4
9. I cough when I eat.	0	1	2	3	4
10. Swallowing is stressful	0	1	2	3	4
Add up the sum of the numbers you circled for a TOTAL EAT-10 Score:					

If your score is greater than 3 you may have swallowing problems. We suggest that you share your EAT-10 results with your doctor.

Reference: Belafky PC, Mouadeb DA, Rees CJ, Pryor JC, Postma GN, Alen J and Leonard RJ. Validity and reliability of the Eating Assessment Tool (EAT-10). *Ann Otol Rhinol Laryngol* 2008; 117(12):919-924.

ESP™ Dysphagia Treatment System Order Form

Email your order to: info@ampcarellc.com
Fax: 817-348-8830 Phone: 682-561-2444
Orders online: www.ampcarellc.com/orders

Today's Date: _____
Certification Number: _____

Bill to:

Customer/Facility Name

Accounts Payable Contact

Address

City, State, Zip

Phone Fax

Email

Ship to (if different than Bill to information):

Customer/Facility Name

Attention

Address

City, State, Zip

Phone

Email

Method of Payment

☐ Invoice PO# _____ Authorized Signature _____

☐ Visa ☐ MasterCard Account# _____ Exp. Date _____

☐ AmEx ☐ Discover Cardholder Name _____ Security Code _____

Signature _____ Billing Zip Code _____

Product Selection

Qty	Product Number	Product Description	Unit Price	Product Total
AMPCARE ESP THERAPY SYSTEM				
	50706LT	ESP™ Therapy System Kit {Ampcare ES™ Unit, user manual, batteries, lead wires and tester, 10 pkg *Large/*Adult E Series Electrodes, Restorative Posture Device (RPD) and replacement pad set, self-adhering wrap, shoulder-strap carrying bag}	$ 799.00	
	50706ST	ESP™ Therapy System Kit {Ampcare ES™ Unit, user manual, batteries, lead wires and tester, 10 pkg *Small/*Youth E Series Electrodes, Restorative Posture Device (RPD) and replacement pad set, self-adhering wrap, shoulder-strap carrying bag}	$ 799.00	
LARGE (Adult) ELECTRODES 1.5" x 1.75":				
	50709LT-1	10 Pack E Series Large Electrodes (4/pkg, 10 pkg/pouch) – 1 pouch	$ 139.50	
	50709LT-3	30 Pack E Series Large Electrodes (4/pkg, 10 pkg/pouch) – 3 pouches	$ 388.50	
	50709LT-5	50 Pack E Series Large Electrodes (4/pkg, 10 pkg/pouch) – 5 pouches	$ 597.50	
	50709LT-10	100 Pack E Series Large Electrodes (4/pkg, 10 pkg/pouch) – 10 pouches	$ 995.00	
SMALL (Youth) ELECTRODES 1.0" x 1.25":				
	50709ST-1	10 Pack E Series Small Electrodes (4/pkg, 10 pkg/pouch) – 1 pouch	$ 139.50	
	50709ST-3	30 Pack E Series Small Electrodes (4/pkg, 10 pkg/pouch) – 3 pouches	$ 388.50	
	50709ST-5	50 Pack E Series Small Electrodes (4/pkg, 10 pkg/pouch) – 5 pouches	$ 597.50	
	50709ST-10	100 Pack E Series Small Electrodes (4/pkg, 10 pkg/pouch) – 10 pouches	$ 995.00	
ACCESSORIES				
	50707	RPD (Restorative Posture Device)	$ 100.00	
	50708	RPD Replacement Pad Set	$ 25.00	
	50710LT	Ampcare ES™ (ES unit, user manual, batteries, lead wires, lead wire tester, 10 pkg *Large/*Adult E Series Electrodes, and Ampcare shoulder-strap carrying bag)	$ 749.00	
	50710ST	Ampcare ES™ (ES unit, user manual, batteries, lead wires, lead wire tester, 10 pkg *Small/*Youth E Series Electrodes, and Ampcare shoulder-strap carrying bag)	$ 749.00	
	50712	Replacement Lead Wire Set (2) for Ampcare ES™ with Lead Wire Tester	$ 40.00	
	50713	Lead Wire Tester	$ 15.00	
	50714	Ampcare Shoulder Strap Carrying Bag	$ 35.00	
Sales tax applies where required by law. If you are tax exempt, please fax your tax exemption certificate along with your order. Taxes, shipping and handling will be added to the final invoice.			**Subtotal**	

Thank you for choosing Ampcare for your dysphagia treatment needs

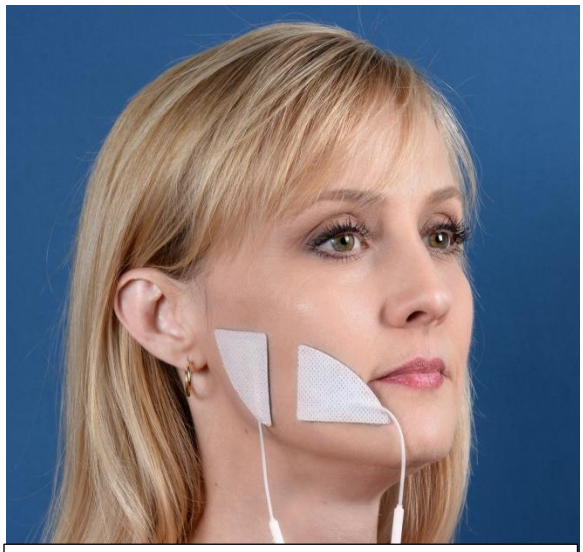
Rev C. 3/2024

Ampcare's ESP™ Placements

1. Submental

- Lead wires will extend beyond the front of the mandible
- Electrodes should not touch one another or the mandible
- Do not place lower than the thyroid notch

2. Facial



- Back electrode should be no higher than the acoustic meatus to prevent eye twitch
- Front electrode can cover both buccinator and orbicularis oris
- Consider smaller electrodes if you want to target specific muscles

General Rules:

Clean the area(s) with soap and water or alcohol wipe and let dry (approx. 45 seconds)
Electrodes should never touch one another
Place the black lead over the weaker side or musculature
Use Posture Device or coban strap to keep electrodes in place

Sample Verbal Instructions for the ESP:

I would like to use this device to rehabilitate some of your swallowing muscles, would that be alright?

I will place (two or four) pads on your skin (either under your chin and or face) and connect them to the device with this lead wire. The pads may feel a little cold when it first touches your skin.

I will place this posture device under your chin, on your chest and fasten around the back of your neck or use this coban strap around your chin.

As I am slowly turning up the vibrations please tell me when you feel a tingle under the pads.

Take as much "tingling" as you can in attempt to make the muscle tighten and wake up. "The more tingling the better."

I will ask you to perform exercises while the vibration is on.

Preset Programming ESP 1 (50 phase duration) or ESP 2 (250 phase duration):

If you are using a Preset program you will only be able to modify the intensity and the cycle "off" time.

The Keypad

To program a treatment session:

1. Press the On/Off button to turn on the power to the unit.
2. Hold the program button 

down for 3 seconds until either ESP 1 or ESP 2 is shown on the screen.

3. If you do not want to modify this program you may proceed to step 7.
4. To modify the cycle off time press the "Menu up" or "Menu down" button once. The off time will begin blinking to allow it to be modified.

5. Press the minus "-" or plus "+" button until the recommended cycle off time is selected. This can be changed to 25, 20 or 15 seconds to lessen the amount of rest time between stimulations and therefore increase the amount of exercise repetitions.

6. Once the parameter has been selected press the enter button 

to accept it.

To start a treatment session:

7. Use the up and down arrows until the prescribed intensity is visible in the LCD (left arrows for channel 1 and right arrows for channel 2).
8. The timer will begin counting down automatically once the intensity is increased and the LED Light Indicator will blink green when the unit is administering current.
9. Once the treatment time has reached zero the unit will automatically power off.
10. Once ESP 1 or 2 has been programmed, this will be the default until it is reprogrammed.

Remember the mechanical causes/impairments that you can address with ESP:

1. Impaired lip closure
2. Poor mastication and bolus control
3. Increased oral pocketing/retention
4. Reduced tongue base retraction
5. Delayed timing and initiation of a swallow
6. Decreased hyolaryngeal excursion
7. Limited epiglottis retroversion
8. Delayed/incomplete laryngeal vestibule closure
9. Retention in the vallecular/pyriform sinus
10. Decreased pharyngeal contraction
11. Reduced opening of the PES/UES
12. Impaired conduction of neural pathways

Cranial Nerves Involved in Swallowing and Their Evaluation Techniques

The term swallow reflex is deceptive in the sense that it is an elicited response requiring both sensory and motor information to initiate the swallow response.

CN V (5) – Trigeminal – conveys sensation to the face and motor to the soft palate (tensor veli palatini), pharynx and muscles of mastication. Primary interests to SLPs are Maxillary and Mandibular branches. (Oral and Pharyngeal Phase}
How to test:

1. Test with a wisp of cotton gently to the nostrils which should result in the wrinkling of the nose.
2. Bulk of masseter and temporalis muscle is tested by palpation of the muscles while the patient clenches their teeth. (Oral)
3. After bulk is determined, strength of muscles should be tested by attempting to open the jaw. Jaw will deviate to the weak side. (Oral)
4. Look inside mouth, weakness of tensor veli palatini may manifest itself as tilting of the uvula to the weak side. (Oral)
5. Palpate the hyoid while asking the patient to swallow and assess the amount of hyo-laryngeal elevation. {Pharyngeal}

CN VII (7) – Facial – conveys sensation (taste) to the anterior 2/3 of the tongue, soft palate and motor to the facial muscles. (Oral Phase)
Taste is tested using substances that are sweet (sugar), sour (lemon swab) or salty (salt).
Test by inspection of facial symmetry and then individual muscle for strength.
"Please raise your eyebrows" (frontalis).
"Please close your eyes tightly and stop me from opening them" (orbicularis oculi).
"Pretend to blow out some candles" (orbicularis oris).
"Puff out your cheeks" (buccinator). Try to push the air out – while keeping your lips sealed. (orbicularis oris).

CN IX (9) – Glossopharyngeal – conveys sensation to the posterior 1/3 of the tongue, soft palate and pharynx and motor to the pharyngeal musculature. (Oral and Pharyngeal Phase}
Testing this musculature is accomplished by testing the gag reflex. The gag reflex is a true reflex. Usually this is triggered by placing a tongue depressor at the back of the tongue or along the soft palate. Your gag response comes from the brainstem function which is why this reflex is often affected with brainstem strokes. Using a lemon swab to the back of the tongue would allow you to test for both sensory and motor. (Oral and Pharyngeal}

CN X (10) – Vagus – conveys sensation to the trachea, larynx and pharynx and motor to the soft palate (levator veli palatini), larynx and pharynx along with other areas. {Pharyngeal Phase}

1. Test by inspecting palate, it will be lower and less arched. Say "ahhh" and you will see deviation to the normal side.
2. Test posterior pharyngeal wall gag reflex
3. Bilateral weakness – may sound breathy or hyper nasal.
4. Unilateral – may have a hoarse voice.

This nerve also influences esophageal motility and UES closure and opening.

CN XI (11) – Accessory – conveys motor to the shoulder, neck and soft palate (musculus uvulae). {Pharyngeal Phase}
Inspect for asymmetry and assess power.
"Please shrug your shoulders up and stop me from pushing them down."
"Please turn your head to the right and stop me from pushing it back." Feel the left sternocleidomastoid at the same time. Repeat on the other side.

CN XII (12) – Hypoglossal – conveys motor to the tongue muscles. (Oral Phase)
Test tongue motor function by protruding tongue, push tongue against cheek. The tongue will deviate to the side of the lesion.
Check for tongue fasciculations - they can be the first clue to impaired neurological function.

One muscle(s) and/or one nerve involvement can affect the normal swallow function.
Assessment: Pt. appears to present with possible impairment of __CN due in part to deficit in __ test.

Oral Phase

Swallowing Problem		Muscle Group		Cranial Nerve
Acceptance		Orbicularis Oris, Zygomaticus		CN VII
Anterior loss		Orbicularis Oris		CN VII
Mastication		Masseter, Pterygoids, and Temporalis		CN V
Oral pocketing or scattering		Buccinator and intrinsic and extrinsic lingual muscles		CN VII, XII
Anterior-posterior propulsion		Intrinsic and extrinsic lingual muscles – Genioglossus, Styloglossus		CN XII
Poor lingual pressure to drive the bolus through the PES/UES		Intrinsic and extrinsic lingual muscles – Hyoglossus		CN XII

Pharyngeal Phase

Swallowing Problem		Muscle Group		Cranial Nerve
Poor velopharyngeal seal		Tensor Veli Palatini, Pharyngeal Constrictors, Levator Veli Palatini, Musculus Uvulae		CN V, IX, X, XI
Decreased closure of the larynx		Aryepiglottic, Lat. Cricoarytenoids, Transverse Arytenoid		CN X, XI
Weak pharyngeal constrictor contraction		Superior, Middle, and Inferior Pharyngeal Constrictors		CN IX, X, XI
Decreased anterior superior elevation of the hyolaryngeal complex		Anterior Digastric and Mylohyoid		CN V
Failure of opening the UES/PES		Inferior Pharyngeal Constrictor, Cricopharyngeus, Superior Longitudinal Esophageal muscle		CN IX, X, XI

International Classification of Diseases (ICD-10) – Dysphagia Diagnosis Codes

R13.11 Dysphagia, oral phase
R13.12 Dysphagia, oropharyngeal phase
R13.13 Dysphagia, pharyngeal phase
R13.14 Dysphagia, pharyngoesophageal phase