



PREFACE

Assessment of Middle Ear Function Using Wideband Acoustic Immittance: Current Practices and Future Prospects

Acoustic immittance tests have been used in clinical practice for the assessment of middle ear function since the 1960s. In the following decades, single-frequency admittance tympanometry has become a staple test of middle ear function in routine audiological practice, and to a lesser extent, multifrequency tympanometry. The acoustic properties of middle ear are best understood through physiological assays of its gain spectrum, tested over a wide range of frequencies; i.e., the middle ear transfer function. Yet, clinical assessment with multifrequency tympanometry has been limited to frequencies below 2000 Hz. Thanks to advances in probe characterization techniques, measurements of impedance at frequencies beyond 2,000 Hz have become possible. These advances ushered in a new frontier for acoustic immittance research and paved the way for a host of new wideband acoustic immittance (WAI) measures that promised improved clinical assessments through better approximation of the transfer function and acoustic mechanics of the middle ear. Translational and clinical research further developed and refined WAI for clinical use through establishment of clinical norms, emergence of data in ears with conduc-

tive disorders, and demonstrated improvements in test accuracy of WAI over single-frequency tympanometry for a variety of clinical populations. Together with emergence of commercially available systems, since the mid-2000s, these developments signal the emergence of WAI testing as a standard audiological tool for the assessment of the middle-ear function. Although clinical adoption of this promising diagnostic technology is lagging, widespread adoption is expected with further refinement of WAI measures, and as updated clinical practice guidelines recommend the incorporation of WAI testing into clinical test batteries (e.g., JCIH, 2019).¹

The primary objective of this *Seminars in Hearing* issue on WAI is to provide hearing health care professionals with a resource that makes accessible concepts of scientific/theoretical nature, and to present ways in which WAI can be used clinically at present and looking into the future. To this end, a group of experts were invited to contribute review articles, original research findings, and original real-life clinical case studies in which WAI testing improved clinical outcomes. In July 2021, the guest editor in coordination with the editor-in-chief,

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Dr. Catherine Palmer, organized and virtually hosted the *Seminars in Hearing Workshop on Wideband Acoustic Immittance*. As the convener for this meeting, I made the decision to not invite colleagues who are affiliates of entities with commercial interests in any WAI systems or products. This was to remove any conflict of interest that would bear on the point of views or content of this issue's titles. In preparation for the workshop, and through a series of one-on-one meetings, I discussed with the invited authors suggested topics that best matched their interests and expertise. Efforts to coordinate collaborations were based on expertise, so that, whenever possible, authors with scientific/research expertise on WAI were matched together with experienced clinicians who have implemented WAI in their practice.

Ten participating authors convened at this workshop meeting, to determine the topics and objectives and to coordinate a congruent and clinically oriented special issue. Following opening remarks by the editorship of the journal, lead authors presented on relevant topics starting with a presentation by Dr. Joseph Kei (Hearing Research Unit for Children, School of Health and Rehabilitation Sciences, University of Queensland, Queensland, Australia) on fundamental principles and analysis of WAI. This was followed by two presentations by Dr. Navid Shanaz (School of Audiology and Speech Sciences at the University of British Columbia, Vancouver, Canada): first, a historical account on the rise and fall of different procedures for the assessment of the middle ear function and, second, on the use of WAI in pediatric assessment of middle ear function. Next, Dr. Sreedevi Aithal (Hearing Research Unit for Children, School of Health and Rehabilitative Sciences, The University of Queensland, Queensland, Australia) presented on WAI applications in newborns and infants. Dr. Chris Sanford (Department of Communication Sciences and Disorders, Idaho State University, Pocatello, Idaho) presented on the diagnostic benefits of WAI measures and their correlation with audiologic and otologic findings. Lastly, Dr. Patrick Feeney (VA Portland Health Care System, National Center for Rehabilitative

Auditory Research, Portland, Oregon) presented on the use of wideband acoustic reflex thresholds in the assessment of sensorineural hearing loss. The workshop concluded with two panel discussions that were led by Drs. Navid Shahnaz, Chris Sanford, and Hammam AlMakadma, wherein participants determined the title of the issue and outlined the framework for collaboration among authors. Authors agreed to use the terminology recommended in the "*Consensus Statement: Eriks-holm Workshop on Wideband Absorbance Measures of the Middle Ear*" in the titles of this issue.²

This collaboration culminated in six titles spanning from fundamental concepts to a wide range of clinical applications of WAI, and in diverse clinical populations. Tests covered in this issue include WAI testing under ambient conditions, wideband tympanometry applications, as well as wideband middle-ear muscle reflex assessments. A concerted effort was made to include one or more of the following features in each title to ensure the topics of this issue are accessible to clinicians: (1) accessible presentation of theoretical concepts, (2) sufficient reference to existing clinical tests/practices is made whenever novel WAI tests/measures are discussed, (3) presentation of holistic clinical case studies, with an upward of 15 cases discussed in this issue. We hope that the readership of this journal will find in this compiled resource both the necessary tools and encouragement to begin incorporating WAI in this clinical practice, and to prepare for a future where this tool becomes a standard test of middle ear function.

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CONFLICT OF INTEREST

None declared.

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ship had no bearing on the content of this edition.

REFERENCES

1. Joint Committee on Infant Hearing. Year 2019 Position Statement: principles and guidelines for early hearing detection and intervention programs. *J Early Hear Detect Interv* 2019;4(02):1–44
2. Feeney MP, Hunter LL, Kei J, et al. Consensus statement: Eriksholm workshop on wideband absorbance measures of the middle ear. *Ear Hear* 2013;34 (Suppl 1):78S–79S

