Dysphagia Assessment and Treatment Planning

A TEAM APPROACH

Fourth Edition
Contents

Introduction vii
Multimedia List xi
Acknowledgments xii
Contributors xiii

1 Anatomy and Physiology of Deglutition 1
   Katherine A. Kendall

2 Head and Neck Physical Exam 27
   Katherine A. Kendall

3 Clinical Swallow Evaluation 37
   Susan J. Goodrich and Alice I. Walker

4 Endoscopy in Assessing and Treating Dysphagia 53
   Rebecca Leonard

5 Radiographic Evaluation of the Pharynx and Esophagus 73
   Jacqui Allen

6 Dynamic Fluoroscopic Swallow Study: Swallow Evaluation with
   Videofluoroscopy 85
   Susan McKenzie and Rebecca Leonard

7 DSS: A Systematic Approach to Analysis and Interpretation 105
   Susan McKenzie and Rebecca Leonard

8 Dynamic Swallow Study: Objective Measures and Normative
   Data in Adults 125
   Rebecca Leonard

9 Other Technologies in Dysphagia Assessment 157
   Maggie A. Kuhn

10 The Treatment Plan 169
    Rebecca Leonard and Katherine A. Kendall
11 Nursing Evaluation and Care of the Dysphagic Patient
   Ann E. F. Sievers

221

12 Nutritional Concerns and Assessment in Dysphagia
   Beverly Lorens and Katherine A. Kendall

243

13 Pediatric Clinical Feeding Assessment
   Anna Miles

279

14 Esophageal Phase Dysphagia
   Peter C. Belafsky and Catherine J. Rees Lintzenich

299

15 Neurogenic Dysphagia
   Jacqui Allen

309

16 Dysphagia in Head and Neck Cancer Patients
   Katherine A. Kendall

327

17 Laryngopharyngeal Reflux
   Catherine J. Rees Lintzenich and Peter C. Belafsky

355

18 Spinal Abnormalities in Dysphagia
   Derrick R. Randall

369

Index

379
Introduction

*Dysphagia Assessment and Treatment Planning: A Team Approach* is now in its fourth edition, which speaks to our continuing emphasis on a multidisciplinary approach to dysphagia, but also, to the willingness of original, new and extended “team” members to be involved in this project. We very much appreciate everyone’s contributions!

The organization of the book has changed, with chapters concerned with assessment techniques coming first, and material addressing special populations comprising the latter portion of the text. This reflects what is likely a more typical approach to dysphagia in graduate courses concerned with the topic, and one that we hope complements teaching of the subject matter. Also new are PowerPoint slides accompanying each chapter hosted on a PluralPlus companion website. The slides are intended to highlight each chapter’s major points, with supplemental content then added as desired by individual instructors. We are also including materials on the website that can be used to complement chapter content. These have been developed by Dr. Barkmeier-Kraemer, first author of the text’s accompanying workbook, for a graduate dysphagia course that utilized the text. Our plan is to continue to update and add to these materials over the course of the next few years, thereby allowing the book to be a more dynamic, evolving source of educational material, as opposed to a static resource.

Some information in the new edition represents updates on material previously presented. In a few cases—for example, head and neck anatomy (Chapter 1) and the clinical head and neck examination (Chapter 2)—information previously presented has not changed, though some edits to the existing text have been made. Similarly, our approach to endoscopy (Chapter 4) remains the same, though new possibilities for quantifying what have previously been only subjective observations are mentioned. Improvements in endoscopic equipment have also continued, contributing primarily to improved diagnostic capabilities, but also enhancing the differentiation of observations critical to oral-pharyngeal dysphagia. Clinical evaluation of swallowing (Chapter 3), incorporating both bedside and actual clinical evaluations, is quite comprehensive and has undergone minimal updating, as well. In other cases, substantial changes are obvious in the material.

For example, the pediatrics chapter (Ch. 13) has been written by Anna Miles, Ph.D., a speech-language pathologist from New Zealand who works in both medical and academic settings. Dr. Miles has expanded this chapter to address specific problems and needs not only of infants, which was a primary
focus of earlier chapters, but rather, the
entire spectrum of childhood. This is an
excellent addition to the book, one that
provides both practical and data-based
evidence for assessing and treating dys-
phagia in infants and children.
A brand-new addition to the book is
Chapter 18 by Dr. Derrick Randall, who
completed a laryngology fellowship at
UC Davis and is now practicing at the
University of Calgary, Alberta, Can-
da. Dr. Randall’s chapter addresses
dysphagia associated with alterations
to the spine as a consequence of either
disease or surgery. His information
not only is current, but also provides
practical information to students and
clinicians who are, or will be, seeing
these patients in clinical practice. In our
own setting at UC Davis, this popula-
tion is substantial, and we believe this
is likely to be true of many settings, in
particular those in which outpatients
are evaluated and treated. We felt we
should address this population in the
current edition, and Dr. Randall’s chap-
ter nicely fulfills this need.
Chapters dealing with nursing
(Chapter 11) and nutrition (Chapter 12)
retain much of the information previ-
ously presented but have been updated
to incorporate the latest recommenda-
tions in nursing care and dietary con-
siderations for patients experiencing
dysphagia. Similarly, chapters address-
ing special populations, including neu-
rogenic disease (Chapter 15) and head
and neck cancer (Chapter 16), provide
details regarding the unique features of
these pathologies, as well as incorpo-
rating the latest information regarding
dysphagia and approaches to treatment
pertinent to each group.
Gastroesophageal reflux continues
to be a major issue in many dysphagic
patients, and is once again the subject of
an entire chapter (Chapter 17). A chapter
devoted to the esophagus (Chapter 14)
dresses both esophageal diseases and
their treatments, and diagnostic tools
used to evaluate them. Other tools used
to evaluate dysphagia, with descrip-
tions of their use and updates on their
emergence, are addressed in Chapter 9,
“Other Technologies in Dysphagia As-
sessment.” This chapter, authored by
Dr. Maggie Kuhn, laryngologist from
UC Davis, provides an excellent over-
view of tools, including ultrasound and
functional MRI, for which continued
exploration has demonstrated unique
potential in the assessment of dyspha-
gia. Material presented will be informa-
tive for those just being introduced
to dysphagia, as well as to those with
substantial experience in the field. SLP
deglutologists who are expanding their
practices to include instrumental tech-
niques such as manometry and perhaps
other esophageal assessments, will find
this information of particular interest.
“GOOSE” (guided observation of swal-
lowing in the esophagus), for example,
is described in the chapter as the esopha-
geal equivalent of FEES for the upper
aerodigestive tract.
As with previous editions, informa-
tion dedicated to fluoroscopic evalu-
ation, or the dynamic swallow study
(DSS), is emphasized (Chapters 6–8, 15).
In part, this is due to the fact that fluo-
roscopy continues to be a major diag-
nostic tool in patients with dysphagia.
Advances in MRI (magnetic resonance
imaging) have emerged in the last few
years—for example, it now has the
potential to capture data in “real-time.”
This, in addition to its excellent soft tis-
sue definition and non-invasiveness,
for replacing fluoro (discussed in Dr. Allen’s updated chapter, “Radiographic Evaluation of the Pharynx and Esophagus,” as well as in Chapter 9). However, a number of major problems must still be resolved before this is likely to happen, some of them technical, and others related to cost and availability. When (or if) it does happen, the ability to quantify mechanical characteristics, a major strength of fluoroscopy, will be retained and, hopefully, expanded. It is, in fact, this feature of fluoroscopy that our Team found to be so valuable in learning about swallowing, and is another major reason we have emphasized fluoroscopy in every edition of this text. In short, attempting to measure mechanical features of swallowing is simply an excellent way to learn about it.

A major new inclusion in the current edition are materials utilizing a new software program, “Swallowtail,” which permits the all-in-one measurement, display and storage of timing, displacement and other measures from fluoroscopic studies. Though the program does not exclude clinician judgment regarding what to measure, or where, once this information has been determined, the software does permit expedient, and in some cases, semi-automatic measurement. Examples of measurements possible with the program, and opportunities to actually try out the software online, are available with both the text and the workbook. Our hope is that these resources will be used, for example, as an outside assignment for graduate students, as a test site for clinicians interested in experimenting with objective measurements, or simply as a means of being introduced to measurement possibilities associated with fluoroscopic swallow studies.

The treatment chapter (Chapter 10) has been updated to reflect the current status of therapeutic approaches previously considered in treating dysphagic patients. Since the last edition of this book, research has in some cases demonstrated the need for critical scrutiny and rethinking of strategies once widely applied. In others, careful research has led to new and promising approaches to intervention that will be further elaborated as they are put to the test and stringently evaluated. Our hope with this chapter is that we have provided sufficient detail for readers to understand the concepts behind a particular treatment, or category of treatment, and that they will then go beyond the text to acquire a deeper understanding, or mastery, of strategies of interest.

A workbook, authored by Dr. Julie Barkmeier-Kraemer, once again accompanies this new edition of the text. We are hopeful that readers will consider the two publications as a “paired set,” in particular, since information and exercises outlined in the workbook are based on content of chapters in the book. Our feeling is that the combination of both works provides an excellent and effective means of learning about dysphagia, for students just being introduced to the area and, to practicing professionals who wish to broaden their understanding of current practices within this complex field.

As noted previously, the participation of physicians, nurse specialists, dieticians and SLP deglutologists in the preparation of this book speaks to the recognition of the value of a team approach to dysphagia. We believe, firmly, that the best approach to this serious and often debilitating condition is one that exploits the knowledge-base,
skills, and experience of individual specialists who bring their own unique talents to the assessment and treatment of dysphagic patients. In our own experience, this endeavor has proved a continual source of education, challenge and satisfaction. We hope this edition of the text, and the accompanying workbook, will inspire others with similar interests to identify and maximize the possibilities for teamwork in their own settings.
Multimedia List

Chapter 1
Video 1–1. Straw Drinking

Chapter 4
Video 4–1. VPPORT
Video 4–2. OROPHX
Video 4–3. HYPOPHX
Video 4–4. FEESPT1
Video 4–5. FEESPT2

Chapter 6
Video 6–1. ZDtwoviews
Video 6–2. A/P Aspiration

Chapter 7
Video 7–1. NrmPhPeristalsis
Video 7–2. AbsIncPhPeristalsis
Video 7–3. ExcPhPeristalsis
Video 7–4. AbsIncEpigInv
Video 7–5. ASPBefore
Video 7–6. ASPDuring
Video 7–7. ASPAfter
Video 7–8. DiffEsophSpasm
Video 7–9. Stasis

Chapter 8
Video 8–1. BOLTRANSITWALL
Video 8–2. BolusTransitTime
Video 8–3. YngEldSwallow
Video 8–4. BP1AEcl

Chapter 9
Video 9–1. Goose

Chapter 10
Video 10–1. Strategy 1
Video 10–2. Strategy 2A
Video 10–3. Strategy 2B
Video 10–4. Strategy 3
Video 10–5. Strategy 4
Video 10–6. Strategy 5
Video 10–7. Strategy 6
Video 10–8. Swallowing Expansion Device [SED]: Fluoroscopy
Video 10–9. Swallowing Expansion Device [SED]: Endoscopy
Video 10–10. Double Balloon Dilation

Chapter 18
Video 18–1. CSpineBolusConsist
Video 18–2. CSpineBolusVol
Video 18–3. CSpineBolusRedirect
Acknowledgments

The authors extend a sincere “thank you” to the members of the UC Davis Dysphagia Team, past and present, as well as to our colleagues at other institutions, for their generosity and expertise in the preparation of this text. Our “team” experience at UCD has convinced us that a highly interactive, interdisciplinary group of individuals with unique backgrounds and skill sets represents an ideal approach to dysphagia management, as well as a perpetual source of continuing education for individual members. We are hopeful that the text will inspire other professionals to develop similar resources in their own settings. We also thank those patients and volunteer subjects who have played a role in materials used in the book, as well as in our collection of normative and other data. These individuals have graciously shared their time and experiences with us, and we gratefully acknowledge their contributions.
Contributors

Jacqui Allen, MD, FRACS
Otolaryngologist, Senior Lecturer
University of Auckland
North Shore Hospital
Takapuna, Auckland
New Zealand
Chapters 5, 15

Peter C. Belafsky, MD, MPH, PhD
Professor & Director, Center for Voice & Swallowing
Department of Otolaryngology
University of California, Davis
Sacramento, California
Chapters 14, 17

Susan J. Goodrich, MS
Senior Speech Pathologist
Voice Speech Swallow Center
Department of Otolaryngology
University of California, Davis
Sacramento, California
Chapters 3, 13

Katherine A. Kendall, MD, FACS
Professor
Division of Otolaryngology
University of Utah
Salt Lake City, Utah
Chapters 1, 2, 10, 16

Maggie A. Kuhn, MD
Assistant Professor
Department of Otolaryngology–Head and Neck Surgery
University of California, Davis
Davis, California
Chapter 9

Rebecca Leonard, PhD
Professor, Emeritus, Department of Otolaryngology–Head and Neck Surgery
University of California, Davis
Sacramento, California
Chapters 4, 6, 7, 8, 10

Anna Miles, PhD
Senior Lecturer
Speech Science
The University of Auckland
Auckland, New Zealand
Chapter 13

Beverly Lorens, MS, RD
Senior Clinical Dietitian, retired
Food and Nutrition Services
University of California Davis Medical Center
Sacramento, California
Academy of Nutrition and Dietics
Chapter 12

Susan McKenzie, MS
Senior Speech Pathologist
Voice and Swallowing Center
University of California Davis
Sacramento, California
Chapters 6, 7
Dysphagia Assessment and Treatment Planning: A Team Approach

Derrick R. Randall, MD, MSc, FRCSC
Section of Otolaryngology–Head and Neck Surgery
Department of Surgery
University of Calgary
Calgary, Canada
Chapter 18

Catherine J. Rees Lintzenich, MD
Associate Professor Otolaryngology–Head and Neck Surgery
Center for Voice and Swallowing Disorders
Wake Forest University School of Medicine
Winston-Salem, North Carolina
Chapters 14, 17

Ann E. F. Sievers, RN, MA, CORLN
ENT Nurse Expert
Department of Patient Care Services and Otolaryngology
University of California, Davis
Sacramento, California
Chapter 11

Alice I. Walker, MS
Senior Speech Language Pathologist
Department of Otolaryngology
University of California, Davis
Sacramento, California
Chapter 3
Familiarity with the anatomy and physiology of normal deglutition enables a more focused approach to the evaluation of patients with disordered swallowing. This chapter discusses those head and neck structures involved in swallowing and reviews the sequence of events resulting in a successful swallow.

The oral cavity, oropharynx, and esophagus can be thought of as a series of expanding and contracting chambers, divided by muscular sphincters. Propulsion of a bolus through this part of the alimentary tract is the result of forces or positive pressure developed behind the bolus, as well as a vacuum or negative pressure developed in front of the bolus. The creation of propulsion pressures depends on the sequential contraction and expansion of the chambers of the upper aerodigestive tract and the competency of the sphincters dividing the chambers. Any disturbance in the functional elements or coordination of this system is likely to result in less efficient transfer of a bolus from the oral cavity to the stomach, resulting in dysphagia. Swallowing involves coordination of the sequence of activation and inhibition for more than 25 pairs of muscles in the mouth, pharynx, larynx, and esophagus. An understanding of how the structures of the head and neck interact and coordinate to bring about the propulsion pressures required for normal swallowing is vital for the clinician involved in the evaluation and treatment of patients with swallowing complaints.

For simplicity, the act of deglutition is traditionally divided into four parts: the preparatory phase, the oral phase, the pharyngeal phase, and the esophageal phase (Dodds, Stewart, & Logemann, 1990; Miller, 1982).
PREPAREDATORY PHASE

The preparatory phase of swallowing includes mastication of the bolus, mixing it with saliva, and dividing the food for transport through the pharynx and esophagus. The preparatory phase takes place in the oral cavity, the first chamber in the swallowing system. This oral preparatory phase of swallowing is almost entirely voluntary and can be interrupted at any time.

During bolus preparation, facial muscles play a role in maintaining the bolus on the tongue and between the teeth for chewing. Specifically, the orbicularis oris muscle, the circular muscle of the lips, maintains oral competence and can be considered as the first sphincter of the swallowing system. The buccinator muscle of the cheek contracts to keep the bolus from pooling in the pockets formed by the gingival buccal sulci. These muscles receive neural input from the facial nerve or cranial nerve VII (Figures 1–1A, 1–1B, and 1–1C).

Most of the movement and positioning of the bolus is carried out by the tongue muscles. In addition to four intrinsic muscles, the tongue has four extrinsic muscles: the genioglossus, palatoglossus, styloglossus, and hyoglossus muscles (Figure 1–2). Along with the genioglossus muscle, the intrinsic muscles act primarily to alter the shape and tone of the tongue while the other three extrinsic muscles aid in

![Figure 1–1. A. Facial musculature shown in relationship to muscles of head and neck.](image-url)
Figure 1-1. continued B. Facial musculature and buccinator muscle, anterior view. (Reprinted with permission from Moore & Dalley, 2006, Clinically Oriented Anatomy, 5th ed., Williams and Wilkins, Baltimore, p. 935, Figure 7–4b.) continues
Figure 1-1. continued C. Facial musculature, lateral view. (Reprinted with permission from Moore & Dalley, 2006, Clinically Oriented Anatomy, 5th ed., Williams and Wilkins, Baltimore, p. 935, Figure 7–4c.)
Figure 1-2. Distribution of the hypoglossal nerve. (Reprinted with permission from Moore & Dalley, 2006, Clinically Oriented Anatomy, 5th ed., Williams and Wilkins, Baltimore, p. 1154, Figure 9-15.)
the positioning of the tongue relative to other oral cavity and pharyngeal structures. Cranial nerve XII, the hypoglossal nerve, carries the motor nerve fibers that innervate both the intrinsic and extrinsic tongue muscles, except for the palatoglossus muscle (see Figure 1–2). A branch of the pharyngeal plexus from the vagus nerve (X) sends motor fibers to innervate the palatoglossus muscle. A high density of mechanoreceptors within and on the surface of the tongue indicates that the tongue is an important sensory region for determining the size of the bolus. Sensory information from the anterior two-thirds of the tongue is carried back to central swallowing control centers via the lingual nerve, a branch of the trigeminal nerve or cranial nerve V. Sensory information from the posterior one-third of the tongue is carried centrally by the glossopharyngeal nerve, or cranial nerve IX (Figures 1–3A and 1–3B). During the bolus preparatory phase of deglutition, the posterior part of the tongue elevates against the soft palate, which pushes downward to keep the bolus from escaping prematurely into the pharynx. The palate is the second sphincter in the swallowing system. Contraction of the palatoglossus muscles approximates the palate and posterior tongue, effectively closing the back of the oral cavity (Figures 1–4 and 1–5).

Mastication of the bolus involves the masseter muscles, the temporalis muscles, and the medial and lateral pterygoid muscles. This muscle group is known collectively as the muscles of mastication. Motor fibers controlling the contraction of these muscles are carried in branches of the trigeminal nerve (V) (Figure 1–6).

**Salivation**

Successful transfer of a food bolus from the oral cavity into the esophagus requires the mixing of the bolus with saliva. Saliva lubricates and dilutes the bolus to a consistency proper for swallowing. Saliva contains two major types of protein secretion: an enzyme for digesting starches, and mucous for lubricating purposes. Normal salivary secretion ranges from 1.0 to 1.5 liters per day. Saliva also plays an important role in maintaining healthy oral tissues. It is bacteriostatic and controls the pathogenic bacteria normally present in the oral cavity that are largely responsible for dental caries. The secretion of saliva is controlled by the salivatory nucleus in the brainstem. The nerve fibers of the parasympathetic nervous system carry signals from the salivatory nucleus to the salivary glands (Guyton, 1981).

**ORAL PHASE**

The bolus is propelled from the oral cavity to the pharynx during the oral phase of swallowing. The top of the tongue is placed on the superior alveolar ridge behind the maxillary central incisors. Voluntary opening of the pharynx then begins with elevation of the soft palate and depression of the posterior tongue (see Video 1–1 of straw drinking on the companion website). In this way, there is expansion of the posterior oral cavity and a chute forms down which the bolus moves into the pharynx. Elevation of the palate occurs as a result of contraction of the levator veli palatini muscle. The levator veli palatini muscle receives motor innervation from the
Figure 1–3. Distribution of the glossopharyngeal nerve (A, B). (Reprinted with permission from Moore & Dalley, 2006, Clinically Oriented Anatomy, 5th ed., Williams and Wilkins, Baltimore, p. 1148, Figure 9–10B.) (continues)
Figure 1-3. (continued)
vagus nerve (X) via the pharyngeal plexus. The hyoglossus muscle (XII), and to a lesser extent the styloglossus muscle (XII), are active in posterior tongue depression. The anterior half of the tongue is then pressed against the maxillary alveolar ridge and the anterior half of the hard palate in rapid sequence, moving the bolus posteriorly on the dorsum of the tongue. Contraction of the orbicularis oris and buccinator muscles prevents pressure escape forward, out of the mouth, or laterally.

Soft palate elevation allows the bolus to pass through the tonsillar pillars. Once the soft palate is fully elevated, it contacts the adjacent pharyngeal walls in a valving action that acts to prevent penetration of the bolus or escape of air pressure into the nasopharynx. The side walls of the nasopharynx, consisting of the superior pharyngeal constrictor muscle, also oppose one another to make a more forceful closure of the nasopharynx (Figure 1–7). Motor nerve fibers from the vagus nerve (X) via the pharyngeal plexus innervate the superior pharyngeal constrictor and palatal musculature. The hyoid bone is then moderately elevated in preparation for the pharyngeal phase of swallowing. Early hyoid bone elevation occurs primarily as a result of mylohyoid muscle contraction. Motor innervation of the mylohyoid muscle comes from a branch of the trigeminal nerve (V).

The muscles involved in the oral phase of swallowing represent three anatomical regions: the suprathyroid suspensorial muscles (which affect the position of the posterior tongue and, thus, the hyoid bone), the muscles surrounding the tonsillar pillars, and the muscles involved in the closure of the nasopharynx. Muscles that discharge during the oral phase of swallowing include the muscles of the face (specifically those within the lips and cheeks), the tongue muscles, the superior pharyngeal constrictor, the styloglossus, stylohyoid, geniohyoid, and mylohyoid muscles with the palatoglossus and palatopharyngeus muscles demonstrating their maximal activity later. The anterior and posterior bellies of the digastric muscle participate in the subsequent elevation of the hyoid and larynx (see Figures 1–1A, 1–1B, and 1–6E).