The
Adult Dysphagia
POCKET GUIDE

Neuroanatomy to Clinical Practice

Second Edition

Yvette McCoy, MS, CCC-SLP, BCS-S
Tiffani Wallace, MA, CCC-SLP, BCS-S

Plural Publishing Inc.

PLURAL PUBLISHING
INC.

9177 Aero Drive, Suite B
San Diego, CA 92123

email: information@pluralpublishing.com
website: https://www.pluralpublishing.com

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Typeset in 10.5/14 Minion Pro by Flanagan's Publishing Services, Inc.
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The adult dysphagia pocket guide
Library of Congress Cataloging in Publication Control Number: 2025019409
ISBN-13: 978-1-63550-771-3
ISBN-10: 1-63550-771-5

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Preface for the First Edition

The Adult Dysphagia Pocket Guide: Neuroanatomy to Clinical Practice was created because of the need for a concise, easy to carry reference book designed specifically for the dysphagia clinician.

The authors wanted to merge clinical neurophysiology of the swallow directly to assessment and treatment in a clear, easy to understand format. The discussion of laboratory values and medications in Chapters 3 and 4, and how they can impact dysphagia, add another layer of uniqueness to this guide. The recurring "Clinician's Note" and "Research to Practice" sections help transform this guide into one that is practical and useful for clinicians based on the current research.

This is not intended to replace continuing education and training, nor is it designed to be a textbook. This guide is also not a panacea. There is no one treatment or approach that will work for everyone. It is up to individual clinicians to think objectively, gather and synthesize the information presented, and apply efficacious research that will benefit each individual patient.

This reference book represents a "quick reference" and answers the need for a practical guidebook that new clinicians, graduate students, and even seasoned clinicians can carry with them and readily access while they are completing their evaluations. The authors believe that this is a much-needed resource and hope that it will be used with the enthusiasm and passion in which it was created. We can make a difference, one swallow at a time.

Preface for the Second Edition

The **second edition** includes **updated references** to reflect the most current research and clinical practices. Additionally, **Chapter 5 has been expanded** to include detailed information about the **muscle fiber types** found in the **intrinsic and extrinsic lingual muscles** as well as the **muscles of mastication**. This new information links muscle physiology to swallowing biomechanics, thus supporting more informed assessments and targeted interventions.

About the Authors

***Yvette McCoy**, PhD, CCC-SLP, BCS-S*

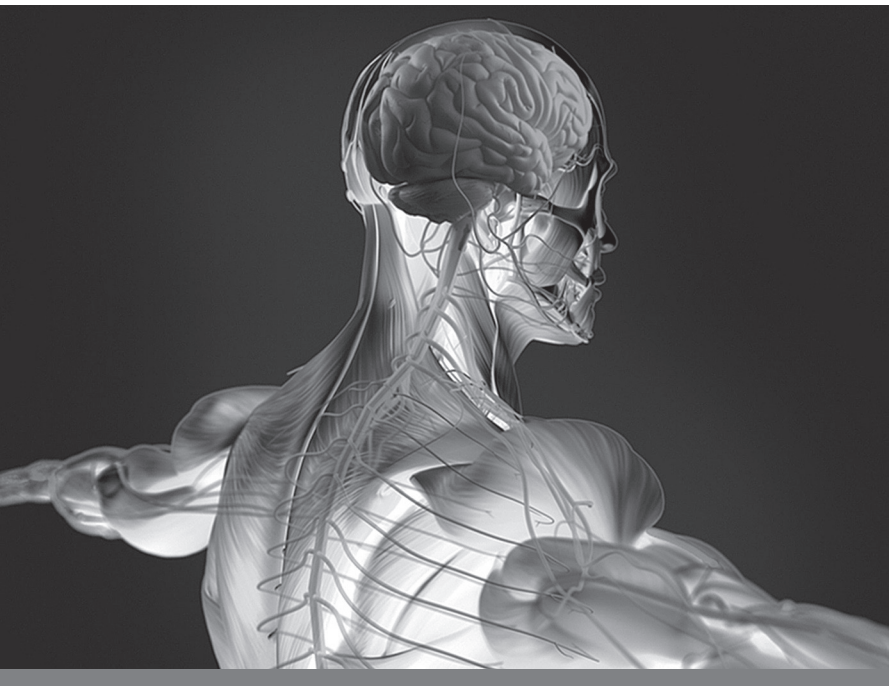
Yvette McCoy is an Assistant Professor of Speech-Language Pathology in the College of Health at Moravian University. She currently holds her board certification in swallowing and swallowing disorders. Her clinical and research interests include swallowing neurophysiology and rehabilitation of the impaired swallowing mechanism. Yvette has numerous peer-reviewed publications and has presented her work at both local and national and conferences as an invited speaker. She has volunteered her time on various committees for the American Speech-Language-Hearing Association, American Board of Swallowing and Swallowing Disorders, and the Dysphagia Research Society.

***Tiffani Wallace**, MA, CCC-SLP, BCS-S*

Tiffani Wallace has been treating patients with dysphagia for over 15 years. Tiffani has worked in various facilities, including schools, hospitals, outpatient clinics, skilled nursing facilities (SNFs), and is currently working in Home Health. Tiffani received her Board Certification in Swallowing and Swallowing Disorders (BCS-S) in 2012. Tiffani is the owner of Dysphagia Ramblings and has maintained her blog and social media presence since 2010. She is the author of the app iScreen Aphasia and Dysphagia2Go through SmartyEars and coauthor of the Dysphagia Therapy app through Tactus Therapy. Tiffani has presented multiple webinars for SpeechPathology.com and Northern Speech Services. She is a mentor and has provided content for the Medical SLP Collective. Tiffani has also traveled and presented through various companies throughout the United States. Tiffani recently became a Certified Nutrition Coach and enjoys educating others on nutrition.

CHAPTER 1

Basic Neurophysiology Review



Why Should Clinicians Care?

- Understanding the basic neurophysiology of the swallow mechanism will help clinicians identify the underlying pathophysiology and the level at which the swallowing system is not functioning properly.
- There are very specific signs/symptoms associated with damage to upper motor neurons (UMNs) as well as lower motor neurons (LMNs), which are essential for differential diagnosis in the clinical swallow assessment.
- Identification and understanding of neural organization can help clinicians become better diagnosticians and therapists.

Three Levels of Nervous System Organization

Swallowing takes place at three different levels of nervous system organization.

1. Peripheral level (cranial nerves) that can be linked to sensory bolus characteristics
2. Subcortical level (brainstem) that executes learned patterns of motor activity
3. Cortical level that responds to needed changes in motor behavior required to modify swallowing (Love & Webb, 2001; Stewart, 2024)

Examples of volitional behavior would be feeling the need to eat faster, eliminating an unwanted bolus, or maybe talking and eating at the same time.

Nervous System Organization

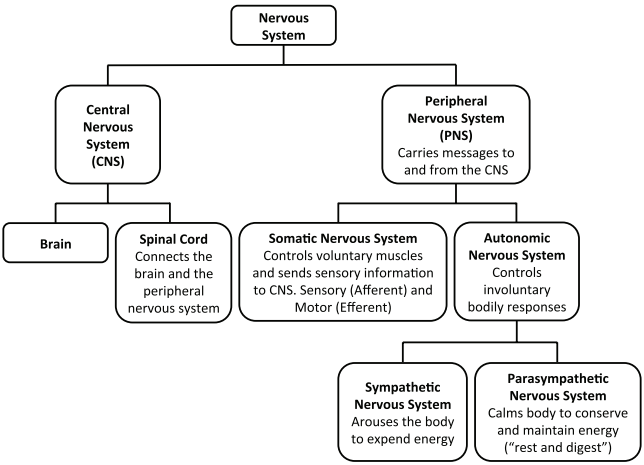
The nervous system is divided into the central nervous system (CNS) and peripheral nervous system (PNS). The CNS integrates information it receives from all parts of the body and coordinates the activity of all that information. The cortical components comprise the two cerebral hemispheres of the brain; the subcortical portions of the CNS comprise the brainstem, cerebellum, and spinal cord (Love & Webb, 2001; Stewart, 2024).

The main function of the PNS is to connect the CNS to the limbs and organs; it is the relay station between the brain and the body's extremities. The PNS is further divided into two subsystems. The autonomic system includes involuntary responses that influence the function of the internal organs. The somatic system communicates with sense organs and is primarily responsible for voluntary muscle movements. The autonomic nervous system is further divided into the parasympathetic nervous system and sympathetic nervous system. The autonomic nervous system in general is responsible for regulating the body's unconscious actions. More specifically, the parasympathetic nervous system is responsible for the "rest and digest" action that occurs when the body is at rest, especially after eating, and it also includes salivation (Love & Webb, 2001; Stewart, 2024). The somatic nervous system is divided into afferent (sensory) and efferent (motor) divisions (Stewart, 2024).

Quick Definitions

- Afferent—(sensory) impulses from peripheral tissues toward brainstem
- Efferent—(motor) impulses from brainstem to muscles

Peripheral nerves detect sensory information and send that information to the brain; that information is processed and sent out as signals to the effectors (muscles) to tell them what to do and how fast or slow to do it. Sensory input in turn drives motor output.



Love & Webb, 2001; Raymond et al., 2024; Stewart, 2024.

Neural Control of Swallowing

Nucleus Tractus Solitarius, Nucleus Ambiguus, and Central Pattern Generator

The cranial nerves involved in swallowing send sensory information to the nucleus tractus solitarius (NTS). Motor components are organized in the nucleus ambiguus (NA); together, the NTS and NA comprise the swallowing center located in the medulla in the brainstem, which is called the central pattern generator (Jean, 2001; Jean & Dallaporta, 2006; Love & Webb, 2001; Miller, 1986). This network of neurons within the brainstem is hardwired to produce a series or sequence of activities that is always the same. In swallowing, which is nonvolitional, the same set of events will happen all the time. It is important to note that since there are some volitional aspects of swallowing, the central pattern generator (CPG) network CAN BE activated by input from the cerebral cortex (Cheng et al., 2022).

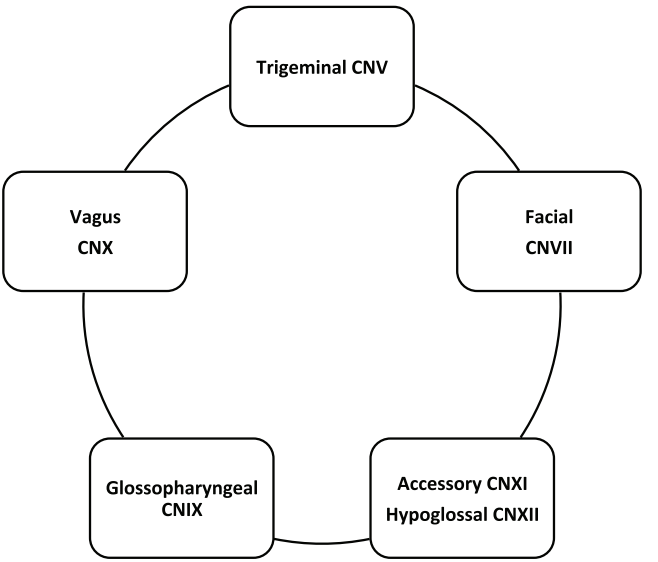
Clinician's Note

The brainstem is primarily responsible for the involuntary aspects of swallowing. Swallow function is represented on both sides of the brainstem; these sides are interconnected (Jean, 2001; Jean & Dallaporta, 2006; Love & Webb, 2001; Miller, 1986). The normal function depends on intact function of BOTH sides, so a patient with a unilateral brainstem lesion could have bilateral pharyngeal dysfunction.

Clinical Relevance

- Nucleus tractus solitarius (NTS) processes general sensory information in the pharynx, larynx, and esophageal mucosa. Special sensory (taste) also synapses predominantly in the NTS (Bradley & Sweazy, 1992; Jean, 2001; Jean & Dallaporta, 2006; Love & Webb, 2001).
- The highest density of laryngeal sensory receptors is located in the supraglottic mucosa near the arytenoid cartilages.
- Aspirators with no physiologic response to airway invasion quite likely have impairment in the NTS.
- NTS integrates sensory input with several reflexes, including coughing, apnea, and pharyngeal swallowing (Kern et al., 2001).
- The nucleus ambiguus (NA) houses significant motor nuclei, and the central nervous system (CNS) uses sensory information from the oral cavity to inform and guide both tongue shape and the associated pressures that are generated to squeeze the bolus successfully toward the pharynx (Jean, 2001; Jean & Dallaporta, 2006; Love & Webb, 2001).

Cranial Nerves Involved in Swallowing



Love & Webb, 2001; Miller, 1986.

Quick Definitions

- Contralateral = opposite side of the lesion
- Ipsilateral = same side of the lesion
- Upper motor neuron (UMN) = neuron that starts in the motor cortex of the brain and terminates within the medulla or within the spinal cord. UMNs send fibers to the lower motor neurons (LMNs) that exert direct or indirect control over the LMNs of the cranial and spinal nerves (Hadjikoutis et al., 2000 Szacka et al., 2016; Waito et al., 2017).

  Axons of upper motor neurons decussate (cross over) before synapsing with lower motor neurons, so the right motor cortex controls the left side of the body and vice versa—contralateral control (Hadjikoutis et al., 2000; Hughes & Wiles, 1996).
- Lower motor neurons (LMNs) = convey signals directly from the nucleus to the muscles; they are the final common pathway connecting the muscle fiber to the nervous system and the last communication between the nervous system and the muscles (Hadjikoutis et al., 2000).

**Generally speaking, UMN damage will cause spasticity and LMN damage will cause flaccidity.*