Contents

Preface xi iii

1 Voice: A Historical Perspective 1
   Ancient History 2
   The Renaissance 4
   The 17th to 19th Centuries 6
   The Laryngeal Mirror 6
   Further Advancements 7
   Voice Therapy 7
   Clinical Voice Pathology 9
   References 11

2 Anatomy and Physiology 13
   Anatomy 13
      The Laryngeal Valve 15
      Respiration for Phonation 16
      Vocal Tract Resonance 18
   Structural Support of the Larynx 18
   Laryngeal Cartilages 19
   Muscles 24
      Muscles for Respiration: Inspiration and Exhalation 24
      Laryngeal Muscles 27
   True Folds, Ventricular (False) Folds, and Ventricle 34
   Vocal Fold Microstructure 35
      Epithelium 35
      Basement Membrane Zone 36
      Lamina Propria 37
      Vocal Muscle 40
   Blood Supply and Secretions 40
   Neurologic Supply 41
      Central Nervous System Control 41
      Peripheral Innervation 42
   Laryngeal Reflexes 44
   Developmental Changes 44
   Geriatric Vocal Folds 45
   DNA Microarray Gene Expression Analysis 46
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Some Etiologic Correlates</td>
<td>55</td>
</tr>
<tr>
<td>4</td>
<td>Pathologies of the Laryngeal Mechanism</td>
<td>71</td>
</tr>
<tr>
<td>5</td>
<td>The Diagnostic Voice Evaluation</td>
<td>113</td>
</tr>
</tbody>
</table>

### Chapter 3: Some Etiologic Correlates

- Etiologies of Vocal Misuse 55
  - Phonotrauma 56
  - Inappropriate Vocal Components 57
  - Medically Related Etiologies 60
- Primary Disorder Etiologies 65
- Personality-Related Disorders 66
  - Environmental Stress 66
  - Identity Conflict 67
- Summary 68
- References 68

### Chapter 4: Pathologies of the Laryngeal Mechanism

- Incidence of Voice Disorders 72
- Pathology Classifications 73
  - Structural Pathologies of the Vocal Fold 74
  - Congenital and Maturational Changes Affecting Voice 84
  - Inflammatory Conditions of the Larynx 85
  - Trauma or Injury of the Larynx 87
  - Systemic Conditions Affecting Voice 88
  - Nonlaryngeal Aerodigestive Disorders Affecting Voice 91
  - Psychiatric and Psychological Disorders Affecting Voice 93
  - Neurologic Disorders Affecting Voice 95
  - Movement Disorders Affecting the Larynx 98
  - Central Neurologic Disorders Affecting Voice 101
  - Other Disorders of Voice Use 104
- Summary 106
- References 106

### Chapter 5: The Diagnostic Voice Evaluation

- The Players 114
- Patient Profile 114
- Referral Sources 115
- Medical Examination 116
- Voice Pathology Evaluation 118
### Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic Voice Evaluation</td>
<td>118</td>
</tr>
<tr>
<td>Referral</td>
<td>118</td>
</tr>
<tr>
<td>Reason for the Referral</td>
<td>119</td>
</tr>
<tr>
<td>History of the Problem</td>
<td>121</td>
</tr>
<tr>
<td>Medical History</td>
<td>122</td>
</tr>
<tr>
<td>Social History</td>
<td>122</td>
</tr>
<tr>
<td>Oral-Peripheral Examination</td>
<td>123</td>
</tr>
<tr>
<td>Auditory-Perceptual Voice Assessment</td>
<td>124</td>
</tr>
<tr>
<td>Impressions</td>
<td>126</td>
</tr>
<tr>
<td>Prognosis</td>
<td>126</td>
</tr>
<tr>
<td>Recommendations</td>
<td>127</td>
</tr>
<tr>
<td>Additional Considerations</td>
<td>127</td>
</tr>
<tr>
<td>Patient Self-Analysis of the Voice Disorder</td>
<td>127</td>
</tr>
<tr>
<td>Summary</td>
<td>128</td>
</tr>
<tr>
<td>References</td>
<td>129</td>
</tr>
<tr>
<td>Appendix 5–A Sample Report</td>
<td>131</td>
</tr>
<tr>
<td>Appendix 5–B Consensus Auditory-Perceptual Evaluation of Voice</td>
<td>134</td>
</tr>
<tr>
<td>Appendix 5–C The Rainbow Passage</td>
<td>135</td>
</tr>
<tr>
<td>Appendix 5–D Vocal Component Checklist</td>
<td>136</td>
</tr>
<tr>
<td>Appendix 5–E Voice Handicap Index</td>
<td>137</td>
</tr>
<tr>
<td>Instrumental Measurement of Voice</td>
<td>139</td>
</tr>
<tr>
<td>Clinical Utility</td>
<td>140</td>
</tr>
<tr>
<td>Basics of Technical Instruments</td>
<td>143</td>
</tr>
<tr>
<td>Microphones and Recording Environment</td>
<td>143</td>
</tr>
<tr>
<td>Digital Signal Processing</td>
<td>144</td>
</tr>
<tr>
<td>Acoustic Measurements</td>
<td>145</td>
</tr>
<tr>
<td>Pitch Detection Algorithm</td>
<td>146</td>
</tr>
<tr>
<td>Fundamental Frequency</td>
<td>147</td>
</tr>
<tr>
<td>Intensity</td>
<td>148</td>
</tr>
<tr>
<td>Voice Range Profile, Phonetogram, and Physiologic Frequency Range of Phonation</td>
<td>149</td>
</tr>
<tr>
<td>Perturbation Measures</td>
<td>149</td>
</tr>
<tr>
<td>Signal (or Harmonic)-to-Noise Ratios</td>
<td>151</td>
</tr>
<tr>
<td>Spectral Analysis</td>
<td>151</td>
</tr>
<tr>
<td>Aerodynamic Measurements</td>
<td>154</td>
</tr>
<tr>
<td>Calibration</td>
<td>155</td>
</tr>
<tr>
<td>Pressure, Flow, Resistance, and Ohm’s Law</td>
<td>155</td>
</tr>
<tr>
<td>Airflow Equipment</td>
<td>156</td>
</tr>
<tr>
<td>Flow Measurement</td>
<td>157</td>
</tr>
<tr>
<td>Subglottal Air Pressure Measurement</td>
<td>158</td>
</tr>
<tr>
<td>Phonation Threshold Pressure</td>
<td>158</td>
</tr>
<tr>
<td>Laryngeal Resistance</td>
<td>160</td>
</tr>
</tbody>
</table>
7 Survey of Voice Management 193
Voice Therapy Orientations 193
Hygienic Voice Therapy 193
Symptomatic Voice Therapy 194
Psychogenic Voice Therapy 195
Physiologic Voice Therapy 197
Eclectic Voice Therapy 199
Case Study 1: Illustrating Voice Therapy Orientations 199
Hygienic Voice Therapy 203
Treatment Strategies for Vocally Traumatic Behavior 203
Vocal Hygiene Therapy Approaches 203
Case Study 2: The Homemaker 204
Case Study 3: The Noisy Work Environment 205
Case Study 4: The Public Speaker 208
Case Study 5: Phonotrauma in Children 208
Case Study 6: Can We Always Expect Success? 212
Hydration 213
Confidential Voice 214
Symptomatic Voice Therapy 214
Therapy Approaches for Respiration 215
Therapy Approaches for Phonation 217
Therapy Approaches for Resonance 218
Therapy Approaches for Pitch 224
Therapy Approaches for Loudness Modification 229
Therapy Approaches for Rate Modification 229
Treatment Approaches for Laryngeal Area Muscle Tension 230
Psychogenic Voice Therapy 232
  Functional Aphonia/Dysphonia 234
  Functional Falsetto 238
  Vocal Fold Dysfunction (VFD) 242
Physiologic Voice Therapy 243
  Case Study 10: Laryngeal Muscle Imbalance 243
  The Postsurgical Patient 244
  The Geriatric Voice 244
  Vocal Function Exercises (VFE) 245
  Resonant Voice Therapy (RVT) 249
  Accent Method of Voice Therapy 254
  Lee Silverman Voice Treatment (LSVT) 257
Team Management of Specific Laryngeal Pathologies 258
  Vocal Fold Cover Lesions 258
  Laryngopharyngeal Reflux (LPR) and Gastroesophageal Reflux Disease (GERD) 259
  Unilateral Vocal Fold Paralysis 261
  Spasmodic Dysphonia 267
Successful Voice Therapy 270
References 272
Appendix 7–A. Phrases and Sentences Graduated in Length 280

The Professional Voice 299
  Overview 299
  The Professional Voice User 300
  History 300
  The “At-Risk” Status 302
  Professional Roles 303
    The Otolaryngologist 304
    The Voice Pathologist 304
    The Producer 306
    The Agent of Manager 306
  Clinical Pathways 307
    Otolaryngology-Voice Pathology-Voice Pedagogy 307
    Voice Pedagogy-Otolaryngologist-Voice Pathology 308
    Voice Pedagogy-Voice Pathology-Otolaryngology 308
    Otolaryngology-Voice Pedagogy 308
    Voice Pathologist-Voice Pedagogy 308
Clinical Voice Pathology: Theory and Management

- Common Etiologic Factors 309
  - Personality Factors 309
  - Phonotrauma 309
  - Drugs 311
  - Hydration 312
- Common Pathologies 312
  - Acute and Chronic Noninfectious Laryngitis 313
  - Vocal Nodules 314
  - Contact Ulcers and Granulomas 315
  - Gastroesophageal Reflux Disease (GERD)/Laryngoesophageal Reflux (LPR) 315
  - Voice Fatigue 317
  - Vocal Fold Hemorrhage and Vascular Pathologies 318
- Supportive Training and Techniques 320
  - Alexander Technique 320
  - The Linklater Method 321
  - The Feldenkrais Method® 321
  - The Lessac System 322
  - Estill Voice Training™ 323
- Summary 323
- Glossary of Terms Used in Singing 323
- References 324

Rehabilitation of the Laryngectomized Patient 327

- Overview 327
- Incidence of Laryngeal Cancer 327
- Etiology 328
- Symptoms of Laryngeal Cancer 328
- Medical Evaluation 330
- Staging and TNM Classification 331
- Lymph Node Distribution 334
- Treatment Options 336
  - Conservation 336
  - Combined Treatments 336
  - Radiation Therapy 337
  - Surgery 338
  - Concurrent Chemoradiotherapy 339
  - Methods of Reconstruction 342
  - Myocutaneous Flaps 343
  - Free Flaps 343
  - Jejunal Free Flap 343
  - Gastric Pull-Up 343
  - Need for Follow-Up Treatment 344
Multidisciplinary Rehabilitation Team 344
Special Concerns of the Laryngectomized Patient 348
  Communication 348
  Physical Concerns 349
Speech Rehabilitation 359
  Artificial Larynges 359
  Esophageal Speech 365
  Surgical Prosthetics 370
Role of the Speech-Language Pathologist and Surgical Prosthetics 374
  Patient Evaluation 374
  Patient Fitting 376
  Independent Care 379
  Maximizing Communication 382
  Hands-Free Speaking Valve 382
Summary 384
Helpful Web Sites on Head and Neck Cancers 384
References 384

Index 393
Preface

Our many years of clinical work have brought each of us great enjoyment and challenge. We have been privileged to work with a vast range of individuals with voice disorders in multiple settings, including clinics, hospitals, private practice, and university training departments. This unique and eclectic population encompasses preschool through elderly ages and represents etiologies arising from medical, environmental, social, psychological, occupational, and even idiopathic threats to vocal health. Our clients may be typical voice users, occupational voice users, elite vocal performers, individuals with head and neck cancer, and any others who have lost the ability to communicate competently and confidently due to detrimental voice changes. Regardless the onset and course of his or her disorder, each patient provides us with a unique diagnostic dilemma: How do we best return the voice to optimal condition?

To answer these questions, voice pathologists must apply knowledge of anatomy and physiology, etiologic correlates, laryngeal pathologies, and differential diagnosis to conduct an accurate evaluation. Traditional clinical management requires well-developed skills in the interpersonal interview, behavioral observation and modification, and task selection and elicitation. The contemporary voice assessment no longer relies solely on audioperceptual voice quality judgments, but also demands technical expertise in using voice laboratory instruments for acoustic analysis, aerodynamic measures, and laryngeal imaging to help inform the management plan. Finally, we can succeed only when we have educated our patients to understand and self-monitor voice production behaviors independently and accurately.

Indeed, we have the same goal for speech-language pathology students and clinicians who may use this text to study clinical voice pathology or to improve their service to individuals with voice disorders. We seek to organize, explain, and illustrate the comprehensive hierarchy of knowledge necessary to manage voice disorders.

Chapter 1 begins with an entertaining history of voice disorders from its ancient foundations to the present. This information clarifies the role of speech-language pathologists in the care of voice disordered patients and introduces the interdisciplinary background that has permeated our history of successful voice therapy.

A progressive development of essential clinical knowledge areas begins with Chapter 2, the anatomy and physiology of voice production. Understanding the structure and function of the laryngeal mechanism is an essential basis for evaluating phonatory function, examining the larynx and vocal folds, and recognizing the impact of abnormal changes or adaptations on voice production. This fourth edition presents entirely new artwork to enhance the written descriptions of the three subsystems of voice: respiration, phonation, and resonance. This edition also expands
the discussion of vocal fold histology and DNA microarray gene expression analysis.

Chapter 3 provides a thorough update on the etiologies of voice disorders by discussing the common factors associated with the cause and maintenance of voice disorders, to understand best options for treatment planning. These etiologies include misuse, medically related factors, primary disorders, and personality-related influences. Chapter 4 presents the pathologies of the laryngeal mechanism, organized according to the Classification Manual for Voice Disorders-I developed by Special Interest Division 3 (Voice and Voice Disorders) of the American Speech-Language-Hearing Association (2006). The pathologies are presented in eight major groups: (1) structural pathologies; (2) inflammatory conditions; (3) trauma or injury; (4) systemic conditions affecting voice; (5) aerodigestive conditions affecting voice; (6) psychiatric or psychological disorders affecting voice; (7) peripheral neurologic disorders affecting voice; and; (8) other disorders of voice. The text illustrates many of the pathologies with color plates.

Chapters 5 and 6 discuss the objectives and procedures of a systematic diagnostic voice evaluation. Chapter 5 introduces traditional evaluation techniques, including the patient interview, audioperceptual judgments, patient self-assessment, determining the cause(s) and maintaining factor(s) of the voice disorder, and educating the patient about these findings to establish a collaborative management plan based on these clinical data. Chapter 6 provides a state-of-the-art overview of the instrumental measures that comprise a comprehensive voice assessment, including the scientific principles that underlie their development, application, and interpretation. In addition to standard measures of acoustics, aerodynamics, electromyography, and stroboscopy, this edition explains the utility of high-speed digital imaging and videokymography tools. The appendix includes instrumental measurement norms and a helpful glossary of terms.

Knowledge of anatomy and physiology, pathologies, etiologies, and the diagnostic process have prepared the reader for Chapter 7, which explores an array of voice therapy approaches following the orientations of hygienic, symptomatic, psychogenic, physiologic, and eclectic treatments. Using frequent patient cases to illustrate major insights about voice treatment that we have each gathered from our 30-plus years of clinical experience, we orient the reader to the theories, selection criteria, and clinical methods for specific voice management principles. This treatment framework is appropriate for common, yet diverse, complaints due to nodules, laryngopharyngeal reflux, paralysis, and vocal fold dysfunction, as well as infrequent disorders such as papilloma, mutational falsetto, and transgendered voice. Finally, we highlight the current clinical evidence that either supports or refutes popular treatments used in voice therapy.

Because of the exceptional concerns of voice performers, Chapter 8 introduces the factors that influence clinical management approaches for this artistic population, such as personalities, temperament, performance routines and schedule, and other special considerations needed for their care and treatment. The chapter defines the roles of their expanded interdisciplinary team, and identifies the affiliated organizations that represent and support voice performers. In addition to traditional
voice therapy considerations, the chapter also discusses nontraditional alternative treatments that are popular with this population.

Chapter 9, Rehabilitation of the Laryngectomized Patient, serves as a stand-alone manual on the management of this special patient population. This chapter reflects the current “best practice” in voice rehabilitation or restoration in head and neck cancer patients. By outlining the complementary roles of the interdisciplinary treatment team, we understand the multiple management goals: cure the disease; select optimal communication methods; ensure safe swallowing; and address any associated physical, social, and emotional changes that affect each patient. The chapter also contains photographs of the latest communication and airway management devices currently on the market.

Over the past four decades, our chosen specialty of clinical voice pathology has expanded greatly within the field of communication disorders. Nonetheless, this fourth edition of our text retains its original purpose: to provide students and clinicians with a strong foundation of basic voice science infused with a deep clinical understanding of the best methods for assessing and treating voice disorders. As we prepared this edition, we challenged ourselves to revise every chapter thoroughly, by referencing the latest relevant published research, infusing clinical treatment evidence, and sharing lessons learned from our ever broadening experience, whenever possible. The effort was both illuminating and rewarding. Consequently, we hope that you, the reader, will find this text clear, informative, and a worthwhile addition to your professional library.

As always, text development and editing requires the expertise of numerous contributors. We remain deeply indebted to Sadanand and Angie Singh, who have commended our work and inspired our revisions for many years. We also thank Stephanie Meissner, Judy Meyer, and Lauren Naransky for their assistance on this edition as well as Sandy Doyle who has been our tireless and talented editor for three editions of this text. We also wish to acknowledge the new artistic illustrations completed by Susan Boeckmann, whose clear eye, careful hand, and steady pen brought features of laryngeal structure to life. Finally, we would be remiss in not thanking the many patients who have taught us so much about voice disorders.

Joseph C. Stemple, Leslie E. Glaze, and Bernice Klaben