



**PROGRAM and ABSTRACTS**

**of the**

**AMERICAN  
NEUROTOXICOLOGY SOCIETY**

**53<sup>rd</sup> Annual Spring Meeting**

**April 20-22, 2018**

*CONFERENCE CENTER  
LEVEL TWO  
MARYLAND C*

**Gaylord National Harbor Resort  
National Harbor, MD**

**AMERICAN NEUROLOGY SOCIETY  
2017-2018 EXECUTIVE COUNCIL**

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**CONTINUING MEDICAL EDUCATION CREDIT INFORMATION**

**Accreditation**

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American College of Surgeons and American Neurology Society. The American College of Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

**AMA PRA Category 1 Credits™**

The American College of Surgeons designates this live activity for a maximum of **7.50** AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.



AMERICAN COLLEGE OF SURGEONS  
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AMERICAN COLLEGE OF SURGEONS  
DIVISION OF EDUCATION

## **American Neurotology Society Mission Statement**

**Purpose:** The American Neurotology Society (ANS) is committed to improving public health care through the provision of high-quality continuing medical education (CME) to our members. The overall goal of the ANS Continuing Medical Education program is to provide CME activities that will address the knowledge gaps and enhance the clinical competence of the participants. The ANS is dedicated to improving public health care through the development, dialogue and dissemination of advances in evidence-based diagnosis and management of neurotologic and related skull base disorders. The focus on the scientific advances in these combined fields is translated into approaches to quality care that are consistent with ACGME/ ABMS general competency areas and the Institute of Medicine recommendations.

**Target Audience:** The primary target audience includes members of both the American Neurotology Society and our sister Society, the American Otological Society as well as healthcare professionals in the fields of otology, otolaryngology neurotology and skull base research and healthcare. The members served include physicians, otologists, neurotologists, residents, fellows, researchers, nurses, occupational and speech therapists and other healthcare professionals who are involved in the care of patients with otologic and neurotologic conditions.

**Types of Activities Provided:** In order to accomplish the goals of the ANS CME program, the Education committee will offer a range of activities with specific educational outcomes in mind. Current offerings include:

- Scientific symposia, delivered twice per year at national venues, showcasing the latest research in the field and featuring national and international experts on related clinical topics.
- Study groups & mini-seminars offered at the annual meeting of the American Academy of Otolaryngology- Head and Neck Surgery.
- Facilitation of manuscript submission on presented materials for publication in a peer reviewed journal (Otology & Neurotology).
- The Otology & Neurotology Journal provides an additional vehicle for further collaboration and dissemination of new information, science and standards of care.

**Content:** The content of the ANS CME program centers on clinical issues related to Neurotology and disorders of the skull base. The ANS also strives to respond to our members' educational needs that are not being met by other organizations, and therefore also offers activities in the areas of risk management, patient safety, physician-patient communications, coding, HIPAA compliance, and other regulatory issues as they relate to Neurotology. The educational efforts will also highlight the ACGME/ABMS general competencies within the context of this field and relate the significance of communication, professionalism, patient safety and systems-based practice within these workplace environments.

**Expected Results:** The CME program of the ANS strives to enhance the participants' knowledge and clinical competence in subject areas relevant to the field of Neurotology. The other expected outcome from this CME program is continued development of new evidence-based science, dissemination of ongoing research in the clinical area of Neurotology.

### **ANS Continuing Medical Education Planning Process**

Practice gaps in Neurotology are identified through polling the ANS membership at the close of each CME activity by way of an exit evaluation at the close of the activity. The responses of the membership are discussed in meetings of the ANS Education Committee, ANS Executive Council and Scientific Program Committee. The evaluation is used as a tool to determine the success of the CME program in meeting program objectives, addressing professional practice gaps and educational needs. The responses are peer reviewed by the ANS Education Committee and the ANS Executive Council prior to the next meeting to assist the Education & Program Committee in developing future ANS Continuing Education programs. The educational program is designed to address the topics identified as practice gaps through individual presentations and in depth panel discussions.

**Based on the responses from the 2017 evaluations and follow up questionnaires, the following data regarding professional practice gaps among attendees were noted:**

- There is inconsistent knowledge regarding the use of imaging in the field of cochlear implantation.
- There is inconsistent knowledge regarding the potential indications and status of the research in the field.

- There remains inconsistent knowledge regarding the diagnosis and management of Meniere's disease and migraine-related vertigo in the field.
- There is inconsistent knowledge of the evolution of the field of neurotology and what the future might bring.
- There is inconsistent knowledge of what constitutes state of the art therapy for congenital aural atresia and what options produce the best results.

**To close the identified practice gaps, participants of this activity will need to learn:**

- Physician should have a broad understanding of the application and utility of imaging as a technology to improve cochlear implant patient performance
- Physicians should be aware of the potential for gene therapy to change the diagnostic and therapeutic paradigm in neurotology. Specific details such as possible indications, current state of the art and possible time frame for the implementation of such approaches in the field of neurotology should be known.
- Physicians should understand the differentiation (and overlap) between vertigo related to Meniere's disease and migraine and understand the application of the different therapies needed to effectively management these patients.
- Physicians and trainees should understand the evolution of the field of neurotology and what the future of the field might look like.
- Physicians should understand the various options and outcomes of the various therapies for patients with congenital aural atresia.

**Learning Objective(s) - At the end of this activity, participants will be able to:**

- Describe in detail the current availability, application and utility, and complex analysis algorithms needed amongst the various imaging modalities being used in the field of cochlear implantation with a focus on improved patient performance.
- Describe the various disorders potentially amenable to gene therapy with a comprehensive description of the status of the current research, potential implementation timelines, and alternatives that need to be considered.
- Describe and discuss the broad accomplishments in the field of neurotology and speculate, in the background of current medical science and practice, what the future of the field might look like.
- Discuss the differentiation between clinical presentations and application of the various treatment options in patients with either Meniere's disease or migraine-related dizziness.
- Compare the various treatment options for patients with congenital aural atresia and propose rationale management paradigms that optimize outcomes while minimizing complications and potential adverse sequelae.

**How will this educational activity improve competence, practice performance, and patient outcomes?**

- This activity will improve competence of physicians by providing education and thus, a more thorough understanding of the scientific advances and the potential evolving imaging modalities and implementation for patients undergoing cochlear implantation. Detailed information on current and emerging protocols for intraoperative and postoperative imaging in cochlear implantation will be presented with an emphasis on optimizing patient outcomes.
- This activity will improve competence by providing physicians education the current status and potential impact that gene therapy could have in the field of neurotology. Specifically, practitioners will be provided with up to date details regarding scientific findings, emerging indications, on-going clinical trials and the timelines for possible implementation of gene therapy. Potential dangers, complications and alternatives will also be presented.
- This activity will improve competence by providing physicians education on the direction of the field of neurotology with some speculation on what its future might look like. Specifically, the presentations will provide an overview of the medical and surgical advancements in the field and how the practice of neurotology might look given scientific advancements and clinical challenges today.
- This activity will improve the competence of physicians by providing education on the differentiating characteristic and various treatment options available for patients with Meniere's disease and migraine-related dizziness.
- This activity will improve the competence of physicians by providing education on the various treatment options and outcomes available for patients with congenital aural atresia.

**Position Statement:** Any presentations, conversations, exhibits, or other meeting communications, including descriptions of the use of drugs or devices, does not imply or constitute endorsement of any company, product, application, or use by the American Neurotology Society.

The following statement was read, submitted, and signed by every individual connected with this educational activity. Failure to comply disqualifies the individual from planning or speaking at any ANS Continuing Medical Education program.

### **Disclosure Information**

In compliance with the ACCME Accreditation Criteria, the American College of Surgeons, as the accredited provider of this activity, must ensure that anyone in a position to control the content of the educational activity has disclosed all relevant financial relationships with any commercial interest. All reported conflicts are managed by a designated official to ensure a bias-free presentation.

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons, as the accredited provider of this activity, must ensure that anyone in a position to control the content of the educational activity has disclosed all relevant financial relationships with any commercial interest. Therefore, it is mandatory that both the program planning committee and speakers complete disclosure forms. Members of the program committee were required to disclose all financial relationships and speakers were required to disclose any financial relationship as it pertains to the content of the presentations. The ACCME defines a 'commercial interest' as "any entity producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients". It does not consider providers of clinical service directly to patients to be commercial interests. The ACCME considers "relevant" financial relationships as financial transactions (in any amount) that may create a conflict of interest and occur within the 12 months preceding the time that the individual is being asked to assume a role controlling content of the educational activity.

ANS is also required, through our joint providership partners, to manage any reported conflict and eliminate the potential for bias during the activity. All program committee members and speakers were contacted and the conflicts listed below have been managed to our satisfaction. However, if you perceive a bias during a session, please report the circumstances on the session evaluation form.

Please note we have advised the speakers that it is their responsibility to disclose at the start of their presentation if they will be describing the use of a device, product, or drug that is not FDA approved or the off-label use of an approved device, product, or drug or unapproved usage.

The requirement for disclosure is not intended to imply any impropriety of such relationships, but simply to identify such relationships through full disclosure and to allow the audience to form its own judgments regarding the presentation.

### **PUBLICATION STATEMENT**

The material in this abstract, has not been submitted for publication, published, nor presented previously at another national or international meeting and is not under any consideration for presentation at another national or international meeting. The penalty for duplicate presentation/publication is prohibition of the author and co - authors from presenting at a COSM society meeting for a period of three years. Submitting Author's Signature (required)

All authors were advised that the submitted paper becomes the property of Otology & Neurotology and cannot be reprinted without permission of the Journal.

**THE AMERICAN NEUROTOLOGY SOCIETY WOULD LIKE TO THANK THE FOLLOWING MEMBERS  
FOR THEIR CONTRIBUTION TO THE 2018 ANS SCIENTIFIC PROGRAM**

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*John P. Leonetti, MD*  
(Coordinator-Facial Nerve Study Group)

**Poster Judges**

*Nancy Young, MD*  
*Soha N. Ghossaini, MD*  
*Ronna Hertzano, MD*  
*Jennifer Maw, MD*

**Combined Poster Reception ANS, AOS, ASPO, TRIO**

Friday, April 20, 2018

5:30 pm – 7:00 pm

*Prince George's Exhibit Hall A*

**ANS WIN Reception (Women in Neurotology)**

Friday, April 20, 2018

6:00 – 7:00

*Chesapeake DE*

**ANS President's Reception** (*members and invited guests only*)

Friday, April 20, 2018

7:00 – 8:30

*National Harbor 4-5*

**UPCOMING MEETINGS**

**ANS “Super Saturday”**

*(ANS registration open July 2nd)*

Saturday October 6th, 2018

Atlanta Omni CNN Hotel - Atlanta, GA

AAO-HNSF Annual Meeting & OTO EXPO

October 7-10, 2018 Atlanta Omni CNN Hotel - Atlanta, GA

54th ANS Spring Meeting (in conjunction with COSM)

May 3-4, 2019 - JW Marriott Austin - Austin, Texas

**The Abstract deadline for the ANS 54<sup>th</sup> Annual Spring meeting is Monday, October 15, 2018.**

Abstract Instructions and submission form will be available on website in July.

Website - [www.americanneurotologysociety.com](http://www.americanneurotologysociety.com)

All primary and contributing authors are required to complete a disclosure/conflict of interest statement at time of abstract submission in order for the abstract to be considered by the Scientific Program Committee.

**Journal Requirements/Instructions to Primary Authors**

Manuscripts are required of ALL ORAL AND POSTER presentations. Manuscripts must be submitted online a minimum of four weeks prior to the annual meeting, via the journal's website. Instructions for registering, submitting a manuscript, and the author guidelines can be found on the Editorial Manager site:

<https://www.editorialmanager.com/on/>

The journal of OTOLOGY & NEUROTOLOGY does not accept paper manuscripts. Manuscripts will be peer reviewed prior to the Annual meeting for conflict of interest review and resolution.

Failure to comply with the guidelines & requirements of the American Neurotology Society and the O&N Journal will result in the disqualification of your presentation.

For Society business, please forward all inquiries to:

**Kristen Bordignon, Executive Administrator**

**Ashley Eikenberry, ANS Co-Administrator**

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**AMERICAN NEUROTOLOGY SOCIETY**  
*53rd Annual Meeting*  
**PRELIMINARY PROGRAM**  
*April 20-22, 2018*  
**Gaylord National Harbor Resort**  
*National Harbor, MD*

**SATURDAY, APRIL 21, 2018**

**1:00 BUSINESS MEETING** (*New member introduction*)  
(*Members Only*)

**1:20 SCIENTIFIC PROGRAM**  
(*Open to registered Members and Non-members – Badge required for admittance*)  
**Welcome & Opening Remarks by the President**  
*Moises A. Arriaga, MD*

**1:23 PRESIDENTIAL CITATIONS**  
*Derald E. Brackmann, MD*  
*Donald B. Kamerer, MD*  
*Antonio De la Cruz, MD*  
*Fred D. Owens, MD*

**1:33 WILLIAM F. HOUSE MEMORIAL LECTURE**  
**How We Can (and should!) Use Imaging to Improve Cochlear Implantation**  
*Robert F. Labadie, MD, PhD, MMHC*

**2:03 INTRODUCTION - Skull Base Surgery and NF-2**  
*Yu-Lan Mary Ying, MD, Moderator*

**2:05 Incidence and Risk Factors for Sigmoid Venous Thrombosis Following CPA Tumor Resection**  
*Hannah L. Kavookjian, MD*  
*Matthew A. Shew, MD*  
*Thomas J. Muelleman, MD*  
*Kelly Dahlstrom, DO*  
*James Lin, MD*  
*Luke N. Ledbetter, MD*  
*Hinrich Staecker, MD, PhD*

**2:12 Audiometric and Radiologic Correlates to Auditory Brainstem Response in Treatment-Naïve Small Volume Cochleovestibular Schwannomas in Neurofibromatosis Type 2**  
*Alvin T. deTorres, MD*  
*Carmen C. Brewer, PhD*  
*Chris K. Zalewski, PhD*  
*Kelly A. King, PhD*  
*Robert Walker, BS*  
*Prashant Chittiboina, MD, MPH*  
*H. Jeffrey Kim, MD*

**2:19 Lateral Skull Base Density and Its Relation to Patients with Obesity and CSF Leaks**  
*Jonathan L. Hatch, MD*



*Heather K. Schopper, BS*  
*Isabel Boersma, BS*  
*Habib G. Rizk, MD*  
*Paul R. Lambert, MD*  
*Theodore R. McRackan, MD, MSCR*  
*Ted A. Meyer, MD, PhD*

**2:26 Contribution of Genomic Large Structural Variations to NF2 Tumorigenesis**

*Daniel S. Roberts, MD, PhD*  
*Yuka Takemon*  
*Jeremie Vitte, PhD*  
*William H. Slattery, MD*  
*Marc S. Schwartz, MD*  
*Marco Giovannini, MD, PhD*  
*Chia-Lin Wei, PhD*

**2:33 DISCUSSION**

**2:35 ANS INCLUSION & DIVERSITY INITIATIVE**

*Elizabeth Toh, MD, MBA*

**2:45 BREAK WITH EXHIBITORS**

**3:15 INTRODUCTION - Cochlear Implantation**

*R. Mark Wiet, MD, Moderator*

**3:17 Evaluation of Outcome Variability Associated with Lateral Wall, Mid-Scalar, and Perimodiolar Electrode Arrays When Controlling for Pre-Operative Patient Characteristics**

*Joshua E. Fabie, BS*  
*Robert G. Keller, MD*  
*Jonathan L. Hatch, MD*  
*Ted A. Meyer, MD, PhD*  
*Shaun A. Nguyen, MD*  
*Paul R. Lambert, MD*  
*Theodore R. McRackan, MD, MSCR*

**3:24 Intra-Cochlear Electrocochleography during CI Electrode Insertion is Predictive of Final Scalar Location**

*Kanthaiah Koka, PhD*  
*Jourdan Holder, AuD*  
*Robert Dwyer, AuD*  
*Jack Noble, PhD*  
*Oliver F. Adunka, MD*  
*Craig A. Buchman, MD*  
*Robert F. Labadie, MD, PhD*

**3:31 TRAINEE AWARD**

**Intraoperative Evoked Compound Action Potential (ECAP) Levels in Hearing Preservation Cochlear Implantation**

*Ashley M. Nassiri, MD, MBA*  
*Robert J. Yawn, MD*  
*Jillian B. Roberts, BHS*

*Max S. Gilbane, BA*  
*Jack Murfee, BA*  
*Rene H. Gifford, PhD*  
*Marc L. Bennett, MD, MMHC*

**3:38 Creation of a Formula to Convert between Consonant-Nucleus-Consonant (CNCw) and AzBio Test Scores Using Imputation in a National Cochlear Implant Database**

*Rahul K. Sharma, BS*  
*Jedidiah J. Grisel, MD*  
*Justin S. Golub, MD, MS*

**3:45 Hearing Preservation Surgery in Cochlear Implantation: Factors Associated with Improved Outcomes in a Single Center**

*Alexander Malone, MD*  
*Kevin Wang, MD*  
*Nicholas Pritchard, MD*  
*Loren Bartels, MD*  
*Kyle Allen, MD, MPH*  
*Michelle Blanchard, AuD*  
*Christopher Danner, MD*

**3:52 DISCUSSION**

**3:56 INTRODUCTION of INVITED PRESENTATION**

*Moises A. Arriaga, MD*

**3:58 Genetic Therapy for Hearing Loss**

*Lawrence R. Lustig, MD*

**4:08 FRED D. OWENS MEMORIAL PANEL  
Vertigo Treatment: Meniere's, Migraine, and Both**

*Derald E. Brackmann, MD – Moderator*  
*Carol A. Bauer, MD*  
*Sujana S. Chandrasekhar, MD*  
*M. Jennifer Derebery, MD*

**5:00 ADJOURNMENT**

**SUNDAY, APRIL 22, 2018**

**7:00 BUSINESS MEETING - Treasurer/O&N/Committee Reports  
(Members Only)**

**7:20 SCIENTIFIC PROGRAM**

*(Open to registered Members and Non-members – Badge required for admittance)*  
**Welcome & Opening Remarks by the President**  
*Moises A. Arriaga, MD*

**7:22 INTRODUCTION - Vestibular Advances and Education**

*Matthew L. Bush, MD, PhD, Moderator*

- 7:24 Unique Clinical Language Patterns among Expert Vestibular Providers Can Predict Vestibular Diagnoses**  
*Jake Luo, PhD*  
*Christy Erbe, MA*  
*David R. Friedland, MD, PhD (presenter)*
- 7:31 Vestibular Testing: Patient Perceptions, Morbidity, and Opportunity Costs**  
*Elizabeth A. Kelly, MD*  
*Carly M. Kempton, AuD*  
*Catherine D. Stocker, AuD*  
*Darcia M. Dierking, AuD*  
*Hannah E. Fehlberg, AuD*  
*Meredith E. Adams, MD*
- 7:38 Mouse Magnetic-field Nystagmus in Strong Static Magnetic Fields is Dependent on the Presence of Nox3**  
*Bryan K. Ward, MD*  
*Yoon Lee*  
*Dale C. Roberts, MA*  
*Ethan Naylor, MA*  
*Americo A. Migliaccio, PhD*  
*Charles C. Della Santina, MD, PhD*
- 7:45 Comparison of Failure Rates for Intratympanic Dexamethasone and Gentamicin in Meniere's Disease**  
*James G. Naples, MD*  
*Jason A. Brant, MD*  
*Steven J. Eliades, MD, PhD*  
*Michael J. Ruckenstein, MD*
- 7:52 NICHOLAS TOROK VESTIBULAR AWARD**  
**Lateral Semi-Circular Canal Pressures during Cochlear Implant Electrode Insertion: A Possible Mechanism for Postoperative Vestibular Loss**  
*Renee M. Banakis Hartl, MD, AuD*  
*Nathaniel T. Greene, PhD*  
*Herman A. Jenkins, MD*  
*Stephen P. Cass, MD, MPH*  
*Daniel J. Tollin, PhD*
- 7:59 DISCUSSION**
- 8:02 PANEL - ELECTRONIC MEDICAL RECORDS AND NEUROTOLOGY**  
*Yuri Agrawal, MD, MPH - Co-Moderator*  
*Neil A. Giddings, MD - Co-Moderator*  
*Yu-Lan Mary Ying, MD*  
*Heather M. Weinreich, MD, MPH*  
*David R. Friedland, MD, PhD*  
*Meena Seshamani, MD, PhD*
- 8:47 INTRODUCTION - Sudden hearing loss, Noise, and Eustachian Tube**  
*Benjamin T. Crane, MD, PhD, Moderator*
- 8:48 The Role of Hyperbaric Oxygen Therapy for Idiopathic Sudden Sensorineural Hearing Loss**

*Galit Almosnino, MD*  
*James R. Holm, MD*  
*Seth R. Schwartz, MD, MPH*  
*Daniel M. Zeitler, MD*

**8:55 Noise-Induced Trauma Produces a Temporal Pattern of Change in Serum Levels of the Outer Hair Cell Biomarker Prestin**

*Kourosh Parham, MD, PhD*  
*Maheep Sohal, MD*  
*Mathieu Petremann, MS*  
*Christophe Tran Van Ba, MS*  
*Charlotte Romanet, MS*  
*Audrey Broussy, MS*  
*Jonas Dyhrfjeld-Johnsen, PhD*

**9:02 NEUROTOLOGY FELLOW AWARD**

**Is Eustachian Tuboplasty Anatomically Safe in Children? A Histopathologic Comparison between Pediatric and Adult Temporal Bones**

*Kathryn Y. Noonan, MD*  
*Fred H. Linthicum, MD*  
*Mia E. Miller, MD*

**9:09 DISCUSSION**

**9:12 WILLIAM E. HITSELBERGER MEMORIAL LECTURE**

**The Future of Otology/Neurotology**  
*Robert K. Jackler, MD*

**9:42 BREAK** (*no exhibitors*)

**10:02 INTRODUCTION - Acoustic Neuroma (Vestibular Schwannoma)**

*Miriam I. Redleaf, MD, Moderator*

**10:04 Factors Associated with Maintaining Serviceable Hearing in Conservatively Managed Vestibular Schwannoma Patients**

*Jacob B. Hunter, MD*  
*Brendan P. O'Connell, MD*  
*Marc L. Bennett, MD*  
*Alejandro Rivas, MD*  
*George B. Wanna, MD*  
*Reid C. Thompson, MD*  
*David S. Haynes, MD*

**10:11 Quality of Life in Sporadic Vestibular Schwannoma: A Cross-sectional Survey of 1,288 Patients Using a Disease-Specific Inventory**

*Matthew L. Carlson, MD*  
*Nicole M. Tombers, RN*  
*Panagiotis Kerezoudis, PhD*  
*Maria Peris Celda, MD, PhD*  
*Christine M. Lohse, MS*  
*Michael J. Link, MD*

**10:18 Does a “Fundal Fluid” Cap Predict Successful Hearing Preservation in Vestibular Schwannoma Resections via the Middle Cranial Fossa Approach?**

*Daniel Q. Sun MD*

*Raymond W. Kung MD*

*Marlan R. Hansen MD*

*Bruce J. Gantz, MD*

**10:25 Shared Decision Making and Decisional Conflict in the Management of Vestibular Schwannoma**

*M. Elise Graham, MD*

*Brian D. Westerberg, MD, MHSc*

*Jane Lea, MD*

*Paul Hong, MD, MSc*

*Simon Walling, MBCHB*

*Andrea L.O. Hebb, MSc, PhD, RN*

*Manohar Bance, MB, MSc*

**10:32 Factors That Affect Length of Hospital Stay after Vestibular Schwannoma Surgery**

*Nopawan Vorasubin, MD*

*Thomas H. Alexander, MD, MHSc*

*Bill Mastrodimos, MD*

*Roberto A. Cueva, MD*

**10:39 DISCUSSION**

**10:42 INTRODUCTION - Experimental Advances and Neurotology Education**

*Michael Hoa, MD, Moderator*

**10:44 Individualized Learning Plan (ILP) is an Effective Tool in Assessing Achievement of Otology-related Subcompetency Milestones**

*Maja Svrakic, MD*

**10:51 The Clinical Stage Otoprotectant SENS-401 Effectively Reduces Hearing Loss in Rats When Administered up to 96 hours after Severe Acoustic Trauma**

*Mathieu Petremann, MS*

*Charlotte Romanet, MS*

*Christophe Tran Van Ba, MS*

*Audrey Broussy, MS*

*Jonas Dyhrfeld-Johnsen, PhD*

**10:58 Anatomical Progression of Otosclerosis Analyzed by High Resolution CT on Surgically Confirmed Patients**

*Chihiro Yagi, MD*

*Yuka Morita, MD, PhD*

*Kuniyuki Takahashi, MD, PhD*

*Manabu Ogi, MD*

*Shinsuke Oshima, MD, PhD*

*Yutaka Yamamoto, MD, PhD*

*Arata Horii, MD, PhD*

**11:05 NEUROTOLOGY FELLOW AWARD**

**Fluorescent Detection of Merlin-Deficient Schwann Cells and Primary Human Vestibular Schwannoma Cells Using Sodium Fluorescein**

*Enrique Perez, MD*  
*Olena Bracho, BS*  
*Paula Monje, PhD*  
*Cristina Fernandez, PhD*  
*Fred T. Telischi, MD*  
*Christine T. Dinh, MD*

**11:12 DISCUSSION**

**11:15 ANTONIO DE LA CRUZ MEMORIAL PANEL**

**Congenital Aural Atresia - State of the Art**

*Simon I. Angeli, MD, Moderator*

*Bradley W. Kesser, MD*

*Vicente G. Diamante, MD*

*Fred F. Telischi, MD*

*Sujana S. Chandrasekhar, MD*

**12:00 CLOSING REMARKS/ADJOURNMENT**

***SELECTED ABSTRACTS***

*IN ORDER OF PRESENTATION*

***ORAL  
PRESENTATIONS***



***53<sup>rd</sup> Annual Spring Meeting  
AMERICAN NEUROTOLOGY SOCIETY***

***April 20-22, 2018  
Gaylord National Resort  
National Harbor, MD***

## **Incidence and Risk Factors for Sigmoid Venous Thrombosis following CPA Tumor Resection**

*Hannah L. Kavookjian, MD; Matthew A. Shew, MD  
Thomas J. Muelleman, MD; Kelly Dahlstrom, DO  
James Lin, MD; Luke N. Ledbetter, MD  
Hinrich Staecker, MD, PhD*

**Objective:** Our primary aim was to determine the incidence of sigmoid venous thrombosis (SVT). Our secondary aim was to determine risks factors and sequelae of SVT following cerebellopontine angle (CPA) tumor resection.

**Study Design:** Retrospective cohort study.

**Setting:** Academic tertiary care hospital.

**Patients:** Patients over 18 years of age who underwent resection of CPA meningioma or vestibular schwannoma from January 2005– April 2016 and had post-operative MRI.

**Intervention(s):** Diagnostic

**Main outcome measure(s):** Incidence of post-operative SVT from official radiology reports was compared to retrospective imaging review by our radiology colleagues. Data collected included age, length of stay (LOS), BMI, surgical approach, and post-operative complications.

**Results:** A total of 127 cases were identified. Official reports significantly underreported the incidence of post-operative SVT compared to retrospective review by Neuroradiologist (n=4 [3.1%] vs n=22 [17.3%];  $p<0.001$ ). There was a statistical trend toward increased risk for thrombosis in patients undergoing translabyrinthine and staged resection ( $p=0.068$ ). CSF leak incidence in patients with thrombosis was significantly increased (n=9 [37.5%] vs n=13[12.6%];  $p=0.007$ ). There was no correlation between SVT and age ( $p=0.788$ ), BMI ( $p=0.686$ ), LOS ( $p=0.733$ ), pre-operative tumor size ( $p=0.555$ ), or increased postoperative ICP ( $p=0.645$ ). Only 1 patient was symptomatic from sigmoid thrombosis compared to 21 who were not.

**Conclusions:** Incidence of SVT is significantly underreported and may predispose patients to increase risk for CSF leak. Staged and translabyrinthine approaches demonstrate an increased trend toward thrombosis risk. Our findings suggest it may not be necessary to treat SVT.

**Define Professional Practice Gap & Educational Need:** Lack of awareness regarding incidence of postoperative sigmoid venous thrombosis following cerebellopontine angle tumor resection, as well as impact of thrombosis on post-operative recovery.

**Learning Objective:** Describe post-operative incidence of sigmoid venous thrombosis following cerebellopontine angle tumor resection. Evaluate risk factors of sigmoid venous thrombosis and impact on post-operative recovery.

**Desired Result: (How will attendees APPLY the knowledge they learned from the presentation):** Improve post-operative patient care following resection of cerebellopontine angle tumors.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4



## **Audiometric and Radiologic Correlates to Auditory Brainstem Response in Treatment-Naïve Small Volume Cochleovestibular Schwannomas in Neurofibromatosis Type 2**

*Alvin T. deTorres, MD; Carmen C. Brewer, PhD  
Chris K. Zalewski, PhD; Kelly A. King, PhD  
Robert Walker, BS; Prashant Chittiboina, MD, MPH  
H. Jeffrey Kim, MD*

**Objective:** To determine the relationship of auditory brainstem response (ABR) changes to hearing loss and tumor growth in patient-ears with small volume ( $<1000\text{mm}^3$ ), treatment-naïve cochleovestibular schwannomas (CVSs) in Neurofibromatosis Type 2 (NF2).

**Study Design:** Prospective, longitudinal cohort study.

**Setting:** Quaternary medical research institute.

**Patients:** 51 NF2 patients (78 ears) with small, treatment-naïve CVSs observed from July 2006 to July 2016.

**Intervention:** Serial ABR, pure tone thresholds, and magnetic resonance imaging (MRI).

**Outcome measures:** Changes in ABR latencies, thresholds at 2 and 4 kHz, 4-frequency pure tone average (0.5, 1, 2, 4 kHz) (4f-PTA), and tumor volume on MRI

**Results:** Mean follow-up was 3.7 years ( $SD$  1.68). Of 78 patient-ears, 40 (51%) experienced a significant change in wave V latency (increase in latency by  $\geq 0.2\text{ms}$ , loss of waveform). Median survival time from enrollment to change was 4.2 years. Analysis of variance demonstrated statistically significant differences ( $p < 0.05$ ) in mean rate of hearing changes at 2kHz (3.5 vs 1.2 dB/year), 4kHz (4.0 vs 0.8 dB/year), and 4-fPTA (3.2 vs 0.77 dB/year) for groups with and without wave V changes, respectively. Statistically significant changes in posterior fossa ( $176.0$  vs  $37.7\text{mm}^3/\text{year}$ ) and total ( $228.4$  vs  $70.2\text{mm}^3/\text{year}$ ) tumor volume growth rates were also found between groups with and without wave V changes. The difference in intracanalicular tumor volume growth rate ( $52.3$  vs  $32.5\text{mm}^3/\text{year}$ ) was not statistically significant between these groups.

**Conclusion:** Changes in ABR may be useful in predicting clinically significant audiometric changes or tumor growth in NF2 patients and help guide clinical decision making.

**Define Professional Practice Gap & Educational Need:** 1) Lack of contemporary knowledge of how auditory brainstem response (ABR) testing in small-volume ( $<1000$  cubic-millimeters), treatment-naïve, vestibular schwannomas in Neurofibromatosis type 2 (NF2) relate to changes in other diagnostic tests such as audiometry and magnetic resonance imaging (MRI).

**Learning Objective:** 1) Discuss the ABR changes seen in small-volume, treatment-naïve, vestibular schwannomas in NF2 during serial follow-up. 2) Relate these findings to changes in pure tone thresholds and tumor volume growth on MRI. 3) Discuss how this information may be used to guide decision making regarding treatment (surgery, radiation, biologic) versus continued observation.

**Desired Result:** Attendees will understand the ABR changes seen in small-volume, treatment-naïve, vestibular schwannomas in NF2 as they relate to audiometric and MRI changes to guide treatment decision making.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Lateral Skull Base Density and Its Relation to Patients with Obesity and CSF Leaks**

*Jonathan L. Hatch MD, Heather K. Schopper BS,  
Isabel Boersma BS, Habib G. Rizk MD  
Paul R. Lambert MD, Theodore R. McRackan MD  
Ted A. Meyer MD, PhD*

**Objectives:** Evaluate temporal bone skull base density and its relation with obesity and spontaneous CSF leaks.

**Study Design:** Blinded retrospective case control series.

**Setting:** Tertiary care university setting.

**Interventions:** A control group consisting of age and gender matched non-obese subjects were compared to obese and CSF leak subjects. Two blinded reviewers measured the density at multiple locations along the tegmen using thin sliced high resolution CT scans. Additional density measurements were obtained from the temporal bone squamosa. The density, as measured with Hounsfield units (HU), was compared between the groups.

**Main outcome measure:** Lateral skull base density in obese and CSF leaks compared to non-obese controls.

**Results:** Sixty-nine (n= 69) subjects were included in the study. The control group (n=21) had an average density along the tegmen of 548 (SD  $\pm$ 309) HU, obese (n=26) and CSF leak groups (n=22) had an average HU of 571 (SD  $\pm$ 215) and 502 (SD $\pm$ 142), respectively (p=0.58). There was no statistically significant difference in the temporal bone squamosa (p=0.52). The correlations of the reviewers ranged from r=0.68 to r=0.88 meaning moderate to strong correlation

**Conclusion:** There appears to be no correlation between the density of the tegmen or squamosa of the temporal bone as it relates to obesity or spontaneous CSF leaks compared to normal weight controls. These findings suggest the bone density does not have a significant role in the development of lateral skull base thinning or dehiscence leading to CSF leaks.

**Define Professional Practice Gap & Educational Need:** There is limited knowledge regarding the density of the temporal bone as it relates to obesity and CSF leaks.

**Learning Objective:** Evaluate temporal bone skull base density and its relation with obesity and spontaneous CSF leaks.

**Desired Result:** Attendees will be able to apply these findings in patients with lateral skull base thinning or CSF leaks.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Contribution of Genomic Large Structural Variations to NF2 Tumorigenesis**

*Daniel S. Roberts, MD, PhD; Yuka Takemon  
Jeremie Vitte, PhD; William H. Slattery, MD  
Marc S. Schwartz, MD; Marco Giovannini, MD, PhD  
Chia-Lin Wei, PhD*

**Hypothesis:** Large structural variants (SVs), as a consequence of genomic instability, predict clinical behavior of vestibular schwannomas (VS) in patients with Neurofibromatosis type-2 (NF2).

**Background:** Comprehensive genetic analysis of NF2-related VS through whole genome-wide sequencing has not been performed. VS in NF2 patients are caused by inactivation or loss of both alleles of the NF2 gene, representing an initiating event in tumor development. This usually involves a combination of single nucleotide variations (SNVs) or deletions, in conjunction with either a second SNV or loss of heterozygosity (LOH). Large SVs occur in genomes associated with malignancies, representing genomic instability and have not been characterized for NF2-associated VS.

**Methods:** From a tissue bank containing 75 VS, DNA was isolated from 10 blood-tumor pairs from the fastest and slowest growing tumors (5 each group,  $p=0.0005$ ). Whole-genome haplotype-specific structural variation analysis was performed using synthetic linked long reads generated through barcoding genomic DNA fragments coupled with high coverage parallel sequencing.

**Results:** Applying specialized SV bioinformatics analysis, all mutations and structural variations were identified. Unique tandem duplications were found harboring potential tumor suppressors associated with the aggressive subtype. NF2 tumor specific SNVs were identified in 9/10 cases indicating possible mechanisms of LOH. Five tumor-specific large SVs were present in one patient with a rapidly growing tumor, including one large 66kb deletion within NF2.

**Conclusions:** For the first time, the genetic landscape of NF2-related VS was investigated through whole genome-wide sequencing. Large SVs appear to be a genetic mechanism of LOH and suggests genomic instability in a subset of these tumors.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of the genetic mechanisms that lead to vestibular schwannomas (VS) in patients with Neurofibromatosis type-2 (NF2).

**Learning Objective:** The objective is to demonstrate the importance of genomic large structural variants to vestibular schwannoma tumorigenesis in patients with NF2.

**Desired Result:** The participant will have a further understanding that large structural variants appear to be a genetic mechanism for vestibular schwannoma tumorigenesis in patients with NF2.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Evaluation of Outcome Variability Associated with Lateral Wall, Mid-Scalar, and Perimodiolar Electrode Arrays When Controlling for Pre-Operative Patient Characteristics**

*Joshua E. Fabie, BS; Robert G. Keller, MD  
Jonathan L. Hatch, MD; Ted A. Meyer, MD, PhD  
Shaun A. Nguyen, MD; Paul R. Lambert, MD  
Theodore R. McRackan, MD*

**Objective:** Determine the impact of electrode array selection on audiometric performance when controlling for baseline patient characteristics.

**Study design:** Retrospective evaluation of a prospective cochlear implant (CI) database (1/1/12-12/31/16).

**Setting:** Tertiary care university hospital

**Patients:** 446 adult CI recipients

**Interventions/main outcomes measured:** Hearing outcomes were measured through unaided/aided pure tone thresholds and speech recognition testing before and after cochlear implantation. All reported post-operative results were performed at least 6 months after CI activation. All device manufacturers were represented.

**Results:** Of the 446 patients, 305 received lateral wall (LW) arrays, 71 received perimodiolar (PM) arrays, and 70 received mid-scalar (MS) arrays. Patients receiving PM arrays had significantly lower pre-operative CNC word, CNC phoneme and AzBio quiet scores ( $2.9\% \pm 6.1$ ,  $9.7\% \pm 15.3$ , and  $6.8\% \pm 13.2$  respectively) compared to patients receiving LW arrays ( $7.9\% \pm 12.1$ ,  $17.4\% \pm 20.7$ , and  $10.2\% \pm 15.5$ ; all  $p < 0.04$ ). After controlling for pre-operative residual hearing and speech recognition ability, there was no statistically significant difference in audiological outcomes (CNC words, CNC phonemes or AzBio quiet) among the three electrode array types (all  $p > 0.05$ ). Subsequent multivariable regression analysis revealed better pre-operative aided AzBio quiet scores (OR 0.35 95%CI 0.09-0.61,  $p = 0.009$ ) and decreased age at implantation (OR -0.25, 95%CI -0.48-0.03,  $p = 0.03$ ) were associated with improved post-operative AzBio scores.

**Conclusion:** While prior studies have demonstrated superior postoperative speech recognition scores in LW electrode array recipients, these differences lose significance when controlling for baseline hearing and speech recognition ability. These data demonstrate the proclivity for implanting individuals with greater residual hearing with LW electrodes and its impact of post-operative results.

**Define Professional Practice Gap & Educational Need:** 1) Lack of knowledge regarding the baseline audiological characteristics of patients undergoing implantation with different CI electrode arrays. 2) Lack of knowledge regarding the association among baseline audiological characteristics, choice of CI electrode array, and hearing outcomes.

**Learning Objective:** 1) Attendees will better understand that preoperative hearing performance differs in patients implanted with lateral wall, mid-scala, and perimodiolar electrode arrays. 2) Attendees will better understand that differences in CI outcomes with various CI arrays are likely driven by differences in pre-operative hearing and speech recognition ability.

**Desired Result:** 1) Attendees will be better prepared to counsel patients with regard to expected CI outcome 2) Attendees will be able to use these results when designing future clinical studies.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Intra-Cochlear Electrocochleography during CI Electrode Insertion is Predictive of Final Scalar Location**

*Kanthaiah Koka, PhD; Jourdan Holder, AuD  
Robert Dwyer, AuD; Jack Noble, PhD  
Oliver Adunka, MD; Craig Buchman, MD  
Robert Labadie, MD, PhD*

**Hypothesis:** Patterns observed in electrocochleography (ECoChG) during cochlear implant (CI) electrode insertion provide information about scalar location of the electrode array.

**Background:** Conventional CI surgery is performed without actively monitoring potential damage to intracochlear structures. Intracochlear ECoChG obtained directly through the CI may provide feedback for better hearing preservation.

**Methods:** Intracochlear ECoChG was performed in 25 patients across 3 different clinics. During electrode insertion, a 50-ms tone burst acoustic stimulus was delivered with a frequency of 500Hz at 110dB SPL. The ECoChG response was monitored from the apical-most electrode. The amplitude and phase changes for the first harmonic were categorized to understand the scalar electrode location and used in an algorithm to predict scalar location (scala tympani (ST) versus translocation/interaction with basilar membrane). Scalar location was verified using post-operative CT scans and image processing.

**Results:** CT analysis showed 18 subjects with ST position and 7 subjects translocating from ST to scala vestibuli. The ECoChG algorithm correctly estimated CI electrode location in 22 out of 25 subjects with 3 subjects wrongly identified as translocation resulting in a specificity of 100%, sensitivity of 57%, false positive of 0%, and false negative rate of 17%. A significant difference in hearing preservation was observed between the translocations (36 dB loss) and scala tympani insertions (25 dB loss) ( $p < 0.05$ )

**Conclusion:** Intracochlear ECoChG may provide information about CI electrode location and hearing preservation.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge about cochlear implant electrode insertion trauma and hearing preservation

**Learning Objective:** The current presentation teaches about objective measurement of insertion trauma and hearing preservation using electrocochleography

**Desired Result:** Attendees will be able to learn about objective electrocochleography and use for hearing preservation.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 1

## ANS TRAINEE AWARD

### **Intraoperative Evoked Compound Action Potential (ECAP) Levels in Hearing Preservation Cochlear Implantation**

*Ashley M. Nassiri, MD, MBA; Robert J. Yawn, MD  
Jillian B. Roberts, BHS; Max S. Gilbane, BA  
Jack Murfee, BA; René H. Gifford, PhD  
Marc L. Bennett, MD*

**Objective:** To evaluate the correlation between intraoperative evoked compound action potentials (ECAP) at the time of cochlear implantation and hearing preservation outcomes.

**Study Design:** Retrospective case review.

**Setting:** Tertiary otologic center.

**Patients:** Two hundred thirty-eight adult ears with residual hearing receiving cochlear implants (51 Advanced Bionics, 90 Cochlear, 97 MED-EL implants).

**Interventions:** Intraoperative ECAP testing and postoperative audiologic assessment.

**Main outcome measures:** Hearing preservation status (preservation of unaided air conduction thresholds at 250 Hz and 500 Hz) as correlated with intraoperative ECAP measurements (basal, middle and apical electrode thresholds and maximum amplitudes), while controlling for age and surgical approach. ECAP thresholds were determined via linear regression for Advanced Bionics and MED-EL and through extrapolation of regression based visual thresholds for Cochlear devices.

**Results:** Maximum amplitudes were significantly higher throughout all regions (basal, middle, apical) of the cochlea in patients that preserved low frequency acoustic hearing versus those that did not ( $p=0.007$ ,  $p=0.0003$ ,  $p=0.0004$ , respectively). Electrode thresholds were not significantly correlated with hearing preservation.

**Conclusions:** Maximum amplitudes detected through ECAP measurements are significantly higher in patients that preserve low frequency acoustic hearing thresholds versus those that do not. This may be suggestive of improved neural health.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge and information regarding the relationship of intraoperative evoked compound action potential (ECAP) levels as it relates to postoperative hearing preservation and patient hearing outcomes.

**Learning Objective:** Identify that ECAP thresholds are correlated with hearing preservation outcomes, and that this may be predictive of hearing outcomes.

**Desired Result:** Although this is a retrospective study, the relationship between ECAP thresholds and hearing preservation can be used in postoperative patient counseling, expectations, and cochlear implant programming.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

# **Creation of a Formula to Convert between Consonant-Nucleus-Consonant (CNCw) and AzBio Test Scores Using Imputation in a National Cochlear Implant Database**

*Rahul K. Sharma, BS; Jedidiah J. Grisel, MD  
Justin S. Golub, MD, MS*

**Objectives:** In the era of big data, it is critical to aggregate results across different institutions. This is a major challenge for cochlear implant (CI) research given the existence of multiple, incompatible outcome measures. We utilize a large, national CI database to develop a formula to convert between the two most common measures: CNCw and AzBio.

**Study Design:** Analysis of a prospective, national, web-based database designed for CI outcome tracking (HERMES; HIPAA-secure, Encrypted, Research Management and Evaluation Solution)

**Setting:** Multi-centered at 32 US private practice and academic medical centers

**Patients:** CI patients (n=470 total, n=518 ears; age 10-102 years; mean: 64 years)

**Main Outcome Measures:** CNCw, AzBio

**Results:** Univariable linear equations ( $y=mx+b$ ) were generated in the form of CNCw Score = (m)(AzBio Score) + b for each time-point. Correlation coefficients ( $R^2$ ) between AzBio and CNCw scores were 0.71 at 3 mos, 0.69 at 6 mos, 0.63 at 12 mos, and 0.56 at 24 mos (all  $p<0.01$ ). Across all timepoints, the average difference between true and calculated (imputed) CNCw was 10.5% (95% CI=9.8-11.2). The average difference between true and calculated AzBio was 12.3% (95% CI=11.4-13.1).

**Conclusions:** We generated simple linear regression equations to calculate CNCw scores from AzBio scores, and vice versa, with good accuracy. It is anticipated that as the database grows, the accuracy using modeling will improve. This tool allows practitioners to study CI outcomes across centers on a national or international level despite the existence of different speech performance measures.

**Define Professional Practice Gap & Educational Need:** The use of different non-compatible CI outcome measures hinders quality improvement on a national level. There is no consensus on which measure to use. There is no current solution to this problem. Educational Needs: Clinicians must understand how having no universally accepted outcome measure impedes quality improvement and how this problem could be addressed with statistical techniques.

**Learning Objective:** To understand how AzBio and CNCw scores are related, and how they can be converted into each other using imputation with linear regression.

**Desired Result:** Clinicians will appreciate the need for a universal outcome measure for CI performance, and how statistical techniques can address this problem.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Hearing Preservation Surgery in Cochlear Implantation: Factors Associated with Improved Outcomes in a Single Center**

*Alexander Malone, MD; Kevin Wang, MD  
Nicholas Pritchard, MD; Loren Bartels, MD  
Kyle Allen, MD, MPH; Michelle Blanchard, AuD  
Christopher Danner, MD*

**Objective:** To assess for factors associated with improved outcomes in cochlear implantation with attempted hearing preservation.

**Study design:** Retrospective chart review.

**Setting:** Tertiary private otologic center.

**Patients:** Adult patients who underwent cochlear implantation with pre-operative residual hearing from January 2015 to December 2015.

**Intervention(s):** Cochlear implantation.

**Main outcome measure(s):** Hearing preservation classification using the HEARRING model was used. Secondary outcome measures included the effect of steroids (perioperative, intra-operative, and topical), sodium hyaluronate, antibiotics, insertion technique, and electrode array design on hearing preservation status.

**Results:** 53 patients and 54 ears met inclusion criteria. The average age was 65.7 years (range 26-88). Hearing preservation rates overall were 5 (9.3%) ears with complete preservation, 23 (42.6%) with partial preservation, 12 (22.2%) with minimal preservation, and 14 with (25.9%) no preservation. Logistic multivariate regression demonstrated a statistically significant association between the dosing of the perioperative prednisone steroid taper and a decreased likelihood of complete hearing loss ( $p < 0.01$ ). When using multinomial multivariate regression to assess for the likelihood of an improved hearing classification level, the use of prednisone approached significance ( $p = 0.05$ ). No other factors were associated with a statistically significant effect on hearing preservation. 11 of these patients met criteria for hybrid implant. Of these, 1 (9.1%) had complete hearing preservation, 7 (63.6%) had partial preservation, and 3 (27.2%) had minimal preservation.

**Conclusions:** In this cohort of patients the use of perioperative oral steroids was associated with increased rates of hearing preservation. This effect did appear to be dose dependent. Further prospective studies are needed to validate these findings.

**Define Professional Practice Gap & Educational Need:** There are inconsistencies with the techniques and methods used to promote hearing preservation in patients undergoing cochlear implantation.

**Learning Objective:** This abstract will demonstrate factors identified that were associated with improved hearing preservation outcomes in patients undergoing cochlear implantation.

**Desired Result:** Attendees will be able to apply the factors identified to contribute to improve outcomes to their practice. This could also identify areas ripe for further investigation.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5



## Unique Clinical Language Patterns among Expert Vestibular Providers Can Predict Vestibular Diagnoses

*Jake Luo PhD; Christy Erbe, MA  
David R. Friedland, MD, PhD*

**Objective:** To identify novel language usage by expert providers predictive of specific vestibular conditions.

**Study design:** Retrospective chart review and natural language processing. Level IV

**Setting:** Tertiary referral center

**Patients:** New patients seen for primary vestibular complaint.

**Intervention(s):** Machine learning assessments of semantic and syntactic patterns in clinical documentation and correlation analyses with vestibular diagnosis.

**Main outcome measure:** Unique semantic and syntactic elements associated with vestibular conditions.

**Results:** Natural language analyses on 866 physician-generated histories from vestibular patients found 3,286 unique common data elements (CDEs) of which 614 were used 10 or greater times. The top 15 semantic types represent only 11% of the all Unified Medical Language System semantic types but covered 86% of the CDEs in vestibular patient histories. A similar pattern was shown on the vocabulary level in which the top 50 CDEs covered 93% of all signs and symptoms found in vestibular patient histories. Machine learning algorithms, including the Naïve Bayes algorithm and the J48 Decision Tree algorithm, were applied to a subset of notes to correlate language usage with clinical diagnosis. The Naïve Bayes algorithm generated a stronger model showing an average sensitivity rate of 86.0% and a specificity rate of 93.0% in predicting common conditions, including migraine and BPPV.

**Conclusions:** These results indicate that expert providers utilize unique language patterns that are highly conserved. These patterns have strong predictive power toward specific vestibular diagnoses. Such language elements can thus be incorporated into clinical decision support systems to facilitate accurate vestibular diagnosis by non-expert providers.

**Define Professional Practice Gap & Educational Need:** 1) Poor recognition of specific vestibular disorders 2) Lack of knowledge regarding complete vestibular history taking

**Learning Objective:** 1) Recognize elements in patient histories used by expert providers. 2) Recognize elements in patient histories used to disambiguate specific vestibular conditions.

**Desired Result:** Attendees will be able to acquire more complete and accurate vestibular histories and use this information to make informed clinical diagnoses.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## Vestibular Testing: Patient Perceptions, Morbidity, and Opportunity Costs

*Elizabeth A. Kelly, MD; Carly M. Kempton, AuD  
Catherine D. Stocker, AuD; Darcia M. Dierking, AuD  
Hannah E. Fehlberg, AuD; Meredith E. Adams, MD*

**Objective:** To characterize patient tolerance and non-monetary cost burdens of vestibular testing. Rigorously acquired data are essential for patient counseling and to determine if proposed additions/modifications to current protocols improve quality, experience, and efficiencies of care.

**Study Design:** Prospective observational study.

**Setting:** Tertiary center.

**Patients:** Adults referred to audiology clinic for vestibular testing.

**Intervention(s):** Surveys administered to patients and audiologists immediately and one week following videonystagmography with caloric (VNG) and/or rotational chair testing.

**Main outcome measure(s):** Symptoms, visual analog scale ratings of dizziness, distress, and nausea during testing; test completion; opportunity costs (time, missed work).

**Results:** Of 113 patients enrolled (63% women, mean age 55 years), 61 (58%) experienced undesirable symptoms during testing, including nausea (48%), vomiting (3%), and headaches (9%). Distress and nausea ratings during VNG and rotary chair were low (<3/10). Fourteen (13%) patients were unable to complete testing, rating distress and nausea during VNG and rotary chair 2 to 3-times higher than those who completed testing ( $p<0.01$ ). Migraine history, sex, age, and nystagmus intensity were not significantly associated with dizziness, distress, or nausea ratings during testing. Test performance times were 68 [22] and 25 [12] minutes for VNG and rotary chair, respectively. Testing required 51% to miss work (range of 2 to 48 hours) and 79% obtained another's assistance to/from the appointment. Post-test symptoms included drowsiness/fatigue (36%), nausea (26%), and headache (32%).

**Conclusions:** While vestibular tests elicit patient distress ratings comparable to other in-office otolaryngology procedures, high frequencies of undesirable symptoms, post-test morbidity, and opportunity costs warrant efforts to modify current protocols.

**Define Professional Practice Gap & Educational Need:** There are proposals to modify the current vestibular test methods to limit duration of testing and patient discomfort, either by changing the administration of existing tests or by substituting new tests. However, the benefit of these modifications is not known due to the lack of knowledge and investigation of the frequency of incomplete vestibular tests due to patient morbidity, patient perceptions/experiences, and opportunity costs of these tests.

**Learning Objective:** 1. To describe patient morbidity associated with vestibular testing and the frequency with which it occurs. 2. To understand the non-monetary costs of vestibular evaluation.

**Desired Result:** The information obtained regarding the frequency of complications associated with vestibular testing and the patient morbidity will provide essential information for patient counseling prior to testing. This information will provide attendees with an understanding of the risks, patient tolerance, and the time consumption of this testing to ensure patients are receiving an efficient and quality evaluation, which may help inform practices of those ordering these tests. Additionally, it will provide more information on the need for additional modifications to our current testing and referral patterns for this testing to ensure optimal patient comfort and quality of the diagnostic evaluation and reduce indirect costs associated with specialized testing.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Mouse Magnetic-field Nystagmus in Strong Static Magnetic Fields is Dependent on the Presence of Nox3**

*Bryan K. Ward, MD; Yoon Lee; Dale C. Roberts, MA  
Ethan Naylor, MA; Americo A. Migliaccio, PhD  
Charles C. Della Santina, MD, PhD*

**Hypothesis:** Magnetic vestibular stimulation (MVS) elicits nystagmus in C57BL/6J mice but not *het* mice lacking Nox3, which is required for normal utricular and otoconial development.

**Background:** Humans have vertigo and nystagmus in strong magnetic fields within MRI machines. The hypothesized mechanism is a Lorentz force driven by utricular current, acting indirectly on crista hair cells via endolymph movement deflecting cupulae. We tested an alternate hypothesized mechanism: Lorentz action directly on crista hair cell stereocilia, driven by their currents independent of the utricle.

**Methods:** Before MVS, vestibulo-ocular reflex (VOR) responses of 8 C57BL/6J mice and 6 *het* mice were measured during whole-body sinusoidal rotations and tilts using video-oculography. Mice were then placed within a 4.7 Tesla magnetic field with the horizontal semicircular canals approximately Earth-horizontal for  $\geq 1$  minute in several head orientations, while eye movements were recorded via infrared video in darkness.

**Results:** Outside the magnet, both C57BL/6J and *het* mice had intact horizontal VOR, but only C57BL/6J mice exhibited static counter-roll responses to tilt. When placed in the magnet nose-first, C57BL/6J mice had left-beating nystagmus, lasting a median of 32.8 seconds. When tail-first, nystagmus was right-beating and similar duration (median 28.0s,  $p > 0.05$ ). In contrast, *het* mice lacked magnetic field-induced nystagmus ( $p < 0.001$ ).

**Conclusions:** C57BL/6J mice generate nystagmus in response to MVS, while mice deficient in Nox3 do not. Per the Lorentz force model of MVS, this suggests (1) utricular current is necessary, and (2) semicircular canal hair cell current is insufficient, to generate MVS-induced nystagmus in mice.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of the relationship between strong magnetic fields like those of MRI machines and the vestibular system, and how MRI machines can cause dizziness and vertigo.

**Learning Objective:** To understand how strong magnetic fields like MRI machines induce dizziness in both humans and mice, and to demonstrate how mice can be used to study magnetic vestibular stimulation.

**Desired Result:** Participants will better understand how MRI machines cause vertigo and how a mouse model can help us better understand the mechanism.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** Does not apply- This is a basic science study using mice.

## Comparison of Failure Rates for Intratympanic Dexamethasone and Gentamicin in Meniere's Disease

*James G. Naples, MD; Jason A. Brant, MD  
Steven J. Eliades, MD, PhD; Michael J. Ruckenstein, MD*

**Objective:** To compare failure rates of intratympanic (IT) dexamethasone and gentamicin in Meniere's Disease (MD).

**Study Design:** Retrospective chart review

**Patients:** Adult patients with unilateral MD requiring IT therapy from 2005-2017.

**Intervention(s):** Prior to 2011, IT gentamicin (27mg/ml) was administered as primary therapy. Beginning in 2011, the treatment algorithm shifted to IT dexamethasone (10mg/ml) as initial treatment. Gentamicin was administered every 2 weeks (up to 3 injections) until objective testing revealed vestibular loss. Dexamethasone was administered weekly for 3 planned injections. Treatments were repeated if symptoms recurred after an initial response.

**Main Outcome Measures:** Failure rates of each treatment group were evaluated. Similar treatment algorithms within each cohort permits direct comparison. Failure was defined as persistent vertigo symptoms that required a more aggressive therapy.

**Results:** Fifty-six patients received IT dexamethasone and 100 patients received IT gentamicin. Dexamethasone patients received a mean of 3.2 injections compared to 2.4 in the gentamicin group ( $p=0.001$ ). Twenty-seven(48%) dexamethasone patients remained symptomatic after their last recorded injection compared to 13(13%) gentamicin patients ( $p=0.001$ ). There were 14(25%) failures in the dexamethasone group and only 7(7%) gentamicin failures ( $p=0.006$ ). No patients failed both treatments. The mean time to failure in the dexamethasone group was 3.5 months, while in the gentamicin group it was 27.3 months ( $p=0.011$ ).

**Conclusions:** IT gentamicin achieved higher rates of vertigo control and had significantly fewer failures than IT dexamethasone. The time to failure occurred sooner in the dexamethasone group. Further long-term data is necessary to understand the utility of IT dexamethasone in MD.

**Define Professional Practice Gap & Educational Need:** The professional practice gap that this research aims to address is to improve the understanding of failure rates of intratympanic (IT) therapies in Meniere's Disease. Since the introduction of IT dexamethasone to the treatment algorithm for Meniere's Disease, there is a lack of head-to-head comparisons of dexamethasone and gentamicin. In this research, we compare rates of failure in each group of patients.

**Learning Objective:** The learning objective is to improve understanding of the utility of IT dexamethasone and IT gentamicin in treating Meniere's Disease by comparing failure rates. This research will improve clinician expectations with each therapy, which will afford the opportunity for improved patient counseling for each therapy.

**Desired Result:** The desired result is that clinicians gain a better understanding of the failure rates of IT dexamethasone as compared to IT gentamicin, which will allow them to better counsel their patients about treatment expectations. The application of this research has potential to change therapeutic discussions between the patient and physician.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## NICHOLAS TOROK VESTIBULAR AWARD

### **Lateral Semi-Circular Canal Pressures during Cochlear Implant Electrode Insertion: A Possible Mechanism for Postoperative Vestibular Loss**

*Renee M. Banakis Hartl, MD, AuD; Nathaniel T. Greene, PhD  
Herman A. Jenkins, MD; Stephen P. Cass, MD, MPH  
Daniel J. Tollin, PhD*

**Hypothesis:** Insertion of cochlear implant electrodes generates transient pressure spikes within the vestibular labyrinth that are equivalent to high intensity acoustic stimuli.

**Background:** Though cochlear implants (CI) are generally regarded as having a low-risk of impacting the vestibular system postoperatively, several articles have documented changes in balance function after implantation. The mechanism of such a loss is poorly understood. We have previously established that large, potentially-damaging pressure transients can be generated in the cochlea during electrode insertion, but similar changes within the vestibular labyrinth have yet to be characterized. Here, we attempt to quantify the potential exposure of the vestibular system to damaging pressure levels during CI surgery.

**Methods:** Five human cadaveric heads were prepared with an extended facial recess and implanted sequentially with seven different CI electrode styles via a round window approach. Fiber-optic sensors measured intralabyrinthine pressures in scala vestibuli (SV), scala tympani (ST), and the lateral semicircular canal (LSCC) during insertions.

**Results:** Electrode insertion produced a range of high-intensity pressure spikes simultaneously in the cochlea and the LSCC with all electrodes tested. Pressure transients recorded were found to be comparable between the vestibular and cochlear labyrinths at peak levels known to cause acoustic trauma.

**Conclusion:** Insertion of CI electrodes produces transients in intralabyrinthine fluid pressure levels that are equivalent to high-intensity, impulsive acoustic stimuli. Results from this investigation affirm the importance of atraumatic surgical techniques and suggest that the vestibular system, in addition to the cochlea, is potentially exposed to damaging fluid pressure waves during cochlear implantation.

**Define Professional Practice Gap & Educational Need:** Limited understanding of the intralabyrinthine (cochlear and vestibular system) environment during insertion of cochlear implant electrodes.

**Learning Objective:** 1. Better appreciate the potential for causing both cochlear and vestibular trauma during cochlear implant electrode insertion. 2. Develop an understanding of the relative levels of damaging exposures by examining the equivalent ear canal sound pressure level exposures that correlate with cochlear and vestibular pressure levels during cochlear implant electrode insertion.

**Desired Result:** 1. Participants will improve understanding of one potential intraoperative causes of new-onset vestibular dysfunction following cochlear implant surgery. 2. Participants will consider iatrogenic vestibular trauma from intralabyrinthine pressure transients created during cochlear implant electrode insertion when analyzing their own patient outcomes.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** Does not apply - This is a basic science translational project aimed at examining the potential mechanism of vestibular trauma that cannot be randomized or blinded in a traditional sense.

## **The Role of Hyperbaric Oxygen Therapy for Idiopathic Sudden Sensorineural Hearing Loss**

*Galit Almosnino, MD; James R. Holm, MD  
Seth R. Schwartz, MD, MPH; Daniel M. Zeitler, MD*

**Objective:** Evaluate hearing outcomes following adjuvant hyperbaric oxygen therapy (HBO2) for idiopathic sudden sensorineural hearing loss (ISSHL).

**Study Design:** Retrospective, case-control

**Setting:** Tertiary referral teaching hospital

**Patients:** Adult patients undergoing treatment for ISSHL between 2014-2017 (n=59). Patients with autoimmune disease (n=4), Meniere's disease (n=3), or patients with ISSHL who did not undergo treatment (n=12) were excluded. A total of 40 patients were included. Twenty patients were treated with HBO2 with oral and/or IT steroids (Group 1). The remaining 20 patients received oral and/or IT steroids alone (Group 2). There were no significant differences in age, gender or hearing between groups.

**Intervention:** HBO2 with steroids vs. steroid therapy alone.

**Main Outcome Measure:** Improvement in pure tone average (PTA) and speech discrimination scores (SDS). Non-serviceable hearing was defined as SDS < 50%.

**Results:** There was no significant difference in mean post-treatment PTA between Group 1 (60.4 dB) and Group 2 (52.7 dB). There was no significant difference in mean post-treatment SDS between Group 1 (42.3%) and Group 2 (51%). Twenty percent of patients receiving HBO2 (Group 1) went from non-serviceable hearing to serviceable hearing. Twenty five percent of controls (Group 2) went from non-serviceable to serviceable hearing.

**Conclusion:** In this study, there were no significant differences in hearing outcomes between patients receiving HBO2 and steroids vs. patients receiving steroid therapy alone. There was a low rate of complications in both groups. Larger, prospective randomized trials are needed to help quantify the outcomes of HBO therapy and establish guidelines for treatment of ISSHL.

**Define Professional Practice Gap & Educational Need:** 1. Inconsistencies in published outcomes following hyperbaric oxygen therapy for treatment of idiopathic sudden sensorineural hearing loss (ISSHL).

**Learning Objective:** 1. Evaluate hearing outcomes following adjuvant hyperbaric oxygen therapy (HBO2) for treatment of idiopathic sudden sensorineural hearing loss (ISSHL). 2. Compare outcomes of present study regarding use of hyperbaric oxygen therapy for treatment of ISSHL to outcomes in the literature.

**Desired Result:** 1. Increase physician knowledge regarding management trends for idiopathic sudden sensorineural hearing loss (ISSHL) 2. Improve knowledge and awareness of the potential benefits as well as associated costs and risks of adjuvant hyperbaric oxygen therapy for treatment of ISSHL.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Noise-Induced Trauma Produces a Temporal Pattern of Change in Serum Levels of the Outer Hair Cell Biomarker Prestin**

*Kourosh Parham, MD, PhD; Maheep Sohal, MD  
Mathieu Petremann, MS; Christophe Tran Van Ba, MS  
Charlotte Romanet, MS; Audrey Broussy, MS  
Jonas Dyhrfeld-Johnsen, PhD*

**Hypothesis:** After intense noise exposure serum levels outer hair cell (OHC) protein, prestin, gradually decrease over days.

**Methods:** After assessing ABR thresholds and reduced DPOAE levels, rats were exposed to intense octave band noise for 2 hours at either 110 or 120 dB SPL. Auditory function was assessed 1 and 14 days later. Blood samples were collected at baseline, 4, 24, 48, 72 hrs and 7 and 14 days post exposure and prestin concentrations were measured using ELISA.

**Results:** Functional measures showed temporary hearing loss 1 day after exposure in the 110 dB group, but permanent loss through Day 14 in the 120 dB group. Prestin levels temporarily increased 5% at 4 hrs after 120 dB exposure, but only 1% in the 110 dB group. There was a gradual decline in prestin levels in both groups thereafter, with prestin being below baseline on Day 14 by 5% in the 110 dB group and more than 10% in the 120 dB group ( $p = 0.043$ ). Closer inspection of the data showed that only a subset of subjects had increased prestin levels at 4 hrs after trauma. In that subset, DPOAE level on Day 1 was lower by about 8 dB.

**Conclusion:** There is a temporal pattern of change in serum prestin level after noise-induced hearing loss that is related to severity of hearing loss. These results suggest that in the era of personalized medicine, circulatory levels of prestin may be able to act as surrogate biomarker for hearing loss involving OHCs.

**Define Professional Practice Gap & Educational Need: (Examples:** At present there are no inner-ear specific serological biomarkers available for research or clinical utilization.

**Learning Objective:** To inform participants on potential application of serum levels of prestin as a biomarker for hearing loss.

**Desired Result:** The learner will recognize potential applications of serum biomarkers to inner ear disorders

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## NEUROTOLOGY FELLOW AWARD

### **Is Eustachian Tuboplasty Anatomically Safe in Children? A Histopathologic Comparison between Pediatric and Adult Temporal Bones**

*Kathryn Y. Noonan, MD; Fred H. Linthicum, MD  
Mia E. Miller, MD*

**Hypothesis:** In children, the distance between the carotid canal (CC) and Eustachian tube (ET) is not significantly narrower than the adult population.

**Background:** ET dysfunction treated with ET dilation is FDA approved for adults. Several studies describe the close relationship between the CC and the ET in adults, but the anatomy of the ET has not been well defined in children. This study seeks to investigate these relationships in the pediatric population.

**Methods:** Histologic sections from 23 temporal bones of pediatric patients ages 0-18 were reviewed by two independent observers. The distance between the CC and the cartilaginous Eustachian tube (CET), bony-cartilaginous junction (BCJ), and bony Eustachian tube (BET) were measured. Fifteen adult temporal bones were used as a control group.

**Results:** The distance to the CC was narrowest at the BET, and was actually higher in the pediatric population when compared to adults (0.5mm and 0.2mm, respectively,  $p=0.06$ ). The CC-CET distance was smaller in the pediatric group (2.3mm vs 3.3mm,  $p<0.01$ ). The bony-cartilaginous junction is often the region of most concern during dilation. There was no significant difference between the CC-BET distance in pediatric and adult groups (1.9mm vs 2.3mm,  $p=0.20$ ).

**Conclusions:** CET-CC is smaller in the pediatric population, as expected due to smaller anatomic structures. However, the variable incline of the ET results in a CC-BCJ distance that is similar to the adult population. Although imaging studies are necessary to validate ET-CC in vivo, ET dilation may be safe in the pediatric population.

**Define Professional Practice Gap & Educational Need:** Eustachian tube dysfunction is increasingly being treated with Eustachian tube dilation. Currently the FDA has approved devices for adults ages 18 and older. There are published retrospective reviews totaling 86 pediatric patients (Jenckel 2015, Leichtle 2017, Tisch 2013) who were treated with Eustachian tube dilations however this anatomic relationship is yet to be explored. Several studies describe the close relationship between the carotid and various portions of the ET in adults (Ozturk 2012, Savic 1985, Olander 2017). This study seeks to investigate these relationships in the pediatric population.

**Learning Objective:** Determine the relationship between the carotid artery and the Eustachian tube in children  
Compare the distances between these two structures at key portions in children and adults

**Desired Result:** Understanding the relationship of the Eustachian tube and carotid artery will aid in the decision-making process when treating pediatric patients with Eustachian tube dysfunction.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4



## **Factors Associated with Maintaining Serviceable Hearing in Conservatively Managed Vestibular Schwannoma Patients**

*Jacob B. Hunter, MD; Brendan P. O'Connell, MD*

*Marc L. Bennett, MD; Alejandro Rivas, MD*

*George B. Wanna, MD; Reid C. Thompson, MD*

*David S. Haynes, MD*

**Objective:** To characterize the risk of progression to non-serviceable hearing in patients who elect to observe vestibular schwannomas (VS).

**Study Design:** Retrospective case series.

**Setting:** Tertiary care center.

**Patients:** VS patients with serviceable hearing who underwent at least two audiograms and two MRI studies prior to intervention or loss to follow-up.

**Main outcome measure(s):** Serviceable hearing, defined as the pure tone average less than 50 dB HL and word recognition score (WRS) greater than 50%.

**Results:** Two-hundred and forty-nine patients (mean age of 56.2 years and median tumor diameter of 0.84 cm) had serviceable hearing at presentation and were followed for a median of 29.7 months. At the last visit prior to intervention or loss to follow-up, 195 (78.3%) patients maintained serviceable hearing. Presenting age (OR 1.062), presenting tumor diameter (OR 1.962), tumor growth greater than 2 mm (OR 1.969), and absence of a fundal cap (OR 1.858) were all significantly associated with loss of serviceable hearing. Kaplan-Meier analysis found a significant (log rank  $p < 0.001$ ) monotonic increase in developing non-serviceable hearing with poorer WRS at presentation. Of those patients with 100% WRS at presentation, 93.9% maintained serviceable hearing at last follow-up. If the WRS is  $\geq 90\%$ , 88.7% maintained serviceable hearing at last follow-up.

**Conclusions:** In VS patients who elect observation, the majority maintain serviceable hearing during observation. For patients with excellent word recognition scores, particularly those with smaller tumors, younger age, and the presence of a fundal cap, initial observation prior to intervention should be considered.

**Define Professional Practice Gap & Educational Need:** Previous data from one international center has demonstrated that patients with vestibular schwannomas and "normal speech discrimination" should undergo treatment when tumor growth is demonstrated. This has not been re-explored or expanded upon, let alone at a separate center with a comparably sized cohort.

**Learning Objective:** We explored the relationship of serviceable hearing and sporadic vestibular schwannomas, identifying and quantifying a number of factors as to who maintains serviceable hearing in those patients who elect to observe their tumors.

**Desired Result:** This presentation will enable attendees to better understand the natural course of hearing outcomes in patients with sporadic vestibular schwannomas, hopefully helping them to improve their counseling of patients who present with serviceable hearing.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## Quality of Life in Sporadic Vestibular Schwannoma: A Cross-sectional Survey of 1,288 Patients Using a Disease-Specific Inventory

*Matthew L. Carlson, MD; Nicole M. Tombers, RN  
Panagiotis Kerezoudis, PhD; Maria Peris Celda, MD, PhD  
Christine M. Lohse, MS; Michael J. Link, MD*

**Objective:** To evaluate quality-of-life (QoL) in patients with sporadic vestibular schwannoma (VS).

**Study Design:** Cross-sectional survey, Penn Acoustic Neuroma Quality of Life (PANQOL) instrument.

**Setting:** Acoustic Neuroma Association and a single tertiary referral center.

**Patients:** Patients with sporadic VS.

**Main Outcome Measures:** Domain-specific and total PANQOL scores comparing treatment modalities after adjusting for baseline covariates of interest.

**Results:** Among all 1,288 respondents there were 229 (18%) who were recently diagnosed and had not yet selected a treatment modality, 303 (24%) who were observed, 185 (14%) who underwent radiosurgery alone, 507 (39%) who underwent microsurgery alone, and 64 (5%) who underwent radiosurgery and microsurgery. After adjusting for covariates of interest, total PANQOL scores were highest for the observation cohort (65;95% CI 62-68), lowest for patients treated with multimodality therapy (56;51-61) and those recently diagnosed (58;55-62), and intermediate for those who received microsurgery alone (60;58-62) and radiosurgery alone (61;57-64) (global comparison,  $P=0.001$ ). When comparing groups that received single-modality therapy, there were no statistically significant differences in total PANQOL scores at short (0-5 years), intermediate (6-10 years), or long-term ( $\geq 11$  years) follow-up after adjusting for baseline covariates (all,  $P>0.05$ ). Pairwise comparisons between treatment modalities will be presented.

**Conclusion:** The period of time immediately after diagnosis, before an initial management strategy has been chosen, is associated with poor overall QoL. Differences in QoL during observation and following radiosurgery and microsurgery are small. Initial observation should be used in those patients who qualify, as active treatment does not appear to confer a QoL advantage.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge regarding disease-specific quality-of-life outcomes in patients with vestibular schwannoma.

**Learning Objective:** 1. To ascertain disease-specific quality-of-life outcomes after observation, microsurgery, radiosurgery and multimodality therapy in a large cohort of patients with vestibular schwannoma. 2. To ascertain the impact of initial diagnosis (before treatment) on quality-of-life.

**Desired Result:** Attendees will apply this knowledge to patient counseling regarding treatment modality selection.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Does a “Fundal Fluid” Cap Predict Successful Hearing Preservation in Vestibular Schwannoma Resections via the Middle Cranial Fossa Approach?**

*Daniel Q. Sun MD; Raymond W. Kung MD  
Marlan R. Hansen MD; Bruce J. Gantz, MD*

**Objective:** To determine the association between radiographic cerebrospinal fluid (CSF) cap in the lateral internal auditory canal (IAC) and success of hearing preservation in middle cranial fossa (MCF) vestibular schwannoma (VS) surgery.

**Study Design:** Retrospective chart review  
Setting: Academic tertiary referral center

**Patients:** One hundred thirty eight consecutive patients (mean age/standard deviation, SD, 50/11 years; mean tumor size/SD, 9.7/3.9mm) who underwent MCF VS resection.

**Intervention(s):** MCF VS excision

**Main outcome measure(s):** Size of fundal fluid cap on pre-operative magnetic resonance imaging (MRI), pre- and post-operative pure tone average (PTA) and word recognition score (WRS).

**Results:** Mean tumor and fundal fluid sizes were 9.7mm (SD 3.9mm) and 2.8mm (SD 1.7mm), respectively. On bivariate analysis, only inferior vestibular nerve tumor origin was associated with worse post-operative PTA ( $p=0.005$ ) and WRS ( $p=0.005$ ). Fundal fluid size was associated with larger tumor size ( $p=0.005$ ) but not changes in post-operative PTA ( $p=0.56$ ) or WRS ( $p=0.19$ ). When fundal fluid size was stratified as small ( $<2$ mm), medium ( $\geq 2$ mm and  $<4$ mm), or large ( $\geq 4$ mm), no significant differences were seen in rates of hearing preservation. Using multivariate linear regression models adjusting for patient age, gender, tumor nerve of origin, neurofibromatosis type II status, and pre-operative PTA and WRS, several definitions of “hearing preservation” were explored and larger fundal fluid size was not associated with improved likelihood of preserved hearing regardless of classification.

**Conclusions:** Presence or size of CSF fluid cap may not be a reliable prognostic indicator for hearing preservation in MCF VS resection, with important implications for patient counseling.

**Define Professional Practice Gap & Educational Need:** 1. lack of awareness 2. inconsistencies in patient counseling 3. lack of contemporary knowledge

**Learning Objective:** Understand how lateral CSF fluid cap is measured on MRI 2. Discuss the relationship between CSF fluid cap and hearing preservation

**Desired Result:** Better recognition of CSF fluid cap when reviewing MRI and understand its implications for patient counseling

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## Shared Decision Making and Decisional Conflict in the Management of Vestibular Schwannoma

*M. Elise Graham, MD; Brian D. Westerberg, MD, MHSc,  
Jane Lea, MD; Paul Hong, MD, MSc; Simon Walling, MBCHB  
Andrea L.O. Hebb, MSc, PhD, RN; Manohar Bance, MB, MSc*

**Objective:** To determine the extent to which patients with vestibular schwannomas experience decisional conflict when deciding between surgery or non-surgical management, and factors influencing the degree of conflict.

**Study Design:** Survey-based study.

**Setting:** Tertiary ambulatory skull-base clinic.

**Patients:** Inclusion criteria: patients with newly diagnosed or newly growing vestibular schwannoma presenting to the clinic.

**Intervention:** Patients were given a demographic form and the decisional conflict scale (DCS), a validated scale to assess degree of difficulty making medical decisions. The degree of shared decision making (SDM) experienced by the patient and physician were assessed via the SDM-Q-10 and SDM-Q-Doc questionnaires, respectively. Surveys and demographic information were correlated with DCS.

**Outcome measures:** DCS score, SDM-Q-10 score, SDM-Q-Doc score

**Results:** Seventy-seven patients participated: 55% female, aged 37 to 81 years, VS size range 2mm to 50mm. Significant decisional conflict (DCS score 25 or greater) was experienced by 22% of patients. Patients reported an average SDM score of 86. Physician and patient SDM scores were weakly correlated ( $p=0.045$ , correlation coefficient 0.234). DCS scores were lower with a decision to pursue surgery, presence of a trainee, and SDM-Q-10 score. DCS was increased with female gender. Using logistic regression, the SDM-Q-10 score was the only variable associated with decreased DCS.

**Conclusions:** About one fifth of patients deciding how to manage their vestibular schwannoma experience a significant degree of decisional conflict. Involving the patients in the process through shared decision-making significantly reduces the degree of conflict patients experience. Physicians do not estimate patient's perception of SDM well.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of the importance of shared decision making in the decision making process for the management of vestibular schwannomas. Lack of knowledge about the concept of decisional conflict in patient care

**Learning Objective:** - To improve awareness of the role of shared decision making in reducing the decisional conflict experienced by patients considering surgical versus non-surgical management of vestibular schwannomas. - To explore other factors that may influence patient's degree of decisional conflict in vestibular schwannoma management

**Desired Result:** It is hoped that neurotologists attending this presentation will increase the degree of shared decision-making in their consultations, to improve the patient experience when deciding how to manage their vestibular schwannoma. They will also be able to look for other predictors of decisional conflict in their patient populations. This could potentially be applied to other surgical scenarios in which surgery and non-surgical management are both options, with risks and benefits to weigh on both sides.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Factors That Affect Length of Hospital Stay after Vestibular Schwannoma Surgery**

*Nopawan Vorasubin, MD; Thomas H. Alexander, MD, MHSc  
Bill Mastrodimos, MD; Roberto A. Cueva, MD*

**Objective:** To identify perioperative factors that influence hospital length of stay (LOS) after resection of vestibular schwannoma (VS).

**Study design:** Retrospective case review.

**Setting:** Tertiary skull base referral center.

**Patients:** Patients who underwent acoustic neuroma resection between January 1, 2007 to January 1, 2014.

**Interventions:** Approaches used for VS resection included translabyrinthine and retrosigmoid.

**Main outcome measures:** LOS and several perioperative factors that may delay hospital discharge were examined. Factors included were patient demographics (age and gender), tumor characteristics (size), surgical factors (operative time, approach, revision surgery, date of surgery), and immediate postoperative factors (presence of vertigo or immediate postoperative complications).

**Results:** 288 patients underwent VS resection during the study period. 255 patients had complete charts available for review. LOS ranged from 1 to 10 days with an average of 2.66 days and mode of 2 days. 131 patients were admitted for  $\leq 2$  days and 124 patients stayed longer. Of the perioperative factors examined with univariate analysis, female gender ( $p=0.0266$ ) and presence of postoperative vertigo ( $p<0.0001$ ) were statistically significant factors associated with LOS  $>2$  day. On multivariate logistic regression analysis with odds ratios (OR), older patient age (OR=1.028,  $p=0.0177$ ), female gender (OR=1.810,  $p=0.0314$ ), longer operative time (OR=1.424,  $p=0.0007$ ) and presence of postoperative vertigo (OR=4.904,  $p<0.0001$ ) carried a statistically significant increased odds towards a LOS  $>2$ days.

**Conclusions:** VS surgery and postoperative care can be carried out efficiently with a minimal LOS. Identifying factors that may prolong LOS may help the operative team anticipate and address needs to optimize LOS.

**Define Professional Practice Gap & Educational Need:** Epidemiological data on outcomes for patients undergoing vestibular schwannoma surgery for the state of California in surgical centers treating a high volume of patients with acoustic neuromas reported the mean length of stay for patients was 4.7 to 5.4 days. Lower volume centers ranged from 6.8 to 9.2 days. A review of a national database in 2012 found a range of mean length of stay for vestibular schwannoma surgical patients to be 5.4 to 8.7 days. These studies illustrate the current lack of standardization with a wide range of average length of stay after vestibular schwannoma surgery even among high-volume skull base centers.

**Learning Objective:** We aim to report our experience with acoustic neuroma surgery from 2007- 2014 and describe our patient presentations, surgical findings, and outcomes. We intend to carefully analyze our length of stay data and assess for factors that impact deviations from the mean.

**Desired Result:** To initiate a discussion within and among skull base centers on how the length of hospital stay after vestibular schwannoma surgery can be minimized without compromising patient outcome.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Individualized Learning Plan (ILP) is an Effective Tool in Assessing Achievement of Otolaryngology-related Subcompetency Milestones**

*Maja Svrakic, MD*

**Objective:** To investigate the Individualized Learning Plan (ILP) as a tool in assessment of residents' milestone achievements as they pertain to Otolaryngology subcompetencies: Chronic Ear Disease, Pediatric Otitis Media and Hearing Loss.

**Study Design:** Prospective study.

**Methods:** Twenty Otolaryngology residents were instructed to utilize an ILP and identify 6 milestones from three Otolaryngology-related subcompetencies to focus on during the course of a 3-month rotation. They were also asked to plan out specific activities which would help them achieve these milestones, to specify whether or not they successfully achieved them, by what instructional or learning methods and if to identify any barriers. The completed ILPs were reviewed by a faculty member. The effectiveness of the ILP was assessed by response compliance rate, corroboration of self-reported milestone achievement with faculty evaluations and the ability to set attainable milestones.

**Results:** There was 90% compliance in utilizing an ILP to achieve milestones. Self-reported milestone scores corresponded to the faculty evaluations in a large majority (87.3%) of cases, and tended to be underestimated by the residents. Out of 114 total milestones identified, 24 (21.5%) were not achieved, with particular overestimation in the use of independent study as a learning method.

**Conclusions:** The ILP is an effective tool in measuring residents' achievement of Otolaryngology-related milestones, and could possibly be used to supplement or replace faculty assessment. The ILP provides valuable information on barriers to achieving milestones and informs trainees on how to set attainable goals as they pertain to patient care and medical knowledge in Otolaryngology.

**Define Professional Practice Gap & Educational Need:** 1. Lack of data on utilizing Individualized Learning Plans as a means of assessing Otolaryngology residency milestone achievements as they pertain to Otolaryngology subcompetencies (Chronic Ear Disease, Pediatric Otitis Media and Hearing Loss). 2. Lack of data on what instructional/learning methods are most conducive to achievement of specific milestones within the Otolaryngology subcompetencies

**Learning Objective:** 1. Describe why the Individualized Learning Plan is a successful method of assessment of achievement of Otolaryngology subcompetency milestones 2. Recognize the instructional/learning methods which are most and leadt conducive to achievement of Otolaryngology subcompetency milestones

**Desired Result:** 1. Implement the Individualized Learning Plan as a method of assessment of achievement of Otolaryngology subcompetency milestones 2. Implement the successful instructional/learning methods to help residents achieve Otolaryngology subcompetency milestones

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 3

## **The Clinical Stage Otoprotectant SENS-401 Effectively Reduces Hearing Loss in Rats When Administered up to 96 hours after Severe Acoustic Trauma**

*Mathieu Petremann, MS; Charlotte Romanet, MS  
Christophe Tran Van Ba, MS; Audrey Broussy, MS  
Jonas Dyhrfeld-Johnsen, PhD*

**Hypothesis:** SENS-401 can protect against acoustic trauma induced SSNHL in rats with delayed administration.

**Background:** SENS-401 is an orally administered small molecule which reduces death of outer hair cells. It has orphan status for treatment of Sudden Sensorineural Hearing Loss and Platinum-induced Ototoxicity. A challenge for treatment of SSNHL patients is the delay between onset, diagnosis and treatment start. The goal of this study was to evaluate whether SENS-401 could effectively treat acoustic trauma-induced SSNHL with delayed administration.

**Methods:** After baseline audiometry Wistar rats were subjected to severe acoustic trauma (120 dB octave band noise, 8-16 kHz, 2hrs). Following audiometric characterization at 24hrs, rats were assigned to receive 13.2 mg/kg SENS-401 bid for 28 days starting at 24 or 96 hrs post trauma or placebo control. Final hearing outcome was evaluated at D32-33.

**Results:** Mean ABR threshold shifts at 24h after acoustic trauma were above 60 dB and placebo treated animals displayed mean ABR threshold recovery of less than 10 dB at the end of the study. SENS-401 significantly increased ABR threshold recovery as a function of treatment initiation time after acoustic trauma with improvements of 200% (24hrs group) and 90% (96hrs group) compared to placebo treatment.

**Conclusions:** Twice daily, oral SENS-401 treatment significantly improved recovery of hearing loss in rats when initiated up to 96hrs after severe acoustic trauma. This suggests an acceptable treatment window for the management of SSNHL patients who may not seek medical help immediate after the onset of hearing loss.

**Define Professional Practice Gap & Educational Need:** There is a lack of knowledge and awareness of whether the clinical stage otoprotectant SENS-401 can be effective as a therapeutic agent for the treatment of SSNHL.

**Learning Objective:** At the conclusion of this presentation, the attendees will learn that clinical stage otoprotectant SENS-401 significantly reduced hearing loss in rats when administered up to 96 hrs after severe acoustic trauma and can be further developed as a treatment of SSNHL in patients.

**Desired Result:** The attendees may be able apply this knowledge by recognizing that SENS-401 may be a promising future therapeutic agent for treating SSNHL.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** Does not apply- The abstract only contains preclinical data

## **Anatomical Progression of Otosclerosis Analyzed by High Resolution CT on Surgically Confirmed Patients**

*Chihiro Yagi, MD; Yuka Morita, MD, PhD  
Kuniyuki Takahashi, MD, PhD; Manabu Ogi, MD  
Shinsuke Oshima, MD, PhD; Yutaka Yamamoto, MD, PhD  
Arata Horii, MD, PhD*

**Objective:** To clarify the anatomical progression of the otosclerosis lesion in relation to age and hearing level.

**Study Design:** Retrospective chart review.

**Patients:** Ninety-five patients with surgically confirmed uni- or bilateral otosclerosis.

**Main Outcome Measures:** Otosclerotic loci were defined if hypodense area was observed in otic capsule by high resolution computed tomography (HRCT). Location and the number lesions were examined and their correlation with age and hearing level at the time of CT was tested.

**Results:** Among 115 operated ears, otosclerotic lesions were observed in 77 ears. Anterior part of the oval window (ant-OW), anterior part of the internal auditory canal (ant-IAC), and the pericochlear area (PCochA) were the three most affected sites. In 77 ears with lesions, ant-OW was affected in 74 ears (96.1%), ant-IAC in 36 ears (46.8%), and PCochA in 20 ears (26.0%) with overlaps. Ant-OW was solely affected in 37 ears (48.1%), ant-IAC in 3 ears (3.9%), and PCochA in no case. Among 74 ears with ant-OW lesion, overlap with ant-IAC lesion (33 ears, 44.6%) was more frequently seen than with PCochA (20 ears, 27.0%). Triple sites disease was seen more in the latter 20 ears (80%) than the former 33 ears (48.5%). There were no differences in age and hearing level between patients those affected with only ant-OW and with triple sites.

**Conclusion:** Otosclerosis lesions may extend from ant-OW to ant-IAC followed by PCochA. Progression of the disease may vary within individuals, resulting in no correlation between the number of disease sites and age/hearing level.

**Define Professional Practice Gap & Educational Need:** The progress of the recent imaging technology is remarkable, the extent of disease progression in the patients with otosclerosis can be accurately evaluated by high-resolution CT scan. Lack of awareness of CT findings in otosclerosis patients can result in delays in diagnosis and failure in prognostic prediction. Our understanding of CT findings will increase with awareness of the anatomical progression of otosclerosis.

**Learning Objective:** 1) Review CT findings and sex, age, hearing level in otosclerosis patients. 2) Discuss the anatomical progression of otosclerosis.

**Desired Result:** 1) Increased awareness of CT findings in otosclerosis patients. 2) Increased ability to correctly diagnose and forecast of prognosis in otosclerosis patients.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5



## NEUROTOLOGY FELLOW AWARD

### Fluorescent Detection of Merlin-Deficient Schwann Cells and Primary Human Vestibular Schwannoma Cells Using Sodium Fluorescein

*Enrique Perez, MD; Olena Bracho, BS  
Paula Monje, PhD; Cristina Fernandez, PhD  
Fred F. Telischi, MD; Christine T. Dinh, MD*

**Hypothesis:** Merlin-deficient mouse Schwann cells (MTC) and primary human vestibular schwannoma cells (VSC) have selective uptake of sodium-fluorescein, allowing better direct visualization when compared to wild-type Schwann cells (WT-SCs).

**Background:** sodium-fluorescein is a fluorescent compound used in the field of Neurosurgery for fluorescent-guided resection of malignant gliomas due to preferential uptake by the tumor. Fluorescein can also potentially improve detection of the tumor-nerve interface in vestibular schwannomas (VS). The utility of sodium-fluorescein in fluorescent-guided VS surgery has not been assessed.

**Methods:** MTC, VSC, and WT-SCs were cultured at different cell densities and treated with sodium-fluorescein at several drug concentrations and durations. Fluorescence following blue-light excitation was quantified. The threshold of visual detection of fluorescent cells was determined from blinded observers using a four-point Likert scale. Kruskal-Wallis Test with multiple pairwise comparisons, as well as inter-rater and intra-rater reliabilities were calculated.

**Results:** Higher sodium-fluorescein concentrations resulted in a dose-dependent increase in the relative fluorescent units (RFU) of MTC and VSC in vitro, compared to WT-SCs. In addition, RFUs increased proportionately to the density of MTC and VSCs. The Likert scale was validated using independent observers with good inter-rater and intra-rater reliability. Observers detected MTC and VSCs at concentrations as low as 50,000 cells-per-well. No observable fluorescence was visualized in WT-SCs. Duration of drug exposure augmented fluorescent measurements.

**Conclusion:** MTC and VS cells demonstrate preferential uptake of sodium-fluorescein allowing direct visualization of the cell fluorescence when compared to WT-SCs. Further investigations into the utility of fluorescein-guidance in VS surgery using a pre-clinical animal model is warranted.

**Define Professional Practice Gap & Educational Need:** 1. Persistent challenges in defining the tumor-nerve interface during vestibular schwannoma surgery 2. Lack of contemporary knowledge on the feasibility of fluorescent-guided surgery for vestibular schwannomas 3. Specifically- lack of in vitro studies to serve as the foundation for future preclinical research using fluorescein to target and better visualize vestibular schwannomas

**Learning Objective:** 1. Have a better understanding regarding the efficacy of using sodium to selectively target and visualize merlin-deficient mouse Schwann cells and primary human vestibular schwannoma cells compared to wild type schwann cells. 2. Grasp the overall concept of utilizing this fluorescent marker for improving visualization of the tumor-nerve interface during vestibular schwannoma surgery.

**Desired Result:** 1. Discuss future preclinical studies to further determine the feasibility of using sodium fluorescein for vestibular schwannoma surgery. 2. Consider other possible applications in skull base surgery for which fluorescent-guidance may prove useful.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** Does not apply- Basic science in vitro research

***SELECTED ABSTRACTS***

***POSTER  
PRESENTATIONS***



***53<sup>rd</sup> Annual Spring Meeting  
AMERICAN NEUROTOLOGY SOCIETY***

***April 20-22, 2018  
Gaylord National Resort  
National Harbor, MD***

POSTERS WILL BE VIEWED ON FRIDAY & SATURDAY;  
ORAL PRESENTATIONS WILL BE SATURDAY & SUNDAY

## **Prevalence of Obstructive Sleep Apnea (OSA) in Spontaneous Cerebrospinal Fluid (CSF) Leaks: a Prospective Observational Study**

*Cyrus C. Rabbani, MD; Mohamad Z. Saltagi, BA  
Shalini K. Manchanda, MD; Charles W. Yates, MD  
Rick F. Nelson, MD, PhD*

**Objective:** To determine the prevalence of obstructive sleep apnea (OSA) in a prospective cohort of patients with spontaneous cerebrospinal fluid (sCSF) leaks of the temporal bone.

**Study Design:** Prospective cohort study

**Setting:** Tertiary referral center

**Patients:** Consecutive sCSF leak patients (21) over a 3-year period. Four patients presented with a history of OSA and 17 patients were prospectively offered PSG testing during the initial clinic encounter.

**Intervention:** Level I polysomnogram (PSG)

**Main Outcome Measures:** Patient characteristics (age, sex, BMI), apnea hypopnea index (AHI), presence of snoring, and presence of hypoxia (oxygen saturation less than 88% for > 5 minutes). OSA was defined as mild (AHI  $\geq$ 5 and <15/hr), moderate (AHI  $\geq$ 15 and <30/hr), and severe (AHI  $\geq$ 30/hr).

**Results:** The prevalence of OSA in sCSF leak patients is 83.3%. PSG studies were performed on 18 of 21 patients. There were 15 females and 6 males with an average age (SD) of 56.3 (11.3) years and an average BMI of 35.3 (7.7) kg/m<sup>2</sup>. Objectively, the AHI ranged from mild to severe (range = 5.7–92, median = 20.5). Snoring was present in 61% of patients and hypoxia was present in 33% of patients. sCSF leak patients with OSA were significantly older than sCSF leak patients without OSA (56.9 (8.3) vs. 43.8 (11.3) years, p=0.02).

**Conclusions:** OSA is highly prevalent among patients with sCSF leaks. All patients with sCSF leaks should undergo formal polysomnogram testing. Future studies are needed to determine the role of OSA in the development of sCSF leaks.

**Define Professional Practice Gap & Educational Need:** Lack of understanding of the relationship between obstructive sleep apnea and spontaneous cerebrospinal fluid leaks.

**Learning Objective:** To determine the prevalence of obstructive sleep apnea in a prospective cohort of patients with spontaneous cerebrospinal fluid leaks of the temporal bone

**Desired Result:** All patients evaluated for lateral skull base spontaneous CSF leaks should undergo a formal polysomnogram.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 4

## **Prediction of Hearing Outcomes Using Intraoperative Monitoring for Removal of Vestibular Schwannomas via a Middle Cranial Fossa Approach**

*C. Blake Sullivan MD; Daniel Q. Sun MD  
Raymund W. Kung MD; Megan Asklof  
Marlan R. Hansen MD; Bruce J. Gantz MD*

**Objective:** To evaluate the association between signal changes during intra-operative audiologic monitoring and post-operative audiometric outcome in patients undergoing vestibular schwannoma (VS) resection via middle cranial fossa (MCF) approach.

**Study Design:** Retrospective chart review

**Setting:** Academic tertiary referral center

**Patients:** One hundred twenty five consecutive patients (mean age 48.6 years, range 16-67; mean tumor size 9.9mm, range 1.8-18.9 mm) who underwent MCF VS resection.

**Interventions:** Intra-operative audiologic monitoring using auditory brainstem reflex (ABR) and direct cochlear nerve action potential (CNAP).

**Main outcome measures:** Intra-operative ABR wave V and CNAP amplitudes and post-operative pure-tone average (PTA) and word recognition score (WRS).

**Results:** On ABR, decreased wave V amplitude or absent waveform was associated with 65.3% and 81.1% increase, respectively, in post-operative PTA; and 63.8% and 82.3% decrease, respectively, in post-operative WRS. Similarly, decreased amplitude or absent waveform on CNAP was associated with 47.3 and 100% increase, respectively, in post-operative PTA; and 45.3% and 100% decrease, respectively, in post-operative WRS. Receiver-operating curve analysis showed that ABR combined with CNAP achieved the highest diagnostic accuracy in predicting post-operative hearing decline (sensitivity 70.3%, specificity 100%), and performed better compared to each modality alone (ABR: sensitivity 60.3%, specificity 92.4%; CNAP: sensitivity 57.9%, specificity 100%).

**Conclusions:** Intra-operative ABR wave V and CNAP amplitude changes are associated with changes in post-operative hearing, and dual modality monitoring was more diagnostic of post-operative hearing decline compared to each modality alone during MCF VS resection. Overall, intra-operative ABR and CNAP were more specific than sensitive for post-operative hearing decline.

**Define Professional Practice Gap & Educational Need:** There is a lack of contemporary knowledge in regards to intraoperative auditory monitoring during middle cranial fossa tumor removal and how these monitoring methods are related to postoperative hearing loss.

**Learning Objective:** To demonstrate that dual modality auditory monitoring intraoperatively is a better predictor of postoperative hearing loss compared to single modality monitoring.

**Desired Result:** Assess one's institutional techniques for monitoring auditory changes during middle cranial fossa tumor removal and that dual modality monitoring can be used as a more predictive guide to counsel patients about potential postoperative hearing loss.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Impact of Cochlear Implantation on Environmental Sound Awareness**

*Kevin R. McMahon, BS; Aaron C. Moberly, MD  
Michael S. Harris, MD*

**Objective:** To determine if post-lingually deaf adult cochlear implant (CI) users have better environmental sound awareness (ESA) compared to adult patients eligible for CIs who have not yet undergone implantation.

**Study Design:** Cross-sectional cohort study.

**Setting:** Tertiary referral center

**Patients:** A group of 42 post-lingually deaf adult patients who are experienced CI users (ECI), and a group of 19 post-lingually deaf adult patients who are CI candidates (CIC) awaiting implantation.

**Intervention:** Cochlear implantation

**Main outcome measure:** Environmental sound awareness as measured by accuracy using a computerized, Familiar Environmental Sounds Test—Identification (FEST-I).

**Results:** There was no significant difference between environmental sound awareness in our sample of ECI users versus CIC patients. The ECI users scored an average FEST-I accuracy of 60% (SD 15). In comparison, the CICs had an average FEST-I accuracy of 52% (SD 26). This difference was not statistically significant. To determine if the observed similarity in environmental sound awareness between groups was related to differences in pre-operative auditory perception abilities (e.g., if CIC participants had better pre-operative hearing than ECI users), we also compared pre-implantation best-aided AzBio sentence recognition performance where available from clinical records: these scores were similar between groups (ECI 57%, CIC 56%, respectively).

**Conclusions:** Our findings suggest that, despite the commonly held notion that environmental sound awareness may be a benefit of cochlear implantation, our sample of ECI users did not demonstrate superior environmental sound awareness performance compared to CICs.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge regarding the impact of cochlear implantation on environmental sound awareness.

**Learning Objective:** To determine if cochlear implantation improves environmental sound awareness in the post-lingually deaf population.

**Desired Result:** Attendees will be able to provide cochlear implant candidates with information on the expected impact of cochlear implantation on environmental sound awareness.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Imaging in the Diagnosis and Management of Necrotizing Otitis Externa: A Survey of Practice Patterns**

*Timothy Cooper, MD; Douglas Hildrew, MD  
Jacob S. McAfee, MD; Andrew A. McCall, MD  
Barton F. Branstetter IV, MD; Barry E. Hirsch, MD*

**Objective:** To survey neurotologists and head and neck radiologists regarding use of imaging in the diagnosis and management of necrotizing otitis externa (NOE).

**Participants:** Neurotologists and head and neck radiologists with membership in either the American Neurotology Society or The American Society of Head and Neck Radiology.

**Intervention:** Cross sectional online survey study distributed through email to specialty society membership lists.

**Main outcome measures:** Responses to survey consisting of 2 demographics and 7 clinically oriented questions related to the use of imaging in the diagnosis and management of NOE.

**Results:** 136 participants responded to the survey. The imaging modality of choice in establishing the diagnosis of NOE selected by the respondents was computed tomography (CT) (37.5%) followed by technetium scintigraphy (21.3%). Magnetic resonance imaging (MRI) was the preferred investigation by 41.9% of participants for determining extent of disease. Gallium scanning was the imaging modality preferred by 32.4% of respondents for determining when to cease medical therapy. Ninety-five percent of participants responded that CT scans were always or frequently used in the diagnosis and management of NOE compared to 72.8% for MRI, 34.5% for gallium scans, and 34.2% for technetium scans.

**Conclusions:** There is considerable heterogeneity in the preferred imaging modalities used in the diagnosis and management of NOE. CT and MRI are the preferred contemporary modalities utilized by many physicians, demonstrating a shift away from the historic use of nuclear medicine scans.

**Define Professional Practice Gap & Educational Need: (Examples:** Necrotizing otitis externa (NOE) is a rare condition involving invasive infection and osteomyelitis of the temporal bone. The diagnosis and management of this condition is supported by imaging studies including computed tomography (CT), magnetic resonance imaging (MRI), and nuclear medicine scans. However, a widely accepted protocol outlining the use of imaging in NOE has not been established and there is significant variation in the use of diagnostic imaging studies.

**Learning Objective:** At the conclusion of this activity, the learner will be able to: 1. Recognize the heterogeneity in the use of imaging in the management of NOE by neurotologists and head and neck radiologists. 2. Describe the strengths and limitations of imaging studies commonly used in NOE. 3. Evaluate their own practice pattern in the use of imaging in the diagnosis and management of NOE.

**Desired Result:** To stimulate discussion on the utility and availability of imaging modalities in the diagnosis and treatment of NOE.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 5

# **Novel Computer-based Therapy Enhances Speech Perception in Cochlear Implant Users**

*Akshay R. Narayan, MBBS*

**Introduction:** Our main goal was to investigate if personalized auditory therapy in the comforts of patient's homes, is more effective at improving speech perception than conventional computer-based auditory therapy in cochlear implant users.

**Methods:** In this randomized, prospective study, candidates were split into two groups. In round one, candidates underwent testing to record the percentage of correctly identified words. In round two, they received training by listening to sentences and identifying the constituent words. If they could not identify a word correctly, the sentence was replayed identically for candidates in the first group. In the second group, emphasis was placed on the difficult words by varying its tone and pitch. In round three, they underwent testing again and the percentage of words they were able to correctly identify before and after training was compared. A paired t-test was used to look for any significant difference in the levels of improvements.

**Results:** There were 8 and 9 candidates in the first and second group respectively. The mean percentages for candidates in the first round of testing in the first and second groups were 50.63%(95%CI 37.3-65.2) and 53.5%(95%CI 38.1-69.3). The mean percentages for candidates in the second round of testing were 52.5%(95%CI 38.4-68.2) and 67.78%(95%CI 54.6-80.9). The mean improvement in scores was greater in those in the second group than first group( $p=0.0432$ ).

**Conclusion:** Given our new computer program improves their speech perception to a greater extent, broadening the study to a larger patient population would be ideal.

**Define Professional Practice Gap & Educational Need:** Auditory therapy is offered post-surgery to cochlear implant users and helps them to differentiate between specific sounds, phonemes, and identify words. In the UK, there are very limited facilities for provision of auditory therapy. The main limitations of auditory therapy in the UK are twofold: 1) they mostly require face-to-face interaction which requires patients to come into healthcare centres to receive therapy and 2) computer-based programmes utilise the same pitch and tone.

**Learning Objective:** 1. Investigate if computer-based therapy can improve speech perception 2. Investigate if computer-based therapy with variable pitch and tone produces greater improvements in speech perception than monotonous computer-based therapy

**Desired Result:** 1. Appreciate that auditory therapy can be provided in the comforts of the patient's home 2. Appreciate that computer-based therapy can be tailored to the unique needs of the patient

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 2

## **Association Between Smoking and Dizziness in the U.S. Adult Population**

*Eric J. Formeister, MD, MS; Jeffrey D. Sharon, MD*

**Objective:** To examine the relationship between smoking and dizziness in the U.S. adult population.

**Study Design:** Cross-sectional survey study.

**Setting and Subjects:** Non-incarcerated U.S. adults who responded to the National Health Interview Survey in 2008 (n = 21,781).

**Patients:** n/a

**Interventions:** Diagnostic

**Main Outcome Measures:** Self-reported smoking status and/or dizziness problem.

**Results:** Of the 21,781 adults in the survey, 41.8% smoked more than 100 cigarettes in their lifetime. Of the 2,490 adults who had a self-diagnosed problem with dizziness, 54.1% had smoked more than 100 cigarettes in their lifetime. This corresponded to an odds ratio of 1.72 (95% CI, 1.56 – 1.89; p<0.001) for experiencing dizziness with a history of smoking. In a multivariate analysis that included prior lung disease (asthma, emphysema) preexisting cardiovascular disease, diabetes, hypertension, prior stroke, prior head trauma, age, sex, hearing loss, and vision loss, anxiety, depression, and history of migraines, smoking was still a significant risk factor for dizziness (OR 1.30; 95% CI, 1.17 – 1.46; p<0.001).

**Conclusions:** In a representative nationwide survey of U.S. adults, smoking is an independent risk factor for dizziness, even after controlling for demographic variables, known risk factors for dizziness, and smoking related diseases.

**Define Professional Practice Gap & Educational Need:** 1. Lack of contemporary knowledge of the association between smoking and dizziness within the context of a large, population-based study. Dizziness is an extremely common presenting complaint to otolaryngologists and neurotologists, but very little is known about the epidemiologic associations between demographic variables, preexisting conditions, and social habits such as smoking in the U.S. population, when studied on a large, population-based scale.

**Learning Objective:** 1. To describe the association between smoking and dizziness in the adult U.S. population. 2. To show, through multivariate analyses, that smoking is an independent risk factor for dizziness in the adult U.S. population. after controlling for other smoking-related diseases and other known risk factors for dizziness.

**Desired Result:** Attendees will better understand the association between smoking and dizziness, and will hopefully ask all dizzy patients about smoking history and offer smoking cessation counseling or therapeutic interventions for smoking cessation, if needed.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 3



**Pilot Study of Diffusion MRI Tractography for Identification  
of the Cochleovestibular Nerve in Children  
with Unilateral Profound Sensorineural Hearing Loss**

*Elina Kari, MD; Courtney Voelker, MD, PhD  
Marta Kulich, BA; Ryan B. Cabeen, PhD  
Arthur W. Toga, PhD; Laurel M. Fisher, PhD*

**Objective:** To develop a reliable measure of cochleovestibular nerve (CVN) integrity in children with sensorineural hearing loss as a guide for cochlear implantation. Current imaging protocols do not provide biomarker information for the integrity, size, or functional ability of the CVN. This information is urgently needed for parent counseling before cochlear implant surgery.

**Study Design:** Feasibility study

**Setting:** Academic pediatric clinic and imaging center

**Patients:** Children with unilateral SNHL who are able to tolerate magnetic resonance imaging without sedation (n=3, average 11 years old, 1M, 2F)

**Intervention(s):** Diffusion-weighted magnetic resonance imaging (dMRI) of the temporal bone was conducted with voxel size  $1.5\text{mm}^3$  and a multi-shell protocol, 28 scans at  $b=0\text{s/mm}^2$ , 185 scans at  $b=1500\text{s/mm}^2$ , and 184 scans at  $b=3000\text{s/mm}^2$ . Pre-processing the imaging data reduced the effects of noise, motion, eddy currents, and susceptibility-induced distortion. Geometric models of each CVN were reconstructed using multi-fiber streamline tractography with manually placed seed, inclusion, and exclusion masks drawn relative to the baseline scan.

**Main outcome measure(s):** Acquisition protocol parameters, hearing, and dMRI CVN size, density, and tracts from the bony structures to the brainstem.

**Results:** The dMRI acquisition protocol was refined and CVN was visualized for all subjects. The small areas within the temporal bone had some movement artefact, primarily from respiration. The respiration artefact indicates that transition to a clinical measure will require sedation in children. Hearing and tractography-derived nerve morphometry were significantly associated.

**Conclusions:** dMRI is promising for excellent CVN visualization and for prognostic information in children with abnormal inner ear anatomy.

**Define Professional Practice Gap & Educational Need:** 1. Inconsistencies between conventional imaging and integrity of the CVN 2. Lack of a biomarker for functional status of the CVN as it pertains to counseling before cochlear implant surgery

**Learning Objective:** 1. Conventional imaging is not adequate for assessing the integrity, size, or functional ability of the CVN 2. DTI of the temporal bone is a novel approach for visualization of the CVN and providing prognostic information in children with abnormal inner ear anatomy

**Desired Result:** Attendees will recognize DTI of the IAC as a prospective tool to improve counseling before cochlear implant.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Evaluation of 3D Printed Temporal Bone Models in Preparation for Middle Cranial Fossa Surgery**

*Monika E. Freiser, MD, MPH; Anish Ghodadra, MD  
Barry E. Hirsch, MD; Andrew A. McCall, MD*

**Hypothesis:** Patient-specific 3D printed models are useful pre-surgical planning tools because they accurately represent the anatomy and drilling characteristics of the middle cranial fossa (MCF) approach to the internal auditory canal (IAC).

**Background:** The MCF surgical approach to the IAC can be challenging due to variability of the bony architecture along the floor of the middle fossa. Patient-specific 3D printed models may enhance surgeon knowledge of a given patient's anatomy when preparing for MCF surgery.

**Methods:** Six temporal bone models were printed from photoacrylic resin based on CT data obtained from cadaveric specimens using a previously described method. Critical structures to avoid injuring, the facial nerve and membranous labyrinth, were modeled as hollow cavities and filled with indicator paint. Two neurotologists performed drilling of the models followed immediately by drilling of the corresponding cadaveric specimen, and then completed a 41-item questionnaire (score range of each item: 0-10) to assess the model's accuracy, utility, and potential as a training tool.

**Results:** Drilling the model was favorably rated (median score 9.2; range 7.3-9.6) for its ability to provide surgeons with an accurate mental image of the corresponding cadaveric anatomy. Overall similarity of feel of drilling the model in comparison to human bone was moderate (median 7.6; range 6.6-9.0). Surgeons would use this model to prepare for future cases (median 9.4; range 5.1-9.9) and felt it had excellent utility for training purposes (median 9.3; range 8.4-9.9).

**Conclusions:** Patient-specific 3D printed models provide an anatomically accurate and favorable tool for preparing for MCF surgery.

**Define Professional Practice Gap & Educational Need:** With recent significant advancements in 3D printing technology, new opportunities to enhance surgeon preparation for cases in a patient-specific manner using 3D printing technologies are now possible. The MCF approach to the IAC can be particularly challenging given the variability of the bony architecture along the floor of the middle fossa. We address this challenge by developing a novel 3D printed model designed to demonstrate specific bony architecture in relation to underlying critical structures and evaluate its accuracy, utility, and potential as a training tool.

**Learning Objective:** 1. Recognize the strengths and weaknesses of using a patient-specific 3D printed model for middle cranial fossa surgery preparation and training. 2. Describe how to create patient-specific 3D printed temporal bone models with indicator colors to identify critical structures using a commercially available 3D printer. 3. Evaluate the utility of this model in the context of their own practice environment.

**Desired Result:** To expand the capabilities of both trainees and seasoned neurotologists to prepare for middle cranial fossa cases in a novel patient-specific manner. To inspire further work in 3D printing for trainee education and case preparation.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 5

## **Diaph3 Expression and Localization in the Inner Ear Suggests Constitutive Function**

*Laura K. House, MD; Bradley J. Walters, PhD*

**Hypothesis:** Diaphanous homolog 3 (DIAPH3) is expressed in the developing and mature inner ear and may contribute to normal function.

**Background:** Auditory neuropathy is a clinical entity characterized by abnormal or absent ABRs, with normal outer hair cell function and without evidence of CNS lesions. Mutations in the DIAPH3 gene that cause its overexpression are linked to nonsyndromic auditory neuropathy. However, whether DIAPH3 is constitutively expressed in the inner ear and whether it contributes to normal hearing or balance function remain unanswered questions.

**Methods:** Mouse embryos taken at embryonic day (E)14.5 and temporal bones from 30-day old (P30) mice, were cryosectioned and in situ hybridization was conducted using probes specific for mouse Diaph3. Sections were co-labeled with antibodies against parvalbumin or p27<sup>Kip1</sup> to label hair cells and neurons, or prosensory cells, respectively.

**Results:** Consistent with previous reports, Diaph3 was highly expressed in the lateral ventricles at E14.5, but was also detected in the cochlear duct, in the vestibulocochlear ganglia, and in the developing vestibular epithelia. At P30, Diaph3 was detectable in cochlear hair cells and supporting cells, but in the vestibular organs was only prominent in hair cells.

**Conclusions:** Constitutive expression of Diaph3 in sensory and nonsensory cells of the inner ear during development and adulthood suggest that Diaph3 likely plays a role in the development and function of the inner ear sensory organs. Therapeutic strategies to reduce DIAPH3 expression or function in patients with DIAPH3 mutations may therefore require careful titration so as not to harm constitutive function.

**Define Professional Practice Gap & Educational Need:** Knowledge regarding causes of auditory neuropathy and diagnosis of auditory neuropathy are not well described in the literature. Therefore, practice patterns of physicians diagnosing and treating auditory neuropathy inevitably vary.

**Learning Objective:** The learner will gain knowledge regarding DIAPH3 gene and how it may play a role in inner ear development and function, specifically relating to auditory neuropathy.

**Desired Result:** Knowledge from this presentation may affect therapeutic strategies aimed at patients with DIAPH3 mutations.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** Does not apply- Basic Science Research

## **The Incidence of Vestibular Schwannoma in Patients with Sudden Sensorineural Hearing Loss**

*Takeshi Fujita, MD, PhD; Kazuya Saito, MD  
Toru Seo, MD, PhD; Katsumi Doi, MD, PhD*

**Objective:** To assess the incidence of vestibular schwannoma (VS) in patients with sudden sensorineural hearing loss (SSNHL).

**Study design:** Retrospective chart review.

**Setting:** Tertiary academic center

**Patients:** Eight hundred sixty-one patients who were diagnosed or treated for SSHNL.

**Intervention:** Patients with SSNHL underwent Magnetic resonance imaging (MRI). The MRI images were reviewed retrospectively.

**Main outcome measure:** Incidence of VS found by MRI in patients with SSHNL.

**Results:** From 2008 to 2017, 499 patients out of 861 patients underwent MRI scans in our department. Of the 499 cases, tumors were found at the cerebellopontine angle in 16 cases (3.21%). In 16 cases, 9 were with VS Koos grade I, intracanalicular tumor. Six were with Koos grade II, up to 2 cm. One was Grade III, up to 3 cm. None of the tumors were with Koos Grade IV, which consist of large tumors with displacement of the trunk or cranial nerves.

**Conclusions:** The incidence of VS patients in SSNHL patients found by MRI was 3.21%. Since the ratio is not low, further examinations besides audiometry should be considered for the patients with SSNHL.

**Define Professional Practice Gap & Educational Need:** Lack of precise data about VS incidence in patients with SSNHL.

**Learning Objective:** Awareness of the VS incidence in SSNHL patients and utilization of the obtained information to improve patient care.

**Desired Result:** The attendees will obtain additional information for counseling of patients with SSNHL.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Intra-operative Evaluation of the Cochlear Implant Electrodes Using Intra-Operative Mobile Cone-beam CT**

*Norio Yamamoto, MD, PhD; Takayuki Okano, MD, PhD  
Hiroshi Yamazaki, MD, PhD; Harukazu Hiraumi, MD, PhD  
Tatsunori Sakamoto, MD, PhD; Juichi Ito, MD, PhD  
Koichi Omori, MD, PhD*

**Objective:** To evaluate the electrode status during cochlear implantation (CI) using mobile cone-beam CT (mCBCT)

**Study design:** Retrospective case review

**Setting:** Tertiary referral hospital

**Patients:** Forty-four patients (four bilateral surgeries) who underwent cochlear implantation (CI) and took the intra-operative mCBCT images. Nineteen patients were less than 10 years old (mean age: 3.3 years old).

**Intervention:** Cochlear implantation and CBCT during surgery

**Main outcome measure:** The electrode location and angular insertion depth (AID) determined by intra-operative mCBCT images.

**Results:** Five were cochlear malformation cases where intra-operative mCBCT was useful to confirm the electrode location. Among 43 cases with normal cochlear morphology, perimodiolar, slim straight and mid-scalar electrodes were used in 20 (cochleostomy), 22 (21 round window (RW) and one extended round window (ERW) insertion), and 1 (RW insertion) cases, respectively. Complete scala-tympani (ST) insertion was achieved in 23 cases (six cochleostomy and 17 RW or ERW cases). The complete ST-insertion rate was significantly higher in the RW or ERW insertion than cochleostomy insertion ( $p=0.006$ ). The AID values (average  $\pm$  standard deviation) for perimodiolar electrodes ( $346.9 \pm 20.99$  degrees) were significantly smaller than those for Cochlear slim straight ( $389.7 \pm 43.22$  degrees), Flex24 ( $464.8 \pm 114$  degrees), and Flex28 ( $517.0 \pm 43.09$  degrees) electrodes ( $p<0.05$ ).

**Conclusions:** Evaluation results of the CI electrodes by intra-operative mCBCT were comparative to those utilizing fan-beam CT or C-arm based CBCT. Considering the low radiation dose of mCBCT and its availability in any operation room, mCBCT is the better selection as a modality to evaluate CI electrodes.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge regarding the usefulness of the intra-operative mobile cone-beam CT for cochlear implantation.

**Learning Objective:** To learn how intra-operative mobile cone-beam CT images can show the status of cochlear implant electrodes.

**Desired Result:** The attendees will understand the merit of using mobile cone-beam CT during the cochlear implantation surgery.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Application of Ultrasonic Bone Aspirator for Decompression of the Internal Auditory Canal via the Middle Cranial Fossa Approach**

*Gavriel D. Kohlberg, MD; Noga Lipschitz, MD  
Zoe Walters, BA; Kareem O. Tawfik, MD  
Joseph T. Breen, MD; Mario Zuccarello, MD  
Ravi N. Samy, MD*

**Objective:** To evaluate the safety and efficacy of the ultrasonic bone aspirator (UBA) during the middle cranial fossa (MCF) approach to vestibular schwannoma (VS).

**Study design:** Retrospective case series.

**Setting:** Tertiary referral center.

**Patients:** The charts of 192 VS patients over 18 years of age were reviewed to identify 26 patients who underwent MCF approach to VS resection with use of the UBA for decompression of the internal auditory canal (IAC) between 2012 and 2017.

**Intervention(s):** Use of the UBA during vestibular schwannoma surgery via MCF approach for decompression of the IAC.

**Main outcome measure(s):** Post-operative facial nerve outcomes are reported using the House-Brackmann (HB) facial nerve grading scale. Rates of gross total resection are also reported.

**Results:** Twenty-six patients underwent IAC decompression with UBA via MCF approach. Twenty-four out of twenty-six patients (92%) had a postoperative HB Grade I or II facial nerve function. Twenty-five out of twenty-six patients (96%) had gross total resection of their tumor. There were no instances of a transected facial nerve or of entrance into the cochlea or ampullated portion of the superior semicircular canal in any case.

**Conclusions:** Ultrasonic bone removal is a safe and effective alternative to high speed drilling during MCF approach to expose the IAC contents. This surgical tool allows for bone removal with a low risk of injury to adjacent structures.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of Ultrasonic Bone Aspirator (UBA) as a tool for skull base surgery.

**Learning Objective:** To promote awareness of the ability to use UBA for decompression of the internal auditory canal during middle cranial fossa surgery for vestibular schwannoma resection.

**Desired Result:** Provide insight into the application of UBA for internal auditory canal decompression during middle cranial fossa approach to vestibular schwannoma resection.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## Prevalence of Radiographic Cochlear-Facial Dehiscence

*Yohan Song, MD; Jennifer C. Alyono, MD  
Ryan A. Bartholomew, BS; Yona Vaisbuch, MD  
C. Eduardo Corrales, MD; Nikolas H. Blevins, MD*

**Objective:** To determine the prevalence of radiographic cochlear-facial dehiscence (CFD).

**Study Design:** Retrospective radiological study

**Setting:** Two Tertiary-Referral Centers

**Patients:** 206 temporal-bone computed tomography (CT) scans (405 total ears) of otology/neurotology clinic patients at two academic institutions between the years 2014-2017.

**Intervention:** Diagnostic

**Main Outcome Measures:** The Cochlear-facial partition width (CFPW) was measured on coronal cross-sections and defined as the shortest distance between the cochlear basal turn and FN labyrinthine segment. We used multiple regression analyses to determine positive predictors for CFD. Our variables included age, sex, CT slice-thickness, Cone-beam CT use, fallopian-canal width, cochlear and FN pathologies, and presence of other third windows.

**Results:** The overall prevalence of radiographic CFD was 6.4% (26/405 ears). 10.6% of patients (22/206) had CFD. Of these 22 patients, only one patient had mixed hearing loss that could not be explained by any other vestibular or auditory pathology. 4 out of 206 patients had dehiscence in both ears (1.9%). The average CFPW was  $0.6 \pm 0.2$  mm, and fallopian canal width was  $1.3 \pm 0.2$  mm (n=405). The prevalence of SCCD in our cohort was similar to that of CFD at 6.9% (28/405 ears). None of our variables were significant predictors for radiographic CFD.

**Conclusions:** Our data demonstrates that the prevalence of radiographic CFD may be higher than what is reported in histologic studies and may over-estimate the true prevalence of CFD.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge of the significance of cochlear-facial dehiscence.

**Learning Objective:** Provide further information of what a cochlear-facial dehiscence could signify when discovered on radiographic imaging.

**Desired Result:** Our study may help clinicians determine the significance of cochlear-facial dehiscence when discovered on imaging.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

# **Round Window Reinforcement versus Transmastoid Superior Canal Occlusion in the Treatment of Superior Semicircular Canal Dehiscence Syndrome**

*Horace C.S. Cheng, MD; Kevin Krysiak  
Sumit K. Agrawal, MD; Lorne S. Parnes, MD*

**Objective:** Outcome study of round window reinforcement (RWR) and canal occlusion (CO) to treat superior canal dehiscence syndrome (SCDS)

**Study design:** Prospective case series comparing RWR and CO procedures

**Setting:** Tertiary referral center

**Patients:** Diagnosis of superior semicircular canal dehiscence by clinical history, physical exam, imaging, and other ancillary testing. Consecutive patients undergoing primary surgery between 2010 – 2016. Twenty-three RWR procedures and sixteen CO procedures included in the study.

**Intervention(s):** The two surgical interventions, RWR and CO, were performed and results analyzed

**Main outcome measure(s):** Symptom questionnaire scores and audiometric data

**Results:** We collected and analyzed data using a published, nine-item questionnaire. Both surgical techniques achieved statistically significant improvement in symptom scores: 40% improvement ( $p < 0.001$ ) for RWR and 56.5% improvement ( $p < 0.001$ ) for CO. The difference in score improvement between the two groups was statistically significant ( $p = 0.011$ ). Preoperative and postoperative audiometric data showed no difference in hearing outcomes using the two surgical interventions. One patient who failed RWR went on to receive CO with a good result.

**Conclusions:** Round window reinforcement and transmastoid canal occlusion are both effective and safe treatments for symptoms associated with SCDS. The former is less invasive while the latter seems more effective. Treatment decisions should be made on a case by case basis using a patient-centered approach.

**Define Professional Practice Gap & Educational Need:** 1. The round window reinforcement and transmastoid canal occlusion approaches have been described as surgical treatment options for superior semicircular canal dehiscence (SSCD) syndrome. Analysis of outcome data for these surgical options is needed to evaluate their efficacies and safety.

**Learning Objective:** 1. Understand the round window reinforcement and transmastoid canal occlusion approaches. 2. Become familiarized with a nine-item questionnaire for standardized evaluation of SSCD symptom severity. 3. Evaluate the efficacies and safety of the two procedures.

**Desired Result:** 1. Incorporate a consistent symptom severity metric in assessing patients with SSCD. 2. Use the data provided to appraise the two surgical approaches. 3. Apply the appropriate surgical option in a patient-centered approach.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5



## **Complex Pitch Perception in Cochlear Implant Users: A Comparison of Monopolar and Tripolar Stimulation**

*Divya A. Chari, MD; Patpong Jiradejvong, MD  
Charles J. Limb, MD*

**Objective:** Cochlear implant (CI) users struggle with pitch perception, particularly for polyphonic stimuli. Tripolar stimulation has been proposed as a way to mitigate the broad spread of neural excitation observed in traditional monophasic stimulation, thereby potentially improving perception of polyphony. We evaluated the effect of tripolar stimulation on pitch perception in CI users.

**Study design:** Prospective cohort study.

**Setting:** Tertiary academic center.

**Patients:** Six post-lingually deafened adults with Advanced Bionics HiRes 90K CIs.

**Intervention(s):** To assess pitch discrimination, users were asked to identify the higher pitch between two notes. In polyphonic pitch testing, users were asked to distinguish between single-pitch tones and two-pitch tones. Two-pitch stimuli consisted of one of three base frequencies (392, 523, 740 Hz) and one pitch between one and 12 semitones above the base frequency. Testing was performed under monopolar and tripolar configurations.

**Main outcome measure:** Response rates were analyzed as a function of pitch distance, with smaller semitone intervals indicating better performance.

**Results:** In pitch discrimination, tripolar configuration did not confer an advantage over monopolar configuration. In polyphonic perception, however, tripolar stimulation improved performance in lower frequencies and resulted in statistically significant ( $p < 0.05$ ) improvement at the highest frequency, 740 Hz. Data acquisition with additional subjects is currently underway to determine the statistical robustness of these findings.

**Conclusions:** These data suggest that tripolar configuration may confer an advantage in the perception of polyphonic pitch, which may not be observed in monophasic pitch discrimination tasks. Since music is typically polyphonic, such data offer approaches towards improving perception of musical polyphony.

**Define Professional Practice Gap & Educational Need:** 1. Lack of awareness about poor music perception among cochlear implant users. 2. Lack of contemporary knowledge about techniques to improve pitch perception in cochlear implant users. 3. Inconsistencies within the literature regarding use of focused, experimental stimulation models to improve perception of complex sounds.

**Learning Objective:** To review the effect of a focused, experimental stimulation on complex pitch perception in cochlear implant users.

**Desired Result:** Attendees will gain an improved understanding about the effect of tripolar stimulation on the perception of complex sounds in cochlear implant users. This knowledge may then be applied to future studies within the field which may ultimately result in programming modifications that improve perception of complex pitch, such as musical polyphony.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **The Use of the Exoscope in Lateral Skull Base Surgery: Advantages and Limitations**

*Jonathan C. Garneau, MD; Benjamin M. Laitman, PhD  
Maura K. Cosetti, MD; Constantinos G. Hadjipanayis, MD, PhD  
George B. Wanna, MD*

**Objective:** We describe our experience using the extracorporeal video microscope, the “exoscope” for various applications within the field of lateral skull base surgery.

**Study Design:** A retrospective case series was performed investigating patient demographics, indications for surgery, procedure type, operative time, approach to the skull base, complications, adequacy of visualization, and surgeon comfortability.

**Patients:** Seven cases were performed with a 3 dimensional surgical exoscope, obviating the use of a traditional binocular microscope.

**Setting:** Academic, tertiary referral center.

**Main outcome measures:** Type of surgical approach, operative time, patient demographics, surgical complications, and surgeon comfortability.

**Results:** The following procedures were performed; 5 vestibular schwannoma resections via suboccipital craniotomy (3) and translabyrinthine approach (2) and two combined transmastoid and transtemporal approaches for temporal lobe encephalocele repairs. The average operative time was 224 minutes and 553 minutes for temporal lobe encephalocele repairs and vestibular schwannoma cases, respectively. No intraoperative complications were encountered during these cases. None of the procedures required abandonment of the exoscope in favor of the microscope during the procedure. Advantages include high-resolution three-dimensional visualization, increased degrees of freedom for exoscope adjustment, and reduced surgeon fatigue in a fixed, unnatural posture. Limitations include decreased depth perception and increased operative time.

**Conclusion:** The exoscope system is a safe and effective alternative or adjunct to the existing binocular operating microscope for lateral skull based procedures. The exoscope provides the surgeon with a comfortable, high-resolution visualization without compromising surgical exposure and patient safety.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of new technology in lateral skull base surgery.

**Learning Objective:** The reader will gain knowledge about the exoscope technology and its application to a variety of lateral skull base procedures.

**Desired Result:** The attendees will be able to apply the cutting edge technology in a clinical setting and tailor its use to their practice.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 5

## **Amelioration of Pulsatile Tinnitus by Creation of a Sound Baffle**

*Yona Vaisbuch, MD; George S. Liu, AB  
Nikolas Blevins, MD; Robert K. Jackler, MD*

**Background:** Most pulsatile tinnitus (not associated with tumor or conductive hearing loss) stems from turbulent flow in the sigmoid-jugular venous system or carotid artery, which transmits sound to the middle ear via the mastoid air cell system.

**Objective:** To share our experience with insulating a dehiscence sigmoid sinus, jugular bulb, or carotid artery by resurfacing using a thick layer of hydroxyapatite.

**Study design:** Retrospective case series

**Setting:** Tertiary academic medical center.

**Patients:** Adult patients with troublesome pulsatile tinnitus emanating from the sigmoid sinus, jugular bulb, and/or intra-temporal carotid artery with radiologic evidence of dehiscence.

**Intervention:** Transmastoid (sigmoid sinus) or hypotympanic (jugular bulb or carotid artery) exposure of vessel followed by resurfacing using hydroxyapatite cement.

**Main outcomes measures:** Alleviation or reduction of pulsatile tinnitus.

**Results:** In our case series of 7 patients with a mean follow up period of 12.1 months, all 5 patients with venous etiologies (3 sigmoid sinus dehiscence, 1 jugular bulb diverticulum, 1 arachnoid granulations at transverse-sigmoid junction) treated by resurfacing had complete elimination of symptoms at most recent follow up. The 2 patients with carotid dehiscence treated by creation of a sound baffle had only partial resolution of symptoms with significantly improved QOL. There were no adverse outcomes (hearing loss, vascular injury or intracranial hypertension).

**Conclusion:** In properly selected patients, vascular resurfacing to establish a sound baffle can effectively improve pulsatile tinnitus with minimal risks.

**Define Professional Practice Gap & Educational Need:** Inconsistencies within the treatment of troublesome pulsatile tinnitus emanating from the sigmoid sinus, jugular bulb, and/or intra-temporal carotid artery.

**Learning Objective:** Vascular resurfacing to establish a sound baffle can effectively improve pulsatile tinnitus with minimal risks. Comparing the outcomes of the different techniques that were reported in the English literature.

**Desired Result:** Changes in physician knowledge regarding the outcomes of resurfacing techniques for the

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## Evidence of Restoration of Binaural Hearing in Bilateral Cochlear Implant Receiver Using Spectral Fusion Test

*Antoine Lorenzi, PhD; Anne Laure Coste, MA  
Jean Charles Ceccato, PhD; Jean Luc Puel, PhD  
Frederic Venail, MD, PhD*

**Objective:** Signal processing in cochlear implant can alter binaural hearing cues. This study aims at demonstrating that bilateral cochlear implantation restores binaural spectral fusion.

**Study design:** Prospective experimental study.

**Setting:** Tertiary referral implant center.

**Patients:** 30 subjects with bilateral cochlear implant, aged  $37\pm 20$  years. All were experienced CI users (mean use  $6.7\pm 5$  years), and had speech perception PBK scores  $>60\%$  with both CIs (mean  $85\pm 13\%$ ).

**Intervention(s):** Subjects were tested with either low-pass (LP 0-1.5 kHz) or high-pass (HP 1.5-8 kHz) filtered monosyllabic words. Fusion signals (LP in one ear and HP in the other one) were presented simultaneously to measure binaural fusion effect. SRTs for speech in noise test were calculated using the French Matrix test.

**Main outcome measure(s):** Speech perception scores were calculated for monaural HP, monaural LP, binaural full bandwidth (FB) and fusion conditions. Speech in noise SRTs were correlated with binaural fusion scores and PBK scores.

**Results:** Speech perception scores with LP and HP filtered lists were similar (43 and 38% respectively,  $p>0.05$ ). Binaural FB scores were  $92\pm 3.5\%$ . Fusion scores ( $84\pm 6\%$ ) were significantly higher than monaural scores ( $p<0.001$ ), but remained significantly lower than binaural FB scores ( $p<0.001$ ). SRT in binaural conditions was significantly higher than SRT in the best implanted ear (4.1 dB,  $p<0.05$ ) and in the worst implanted ear (16 dB,  $p<0.01$ ). Binaural SRT was positively correlated with binaural fusion score ( $r=0.84$ ,  $p<0.01$ ).

**Conclusions:** Bilateral cochlear implantation allows to restore binaural spectral fusion and enhances speech in noise perception.

**Define Professional Practice Gap & Educational Need:** Evaluation of speech perception improvement after bilateral cochlear implantation not only relies on speech perception in quiet, but also in speech perception in noise.

**Learning Objective:** Adding speech in noise and binaural fusion testing in cochlear implant recipients allows to evaluate the proficiency of binaural hearing functions.

**Desired Result:** A broader evaluation of binaural auditory function should support the use of bilateral auditory rehabilitation in severe to profound hearing impaired people, including bilateral cochlear implantation.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **A Comparison of Hearing Changes Over Time in Vestibular Schwannoma: Gamma Knife vs Observation**

*Lauren E. Miller, BS; Michael J. Ruckenstein, MD  
Jason A. Brant, MD*

**Objective:** To examine hearing loss over time for patients with sporadic vestibular schwannoma undergoing observation or following gamma knife.

**Study design:** Retrospective review

**Setting:** Tertiary academic medical center

**Patients:** Patients with sporadic vestibular schwannoma who underwent either primary observation or gamma knife and who had at least two audiograms available for review.

**Interventions:** Gamma knife radiation or observation

**Main outcome measures:** Pure tone average over time

**Results:** 202 patients met inclusion criteria. Of these, 169 underwent observation and 33 patients underwent gamma knife radiation. There was no difference in gender ( $p = 0.14$ ) or side ( $p > 0.9$ ) between groups. The mean follow up was 99 weeks for the observation group and 164 weeks for the gamma knife group ( $p=0.002$ ). For all patients, there was a significant worsening of PTA over time (0.03 dB/week,  $p = 0.001$ ), however there was not a significant different in the rate of change of PTA between the two groups ( $p = 0.1$ ).

**Conclusion:** Despite increased hearing loss over time across both groups, there was no significant difference in the change in hearing over time between the two treatment groups. This information may be yet another valuable tool for counseling to determine appropriate therapy and improve outcomes for patients diagnosed with a vestibular schwannoma.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge of hearing loss over time following vestibular schwannoma treatment

**Learning Objective:** To understand that the rate of hearing loss may not be influenced by treatment type (eg, gamma knife radiation versus observation)

**Desired Result:** Application of knowledge in treatment planning for patients with vestibular schwannoma

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Ki-67 Index as a Predictor of Vestibular Schwannoma Re-growth or Recurrence**

*James C. Prueter, DO; Douglas D. Backous, MD  
Steven W. Rostad, MD*

**Hypothesis:** Ki-67 immunohistochemical staining is predictive of increased risk of vestibular schwannoma (VS) re-growth or recurrence after resection.

**Background:** Ki-67 is a monoclonal antibody that provides a means of rapidly evaluating the growth fraction of normal and neoplastic human cell populations. There currently is no accepted biological marker to predict re-growth or recurrence in total or subtotal resected VS. A Ki-67 index of less than 3% is expected for a typical schwannoma. Cells from total or subtotal resected VS with increased mitotic activity on routine pathological study that then stain positive for Ki-67 with an index greater than 3% are presumed to be actively proliferating and pose a theoretically higher risk for re-growth or recurrence requiring treatment.

**Method:** Retrospective chart review in a tertiary skull base surgery center.

**Results:** 90 consecutive patients treated between 2014-17 were included in the study. Those with prior radiation or surgery were excluded. Five or 5.5% of our cohort (4 male; 1 female) were identified with an elevated a Ki-67 labeling index above 3%. Two required treatment for aggressive tumor re-growth after gross total resection. One opted for revision surgery and the other underwent Cyberknife therapy. Three patients were tumor free at latest, 6-12 month, MRI follow up.

**Conclusion:** Ki-67 labeling index reliably identifies VS with an elevated potential for re-growth or recurrence. In patients with an elevated Ki-67 index we recommend more frequent clinical and radiological follow-up.

**Define Professional Practice Gap & Educational Need:** To optimize the management of patients with vestibular schwannoma this research will help to educate neurotologists

**Learning Objective:** Understand the importance of Ki-67 labeling index and the impact it will have on following patients with vestibular schwannoma

**Desired Result:** Attendees will implement Ki-67 labeling index in the pathologic evaluation of vestibular schwannoma

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Cochlear MRI FLAIR Signal Changes after Hearing Preservation Surgery for Vestibular Schwannoma**

*Nathan C. Tu, MD; Gabriela Bobarnac Dogaru, BS*

*Polly Huang, BA; John L. Go, MD*

*Rick A. Friedman, MD, PhD*

**Objective:** To evaluate the change in magnetic resonance imaging (MRI) T2-weighted cochlear fluid attenuation inversion recovery (FLAIR) signal intensity in vestibular schwannoma (VS) patients undergoing hearing preservation surgery.

**Study Design:** Retrospective review

**Setting:** Tertiary referral academic center

**Patients:** All VS patients who underwent middle fossa craniotomy (MF) approach or retrosigmoid (RS) craniotomy from January 2013 to June 2017 with FLAIR sequences on preoperative and 1-year postoperative MRI, and preoperative and postoperative audiograms.

**Outcome Measure:** Using the AAO-HNS hearing classification, patients were classified as hearing preserved (Class A or B) or not preserved. Mean signal intensity of the affected cochlea was evaluated by an operator-determined region-of-interest technique delineating the middle and apical turns of the cochlea and normalized against the contralateral cochlea.

**Results:** 9 of 34 MF and 26 of 106 RS patients were identified and included. Hearing preservation rates were 89% (8/9) for MF, and 27% (7/26) for RS. There was no difference in preoperative cochlear FLAIR signal intensity between hearing preserved and non-preserved groups (1.92 vs 2.01,  $p=0.38$ ). Postoperative cochlear FLAIR signal intensity was lower in the hearing preserved group, but did not reach statistical significance (1.45 vs 1.73,  $p=0.13$ ). The hearing preserved group demonstrated greater percent decrease than the non-preserved group (-19.4% vs 0.8%,  $p=0.19$ ), but also did not reach significance.

**Conclusion:** In patients undergoing successful hearing preservation VS surgery, there is a trend toward greater improvement in cochlear FLAIR signal than in patients whose hearing is not preserved. A more highly powered and comprehensive study is required to establish statistical significance and may have potential implications in determining the timing of surgical intervention.

**Define Professional Practice Gap & Educational Need:** Lack of awareness regarding the utility of cochlear FLAIR signal in vestibular schwannoma patients.

**Learning Objective:** To gain knowledge regarding the use of cochlear FLAIR signal in vestibular schwannoma management and to understand how the signal may change after surgical intervention.

**Desired Result:** Consideration of cochlear FLAIR signal in counseling patients regarding the need for and timing of surgical intervention for vestibular schwannoma.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Prevalence and Outcome of Hemifacial Spasm following Radiosurgical Treatment of Skull Base Tumors**

*Si Chen, MD; William H. Slattery III, MD  
Mia E. Miller, MD*

**Objective:** To determine the prevalence and clinical features of hemifacial spasm (HFS) following stereotactic radiosurgery (SRS) for lateral skull base tumors.

**Study design:** Retrospective case review

**Setting:** Tertiary referral center

**Patients:** Seventy-seven patients underwent SRS for skull base tumors; 45 tumors were vestibular schwannomas (VS) of the internal auditory canal and cerebellopontine angle (IAC/CPA), 4 facial nerve (FN) schwannomas (FS), 4 lower cranial nerve schwannomas, 6 meningiomas, 11 glomus tumors, and 7 malignant tumors. Of the non-VS and -FS tumors, one involved the CPA, 4 were located in the petrous bone, and others involved the jugular foramen, temporal lobe and cerebellar peduncle. Mean age was 64.8 years (17.4-87.3); mean follow-up was 27.3 months (1-59).

**Intervention(s):** None

**Main outcome measures (s):** 1) Prevalence of HFS; 2) Time between SRS and development of symptoms; 3) Persistence of HFS.

**Results:** Five patients (6.5%) developed new onset HFS after SRS (median time 32 months, range 19 – 40), including 4 VS and 1 FS (9% vs. 25%). In 2 patients HFS resolved spontaneously. Three patients had persistent HFS after an average of 12 months. One additional VS patient with prior HFS did not improve with SRS. Patients with pre-SRS abnormal FN function did not develop HFS, and one patient developed facial paresis without HFS after SRS.

**Conclusions:** Prevalence of HFS after SRS is low and is delayed. HFS only developed in patients with FS and VS; HFS risk is increased for tumors intrinsic to the IAC/CPA. HFS is independent of pre- and post-SRS FN function.

**Define Professional Practice Gap & Educational Need:** Hemifacial spasm have been noted in patients treated with stereotactic radiosurgery surgery for skull base tumors. There is currently no published study which specifically examined the prevalence, risk factors, and clinical outcome of hemifacial spasm related to radiosurgery.

**Learning Objective:** To understand the prevalence, risk factors, and clinical outcomes of hemifacial spasm after radiosurgery.

**Desired Result:** At the conclusion of the presentation, the audience should be better equipped to counsel patients on the probability of developing hemifacial spasm after stereotactic radiosurgery treatment of skull base tumors, and its anticipated clinical course. This allows for informed decision-making regarding further treatments such as medication or botulism injection for radiation-related hemifacial spasm.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5



## **Outcomes following the Shield vs. Palisade Graft Technique during Combined Tympanoplasty and Ossicular Chain Reconstruction**

*Galit Almosnino MD; Seth R. Schwartz, MD, MPH*

**Objectives:** 1) Discuss different approaches to cartilage grafting of the tympanic membrane. 2) Compare outcomes of the shield versus palisade technique combined with ossiculoplasty.

**Study Design:** Retrospective, case-control

**Setting:** Tertiary referral teaching hospital

**Patients:** Patients undergoing cartilage tympanoplasty and ossicular chain reconstruction for Eustachian tube dysfunction by one surgeon between 2006-2016 were identified. Patients with cholesteatoma were excluded. Thirty nine patients were included. Patients underwent a tympanoplasty with a shield (n=16) or palisade (n=23) graft and partial or total ossiculoplasty. Demographic information and medical history, including prior tube placement, tympanic membrane atelectasis or perforation was collected.

**Intervention:** Shield vs. palisade graft for tympanoplasty with ossiculoplasty.

**Main Outcome Measures:** Improvements in pure tone average (PTA), speech discrimination scores (SDS), revisions and complications.

**Results:** The average patient age in the shield group and palisade group was 42.3 and 42.1, respectively. The preoperative PTA was significantly greater in the palisade group (55.3 dB vs 45.7 dB). The pre-op SDS for the shield group was greater than the palisade group but the difference was not significant (96% vs 87%). The postoperative improvement in PTA was no different between groups (17 dB for shield, 17.4 dB for palisade). The postoperative SDS in the shield group and palisade group was 95.6% and 84.6%, respectively. There were two complications reported in each group but no revisions.

**Conclusion:** Cartilage tympanoplasty with ossiculoplasty addresses hearing loss and Eustachian tube disease concurrently. In this study, there were no significant differences in hearing outcomes, revisions and complication rates for patients undergoing a shield vs. palisade graft during combined tympanoplasty and ossiculoplasty.

**Define Professional Practice Gap & Educational Need:** 1. Inconsistencies in outcomes following different approaches to cartilage grafting of the tympanic membrane.

**Learning Objective:** 1. Discuss the different approaches to cartilage grafting of the tympanic membrane. 2. Compare outcomes of the shield graft versus palisade graft technique for tympanoplasty in combination with ossiculoplasty.

**Desired Result:** Improve knowledge regarding the shield graft technique and palisade graft technique for tympanoplasty with concurrent ossiculoplasty, including indications for each approach, technique details, outcomes and potential complications.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Long-Term Outcomes of Primary Radiosurgery Treatment of Glomus Jugulare Tumors: A Systematic Review with Meta-Analysis**

*Scott Shapiro, MD; Brian Kellermeyer, MD  
Jad Ramadan, MS; Garrett Jones, BS  
Brian Wiseman, BS; Adam Cassis, MD*

**Objective:** Determine long-term tumor control, symptomatic control, and complications of primary radiosurgery (PRS) for the treatment of glomus jugulare tumors (GJT) via systematic review and meta-analysis of the available data.

**Data sources:** 1) Search of English language articles of PubMed, Web of Science, Cochrane, and EBSCOhost databases from January 1950 to August 2017

**Study selection:** Inclusion criteria: 1) Treated patients with GJT with radiosurgery who had no previous treatment of any kind 2) Follow patients for greater than one year with magnetic resonance imaging 3) Reported pre and post-treatment symptoms, tumor control, and complications for individual PRS patients or for PRS patients as a group separately than from those who had received previous treatment

**Data extraction:** Data extraction was performed at the patient level because studies often did not report aggregate outcomes of PRS patients separately. For each patient meeting criteria the following were extracted: linear accelerator, maximum dose to tumor margin, pre-treatment tumor volume, tumor control, method of assessing tumor control, length of follow-up, complications, and pre and post-treatment symptoms.

**Data synthesis:** Eighteen studies encompassing 129 patients met criteria. Tumor control was achieved in 125 patients (96.9%). Pre-treatment symptoms worsened in 4 patients (3.1%). Ten (7.8%) patients developed transient cranial neuropathies. Six (4.7%) developed new permanent cranial neuropathies. There were no major complications.

**Conclusions:** In general, PRS is safe and effective at controlling growth and clinical symptoms for patients with GJTs, though there is significant selection bias and clinical heterogeneity among existing studies.

**Define Professional Practice Gap & Educational Need:** Lack of knowledge regarding long-term outcomes of primary radiosurgery for the treatment of glomus jugulare tumors.

**Learning Objective:** Understand the long-term outcomes of primary radiosurgery for the treatment of glomus jugulare tumors.

**Desired Result:** Attendees can more effectively and accurately counsel patients regarding their treatment options for glomus jugulare tumors.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 2

## Reliability of Video Head Impulse Test Based on Clinician Experience

*Desi P. Schoo, MD; Grace X. Tan, MD  
Matthew R. Ehrenburg, BA; Margaret R. Chow, BS  
Charles C. Della Santina, MD, PhD*

**Objective:** The goal of this study is to determine the variability of six-canal video head impulse testing (vHIT) based on clinician experience.

**Study Design:** Descriptive

**Setting:** Continuing medical education course

**Patients:** Thirteen clinicians were recruited to perform a six-canal vHIT using the Otometrics ICS Impulse system on a subject with normal vestibular function. Each clinician performed a standard six-canal head impulse test in each canal plane until 20 were accepted in each canal by the vHIT system, or 50 rejected impulses in a canal pair. The head impulse motion profiles and resultant vestibulo-ocular reflex (VOR) gains were calculated and analyzed.

**Results:** There were 4 (31%) novice examiners, 5 (38%) with intermediate level of experience, and 4 (31%) experts. For the entire cohort, mean standard deviation of VOR gain was  $0.027 \pm 0.011$  for the horizontal canal planes and  $0.074 \pm 0.054$  for the vertical canal planes. Mean standard deviation of VOR gain correlated inversely with clinician experience in the vertical canal planes, but not in the horizontal canal planes.

**Conclusion:** Clinicians with greater experience performing vHIT obtain more consistent VOR gain in the vertical canals. Sensitivity and specificity of the vHIT may depend on clinician experience, particularly when examining the vertical canal planes.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge about the effect of clinician experience on video head impulse testing.

**Learning Objective:** 1. Become familiar with the role of video head impulse testing (vHIT) in the diagnosis of vestibular disorders. 2. Describe the factors that may affect vHIT results, including clinician experience level.

**Desired Result:** Knowledge gained from this study may be applied directly for clinical and research purposes to improve evaluation of the vestibulo-ocular reflex via the video head impulse test.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

**Direct Parasagittal Diffusion Tensor Imaging (DTI)  
Improves Resolution of Facial and Vestibulocochlear Nerves  
in Patients with Vestibular Schwannoma**

*Lorenz Epprecht, MD; Elliott D. Kozin, MD  
Vivek V. Kanumuri, MD; Aaron K. Remenschneider, MD, MPH  
Alexander M. Huber, MD; Katherine Reinshagen, MD  
Daniel J. Lee, MD*

**Objective:** Advanced magnetic resonance imaging (MRI) techniques such as diffusion tensor imaging (DTI) have the potential to improve preoperative assessment of facial (cranial nerve [CN] VII) and vestibulocochlear (CN VIII) nerve anatomy in patients with neoplasms of the lateral skull base. This is especially important in patients with vestibular schwannoma (VS) as the tumor often displaces the normal course of the nerves. Routine axial plane DTI scans provide a limited view of individual cranial nerves because the acquisition plane bisects the nerves at the cerebellopontine angle (CPA). We hypothesize that direct parasagittal DTI improves resolution of CN VII and VIII in patients with VS.

**Study design:** Retrospective case review

**Setting:** Tertiary referral center

**Patients:** Patients with VS

**Intervention:** Axial and parasagittal single-shot epi-planar DTI on a 3.0-Tesla Philips MRI scanner.

**Main outcome measure(s):** Resolution and continuity of CN VII and VIII in the CPA as seen on three-dimensional reconstructions and tractography.

**Results:** CN VII and CN VIII were more clearly identified in continuity along their course in the CPA using direct parasagittal plane compared to axial plane. Direct parasagittal DTI improved craniocaudal resolution (2mm to 0.9mm) without increasing acquisition time. Finally, direct parasagittal plane facilitated seeding for quantitative DTI analysis, such as diffusion anisotropy.

**Conclusions:** Use of the parasagittal plane for DTI acquisition is a novel and immediately clinically applicable imaging modality that improves the resolution of CN VII and VIII in the CPA compared to traditional axial plane DTI. Findings have implications for preoperative evaluation of patients with VS and surgical planning.

**Define Professional Practice Gap & Educational Need:** Lack of awareness and knowledge

**Learning Objective:** Understanding of a new directly clinically applicable imaging modality that improves diffusion tensor imaging for the cranial nerves in tumors of the cerebellopontine angle

**Desired Result:** Incorporation of the new imaging modality in the preoperative workup of patients with vestibular schwannoma

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Unilateral versus Bilateral Cochlear Implantation in Children with Auditory Neuropathy Spectrum Disorder**

*Ashley M. Nassiri, MD, MBA; Robert J. Yawn, MD  
Christine L. Brown, AuD; Matthew R. O'Malley, MD  
Marc L. Bennett, MD; Robert F. Labadie, MD, PhD  
David S. Haynes, MD; Alejandro Rivas, MD*

**Objective:** To evaluate audiologic outcomes following unilateral versus bilateral cochlear implantation in children with auditory neuropathy spectrum disorder (ANSD).

**Study Design:** Retrospective case review.

**Setting:** Tertiary Otolologic Academic Medical Center.

**Patients:** Twenty-four patients with ANSD who underwent unilateral or bilateral cochlear implantation (CI).

**Interventions:** Rehabilitative (cochlear implantation).

**Main outcome measures:** Speech recognition scores and achievement of open set speech recognition.

**Results:** Prior to implantation, all patients had hearing aid trials with lack of auditory skills development. Twenty-four patients were included, of which 66.7% had comorbid developmental delay. Two therapeutic approaches were utilized, with 14 patients undergoing unilateral CI with contralateral hearing aid, and 10 patients undergoing bilateral CI (either simultaneous implantation or sequential implantation within 12 months). The median ages at CI activation were 39.4 and 17.1 months in the unilateral and bilateral CI groups, respectively ( $p=0.0007$ ). The median postoperative follow-ups were 44.3 and 47.2 months in the unilateral and bilateral CI groups, respectively ( $p=0.52$ ). No patients had achieved open set speech recognition prior to implantation. At last follow-up, 8 unilateral CI patients and 7 bilateral CI patients achieved open set speech recognition ( $p=0.68$ ). The median time to achieve open set speech recognition after implantation was 32.9 and 38.1 months for unilateral and bilateral CI groups, respectively ( $p=.96$ ).

**Conclusions:** Although the bilateral CI group is implanted at a younger age, they achieve open set speech recognition within a similar time period compared to the unilateral CI group. Bilateral CI in ANSD may prove advantageous for auditory skills development, but a statistically significant difference was not identified in this series.

**Define Professional Practice Gap & Educational Need:** Lack of information regarding the benefit of a second cochlear implant in patients with auditory neuropathy spectrum disorder (ANSD) who have inadequately benefitted from hearing amplification.

**Learning Objective:** To determine if patients with ANSD would benefit more from unilateral or bilateral cochlear implantation in regards to speech recognition and open set speech achievement.

**Desired Result:** Attendees will have additional information in this subject matter, which may directly impact their practices, and whether they complete bilateral or unilateral cochlear implantation in patients with ANSD.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Volumetric Analysis of Sporadic Vestibular Schwannomas Treated with Gamma Knife Radiosurgery**

*Daniel E. Killeen, MD; Andrew P. Marston, MD  
Anthony M. Tolisano, MD; Michael J. Link, MD  
Samuel Barnett, MD; Matthew L. Carlson, MD  
Jacob B. Hunter, MD*

**Objective:** To assess volumetric changes after stereotactic radiosurgery (SRS) of sporadic vestibular schwannomas (VS) that exhibit pretreatment growth.

**Study Design:** Retrospective case series

**Setting:** Two tertiary referral centers

**Patients:** VS that failed conservative management and underwent SRS with a minimum of 14 months post-SRS radiological surveillance.

**Intervention:** Volumetric tumor segmentation before and after SRS.

**Main outcome measure:** Persistent volumetric growth following SRS (i.e., treatment failure)

**Results:** Ninety-three patients met the inclusion criteria. Patients were observed for median pre- and post-treatment intervals of 28.8 and 36.5 months, respectively. The median dose to the tumor margin was 13 Gy (range 12-14 Gy). The median greatest axial tumor diameter and volume at the time of treatment was 16.3 mm (range 5.5 – 25.9 mm) and 0.70 cm<sup>3</sup> (range 0.077 – 3.75 cm<sup>3</sup>). Post-treatment tumor control was achieved in 80% of patients. Patterns of transient volumetric tumor swell and features associated with treatment failure will be presented.

**Conclusions:** SRS provides effective tumor control in 80% of VS that exhibit pretreatment volumetric growth.

**Define Professional Practice Gap & Educational Need:** Lack of knowledge about the change in volume of vestibular schwannomas after radiation.

**Learning Objective:** Explain the effect of gamma knife radiation on vestibular schwannoma growth.

**Desired Result:** Improved understanding about the efficacy of radiation therapy

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

**Utility of Volume-Rendered Three-Dimensional (3D)  
Magnetic Resonance Imaging for Revision  
Superior Canal Dehiscence Surgery**

*Raphaelle A. Chemtob, MD; Lorenz Epprecht, MD  
Alexander Huber, MD; Per Caye-Thomasen, MD  
Hideko H. Nakajima, MD, PhD; Daniel J. Lee, MD*

**Objective:** Durable outcomes are observed following middle fossa craniotomy for superior canal dehiscence (SCD). Persistent of symptoms after primary repair are uncommon but may be associated with inadequate occlusion of the defect. The extent of the plugged canal cannot be determined on computed tomography (CT) since most repair materials are not radiopaque. In this study, we hypothesize that volume-rendered three-dimensional (3D) magnetic resonance imaging (MRI) combined with 3D reconstruction of the bony defect on CT can determine the extent of repair following primary surgery for SCD.

**Study design:** Retrospective series.

**Setting:** Tertiary care center.

**Patients:** Adults with persistent symptoms following primary SCD repair with MRI and CT imaging prior to revision surgery.

**Interventions:** Revision surgery for SCD syndrome.

**Main outcome measures:** 3D rendering of MRI and CT.

**Results:** We identified revision cases from a cohort of 133 SCD patients who underwent surgery at our institution. We combined analysis of volume-rendered T2-weighted MRI sequences with 3D CT reconstruction of the bony defect. After normalizing for labyrinthine volume, the affected SSC showed significantly lower volumes compared to the contralateral side ( $p < 0.05$ ). Data highlighting the position of the plugged canal (MRI) relative to the canal defect (CT) will also be presented.

**Conclusions:** Lower SSC volumes seen in the operated ear indicate the extent of previous plugging from the primary repair and combined with CT can determine a persistent dehiscence. These data are valuable in the planning of revision surgery in SCD patients with persistent signs and symptoms following primary repair.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge on the utility of volume-rendered three-dimensional (3D) magnetic resonance imaging for revision superior canal dehiscence surgery.

**Learning Objective:** The objective is to use volume-rendered three-dimensional (3D) magnetic resonance imaging to determine the extent of repair following primary surgery for superior canal dehiscence.

**Desired Result:** We hypothesize that volume-rendered three-dimensional (3D) magnetic resonance imaging may be valuable in planning of revision surgery in superior canal dehiscence patients with persistent signs and symptoms following primary repair.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

**Bone Anchored Hearing in Children with Aural Atresia:  
A Comparison of Performance with Surgical  
and Non-Surgical Options**

*Sida Chen, MS; George B. Wanna, MD  
Maura K. Cosetti, MD*

**Objective:** The objective of this study is to compare speech perception, device use, and skin complications between pediatric atresia patients using a non-surgical bone anchored hearing (BAHA) on a soft band or transcutaneous magnetic stimulation (ie BAHA Attract™.)

Study design: case-control study

**Setting:** Tertiary referral center

**Patients:** Two groups of age-matched pediatric patients with unilateral aural atresia who utilize a Cochlear Americas BAHA on a soft band (n=10) and those who use the BAHA Attract (n=10.) Patients with any sensorineural hearing loss (in either the amplified or non-atretic ear) and those who had undergone atresiaplasty were excluded.

**Intervention:** Surgical placement of a transcutaneous bone conduction device

**Main outcome measure:** Aided ear speech performance, Holgers classification for skin complications

**Results:** Age, length of follow-up (8 months- 3 years) and bone conduction thresholds for the atretic and non-atretic ear were comparable between groups. Holdger classification for skin complications were comparable between groups, despite utilization of high strength magnets in some Attract patients (n=5 using  $\geq$  #5 magnets.) Speech perception testing was comparable between groups, with a trend toward improved performance in the surgical group.

**Conclusion:** Minimal complications following Attract surgery and skin irritation following long-term soft band use suggest these are comparable options. Parents may consider the impact of future auricular reconstruction for microtia and improved speech perception in patients with the BAHA Attract when navigating amplification options.

**Define Professional Practice Gap & Educational Need:** 1. Incomplete understanding of benefits of surgical intervention for bone anchored hearing as compared to non-surgical options 2. Lack of awareness of factors involve in surgical decision-making process of parents of children with aural atresia

**Learning Objective:** to provide direct comparison of surgical intervention with the BAHA attract with continued use of the soft band BAHA in pediatric patients with aural atresia - complete understanding of the complications related to each option

**Desired Result:** Attendees will have greater understanding of the outcomes and complications related to each option and will have improved ability to counsel parents as they navigate these treatment decisions

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4



**RECIPIENTS OF AWARDS  
& NAMED LECTURERS**

In honor of the 50th anniversary of the American Neurotology Society, 1965 - 2015, the House/Hitselberger Lifetime Achievement Award was established to honor the legacy of two giants in the field of neurotology, Dr. William F. House and Dr. William E. Hitselberger. The award recognizes those individuals who have demonstrated superb surgical skills and patient care, a commitment toward education and cumulative scientific contributions that have profoundly impacted the field of neurotology. At the 50th Annual Fall meeting in Dallas, TX on September 26, 2015, the first awards were presented to nine neurotologists from the USA and Europe.

**HOUSE/HITSELBERGER  
LIFETIME ACHIEVEMENT AWARD**

**Derald E. Brackmann, MD**

*House Ear Clinic - Los Angeles, CA*

**Prof. Ugo Fisch, MD**

*Fisch International Microsurgery Foundation  
Zurich, Switzerland*

**Emilio García-Ibáñez, MD**

*Instituto De Otologia Garcia-Ibanez - Barcelona, Spain*

**Michael E. Glasscock, III, MD**

*The Otology Group, Nashville, TN  
The Glasscock Hearing Center - Houston, TX*

**Malcolm D. Graham, MD**

*Emory University - Atlanta, GA*

**David A. Moffat, PhD, FRCS**

*Addenbrooks Hospital - Cambridge, UK*

**Joseph B. Nadol, Jr., MD**

*Massachusetts Eye & Ear Infirmary - Boston, MA*

**Prof. Mario Sanna, MD**

*Gruppo Otologico, Piacenza-Rome, Italy*

**Prof. Jean-Marc Sterkers, MD**

*Paris, France*

## WILLIAM F. HOUSE MEMORIAL LECTURE

William F. House, MD - 1988, Palm Beach, CA  
Michael E. Glasscock III, MD - 1989, San Francisco, CA  
Prof. Ugo Fisch, MD - 1990, Palm Beach, FL  
Harold F. Schuknecht, MD - 1991, Hawaii, HI  
Frederick H. Linthicum Jr., MD - 1992, Palm Desert, CA  
William W. Montgomery, MD - 1993, Los Angeles, CA  
Robert J. Keim, MD - 1994, Palm Beach, FL  
Derald E. Brackmann, MD - 1995, Palm Desert, CA  
Antonio De La Cruz, MD - 1996, Orlando, FL  
Malcolm D. Graham, MD - 1997, Scottsdale, AZ  
Brian F. McCabe, MD - 1998, Palm Beach, FL  
William Lo, MD - 1999, Palm Desert, CA  
Jens Thomsen, MD - 2000, Orlando, FL  
Mansfield Smith, MD - 2001, Palm Desert, CA  
Bruce J. Gantz, MD - 2002, Boca Raton, FL  
John W. House, MD - 2004, New York, NY  
Professor Richard Ramsden - 2005, Boca Raton, FL  
John K. Niparko, MD - 2006, Chicago, IL  
Robert K. Jackler, MD - 2007, San Diego, CA  
Richard A. Chole, MD, PhD - 2008, Orlando, FL  
Lloyd B. Minor, MD - 2009, Phoenix, AZ  
Jeffrey P. Harris, MD, PhD - 2010, Las Vegas, NV  
Debara L. Tucci, MD - 2011, Chicago, IL  
Paul R. Lambert, MD - 2012, San Diego, CA  
D. Bradley Welling, MD, PhD - 2013, Orlando, FL  
Yehoash Raphael, PhD - 2014, Las Vegas, NV  
Noel L. Cohen, MD - 2015, Boston, MA  
Per Cayé-Thomasen, MD, DMSc - 2016, Chicago, IL  
Professor Gerard M. O'Donoghue, FRCS - 2017, San Diego, CA

## **WILLIAM E. HITSELBERGER MEMORIAL LECTURE**

William E. Hitselberger, MD - 1999, Palm Desert, CA

Peter Dallos, PhD - 2000, Orlando, FL

James Battey, MD, PhD - 2001, Palm Desert, CA

David Fabry, PhD - 2002, Boca Raton, FL

Amin B. Kassam, MD - 2004, New York, NY

William W. M. Lo, MD - 2005, Los Angeles, CA

G. Michael Halmagyi, MD - 2006, Toronto, Canada

Takanori Fukushima, MD, DMSc - 2007, Wash DC

D. Bradley Welling, MD, PhD - 2008, Chicago, IL

Philip H. Gutin, MD - 2009, San Diego, CA

David A. Moffat, MD - 2010, Boston, MA

George T. Hashisaki, MD - 2011, San Francisco, CA

Karen I. Berliner, PhD - 2013, Orlando, FL

Dennis S. Poe, MD - 2014, Las Vegas, NV

Jeffrey W. Kysar, PhD - 2015, Boston, MA

Ali R. Zomorodi, MD - 2015, Dallas, TX

Marcus Atlas, MBBS - 2017, San Diego, CA

## **FRANKLIN M. RIZER MEMORIAL LECTURE**

Stefan Heller, PhD - 2004, New York

Philip Theodosopoulos, MD -2006, Toronto, Canada

Charley C. Della Santina, MD, PhD - 2007, Wash. DC

Conrad Wall III, PhD - 2007, Wash. DC

Ebenezer Yamoah, PhD - 2008, Chicago, IL

Gerard O'Donoghue, MD - 2009, San Diego, CA

Saumil N. Merchant, MD - 2010, Boston, MA

Richard L. Goode, MD - 2012, Washington, DC

Richard A. Chole, MD, PhD - 2013, Vancouver, BC

Karen B. Avraham, PhD - 2014, Orlando, FL

Professor Mario Sanna - 2015, Dallas, TX

Thomas Lenarz, Prof. Dr.med - 2016, San Diego, CA

Jennifer J. Lentz, PhD - 2017, Chicago, IL

## NEUROTOLOGY FELLOWSHIP AWARD

Colin L.W. Driscoll, MD - 1998, Palm Beach, FL  
Robert M. Owens, MD - 1999, Palm Desert, CA  
Katrinia R. Stidham, MD - 2000, Orlando, FL  
Zoran Becvarovski, MBBS - 2001, Palm Desert, CA  
John S. Oghalai, MD - 2002, Boca Raton, FL  
Anthony O. Owa, MD - 2002, Boca Raton, FL  
Richard J. Kennedy, MD - 2003, Nashville, TN  
Ana H. Kim, MD - 2006, Chicago, IL  
Marc D. Eisen, MD - 2007, San Diego, CA  
Benjamin T. Crane, MD, PhD - 2008, Orlando, FL  
R. Mark Wiet, MD - 2008, Orlando, FL  
Kevin D. Brown, MD, PhD - 2009, Phoenix, AZ  
Jerry W. Lin, MD, PhD - 2009, Phoenix, AZ  
John C. Goddard, MD - 2010, Las Vegas, NV  
Matthew L. Bush, MD - 2011, Chicago, IL  
Felipe Santos, MD - 2011, Chicago, IL  
Alicia Quesnel, MD - 2012, San Diego, CA  
Mia Miller, MD - 2013, Orlando, FL  
Peter L. Santa Maria, MBBS, PhD -2014, Las Vegas, NV  
Christine T. Dinh, MD - 2015, Boston, MA  
Seth E. Pross, MD - 2016, Chicago, IL  
Michael S. Harris, MD – 2017, San Diego, CA

## ANS TRAINEE AWARD

Thomas R. Pasic, MD - 1990, Palm Beach, CA  
*University of Washington, Seattle, WA*

Charles A. Syms III, MD - 1991, Hawaii, HI  
*USAF Medical Center, Lackland AFB, TX*

Eric Tallan, MD - 1992, Palm Desert, CA  
*Mayo Clinic, Rochester, MN*

Mark E. Reiber, MD - 1993, Los Angeles, CA  
*Vanderbilt University Medical Center, Nashville, TN*

Gary B. Coleman, MD - 1994, Palm Beach, FL  
*University of Michigan, Ann Arbor, MI*

Donald D. Robertson, MD - 1995, Palm Desert, CA  
*University of Manitoba, Winnipeg, Manitoba Canada*

Greg A. Krempf, MD - 1997, Scottsdale, AZ  
*University of Texas, San Antonio, TX*

Bac H. Nguyen, MD - 1998, Palm Beach, FL  
*University of Minnesota, Minneapolis, MN*

Jennifer L. Maw, MD - 1999, Palm Desert, CA  
*Hearing Institute for Children & Adults, San Jose, CA*  
Wayne E. Berryhill, MD - 2000, Orlando, FL  
*University of Minnesota, Minneapolis, MN*

Dmitriy Niyazov - 2001, Palm Desert, CA  
*Medical Student, Los Angeles, CA*

Stacey L. Halum, MD - 2003, Nashville, TN  
*Medical College of Wisconsin*

Norman N. Ge, MD - 2004, Phoenix, AZ  
*Davis Medical Center, Sacramento, CA*

Ritvik P. Mehta, MD - 2005, Boca Raton, FL  
*Massachusetts Eye & Ear; Harvard Medical School*

Wade Chien, MD - 2006, Chicago, IL  
*Massachusetts Eye & Ear, Harvard Medical School*

Hideko Heidi Nakajima, MD, PhD - 2009, Phoenix, AZ  
*Massachusetts Eye & Ear; Harvard Medical School*

Yuri Agrawal, MD - 2012, San Diego, CA  
*Johns Hopkins University, Baltimore, MD*

Samuel A. Spear - 2013, Orlando, FL  
*The Ohio State University, Columbus, OH*

Christine T. Dinh, MD - 2014, Las Vegas, NV  
*University of Miami, Miami, FL*

James Naples, MD - 2015, Boston, MA  
*University of Connecticut, Farmington, CT*

Jacob B. Hunter, MD - 2016, Chicago, IL  
*Vanderbilt University, Nashville, TN*

Yarah M. Haidar, MD - 2017, San Diego, CA  
*University of California at Irvine, Orange, CA*

## NICHOLAS TOROK VESTIBULAR AWARD

Stephen P. Cass, MD - 1990, Palm Beach, FL  
*Michigan Ear Institute, Farmington Hills, MI*

P. Ashley Wackym, MD - 1992, Palm Desert, CA  
*University of Iowa Hospitals and Clinics, Iowa City, IA*

Robert P. Muckle, MD - 1993, Los Angeles  
*University of Minnesota, Minneapolis, MN*

Thomas A. Salzer, MD - 1994, Palm Beach  
*Baylor College of Medicine, Houston, TX*

Akira Ishiyama, MD - 1995, Palm Desert  
*UCLA School of Medicine, Los Angeles, CA*

Anil K. Lalwani, MD - 1998, Palm Beach, CA  
*University of California, San Francisco, CA*

Lloyd B. Minor, MD - 1999, Palm Desert, FL  
*Johns Hopkins University, Baltimore, MD*

Vincent B. Ostrowski, MD - 2000, Orlando, FL  
*Northwestern University Medical School, Chicago, IL*

D. Bradley Welling, MD, PhD - 2001, Palm Desert,  
*CAThe Ohio State University, Columbus, OH*

John P. Carey, MD - 2003, Nashville, TN  
*Johns Hopkins University, Baltimore, MD*

John C. Li, MD - 2005, Boca Raton, FL  
*Loyola University Medical Center, Chicago, IL*

Judith A. White, MD, PhD - 2006, Chicago, IL  
*The Cleveland Clinic, Cleveland, OH*

Abraham Jacob, MD - 2007, San Diego, CA  
*The Ohio State University - Columbus, OH*

Rahul Mehta, MD - 2014, Las Vegas, NV  
*Louisiana State University - New Orleans, LA*

Benjamin T. Crane, MD, PhD - 2015, Boston, MA  
*University of Rochester Medical Center - Rochester, NY*

Jeffrey D. Sharon, MD - 2016, Chicago, IL  
*Johns Hopkins University - Baltimore, MD*

Anne K. Maxwell, MD - 2017, San Diego, CA  
*University of Colorado Hospital - Aurora, CO*

**RECIPIENTS OF THE SILVERSTEIN AWARD**  
**ANS/AAO-HNS Otology/Neurotology Research Award**  
**Funding provided by Dr. Herbert Silverstein/ANS/AAO**

Lawrence R. Lustig, MD - 7/1999  
*Johns Hopkins University*

David R. Friedland, MD - 7/00-6/02  
*Johns Hopkins University*

Rose Mary Stocks, MD - 7/02-6/204  
*University of Tennessee*

Clifford R. Hume, MD, PhD - 7/03-6/05  
*University of Washington*

Alan G. Micco, MD - 7/04-6/06  
*Northwestern University*

Romaine Johnson, MD - 7/05-6/07  
*Children's Hospital Cincinnati*

Joseph P. Roche, MD - 7/08-6/10  
*University of North Carolina*

Alan Cheng, MD - 07/10 - 06/12  
*Stanford University*

Yuri Agrawal, MD - 07/10 - 06/12  
*Johns Hopkins University*

Nathan Schularick, MD - 07/12 - 06/14  
*The University of Iowa*

Dylan Chan, MD, PhD - 07/14 - 06/16  
*University of California-SF*

David H. Jung, MD, PhD - 07/16 - 06/18  
*Harvard University/ MEEI*



## RECIPIENTS OF THE ANS RESEARCH AWARD

**\$25,000 annual award established in 2014/15**  
**Funding provided by the American Neurotology Society**

Christine T. Dinh, MD - 2015

*"Cochlear Irradiation and Dosimetry: Apoptosis, Necrosis, and Hearing Loss"*

University of Miami, *Miami, FL*

Harrison Lin, MD - 2016

*"Chronic Implantation of the Facial Nerve for Selective Facial Muscle Contraction"*

University of California-Irvine, *Orange, CA*

Michael S. Harris, MD -2017

*"Verbal Memory as Outcome Predictor in Adults Receiving Cochlear Implants"*

Medical College of Wisconsin, *Milwaukee, WI*

The purpose of the American Neurotology Society (ANS) Research Grant is to encourage and support academic research in sciences related to the investigation of otology and neurotology. Appropriate areas of research include diagnosis, management, and pathogenesis of diseases of the ear and/or skull base. Grants that focus on addressing clinical gaps are especially encouraged. Grants may involve cell/molecular studies, animal research, or human subjects research.

The maximum award request is \$25,000 per year (US dollars) and is annually renewable on a competitive basis. Indirect costs (overhead) are not allowed. Grants are available to physician investigators in the United States and Canada only. We particularly encourage those individuals without a history of K08, R03, R21, or R01 funding to apply.

**If you would like to submit a grant application, the deadline is March 1st.**

**Information may be obtained from:**

**Kristen Bordignon, Assistant to**

**Ronna Hertzano, MD, PhD**

16 S. Eutaw Street

Suite 500

Baltimore, MD 21201

**Email:** RHertzano@smail.umaryland.edu

Kristen Bordignon PH: 217-638-0801

**E-mail:** administrator@americanneurotologysociety.com

**American Neurotology Society  
Research Award Progress Reports**

**AMERICAN NEUROTOLOGY SOCIETY RESEARCH GRANT**

**Project Title: Verbal Memory as Outcome Predictor in Adults Receiving Cochlear Implants**

**Principal Investigator: Michael S. Harris, MD**

Speech recognition relies heavily upon foundational cognitive information processing operations including attention, learning, and memory. The long-term goal of this project is to quantify the influence of verbal working memory on speech perception performance among post-lingually deaf adults using cochlear implants (CIs). Our central hypotheses are that (1) recognition of spoken words in sentences will be strongly correlated with verbal memory, and that (2) CI users will demonstrate discrepancies in specific sub-processes of verbal working memory compared to normal hearing peers. Addressing these hypotheses will provide a basis for the clinically important goal of developing new assessment tools to prognosticate outcomes prior to CI and will assist in the development of targeted, individualized rehabilitation strategies following implantation.

**SPECIFIC AIM 1** addresses the progress-limiting knowledge gap regarding the role of verbal memory on speech recognition following CI in post-lingually deaf adults. Progress: Using a visual version of a clinical neuropsychological verbal memory test, the California Verbal Learning Test (CVLT), we have, to date, successfully assessed 25% of our target sample size. Thus far, within our experienced CI group, recognition of words in sentences is consistently predicted by verbal working memory, based on CVLT performance. Most consistently predictive of speech recognition is the resistance to buildup of proactive interference, a characteristic of verbal working memory.

**SPECIFIC AIM 2** quantifies the effects of auditory deprivation on specific verbal memory sub-processes – encoding, storage, retrieval, and organizational strategies – by comparing the performance of post-lingually deaf adults with CIs to a control group of normal hearing, age-matched peers. Progress: Using our visual version of the CVLT, findings thus far indicate that experienced CI users and normal hearing listeners do not significantly differ on most measures of the CVLT. Deficits in the experienced CI group are being shown in recency recall, the buildup of proactive interference, and retrieval-induced forgetting.

For the remaining six months of the grant period, we will continue to collect data on experienced CI users to appropriately power our study. We have requested and been granted a no-cost extension in order to further pursue our Specific Aims. Additionally, in order to more fully appreciate the benefits and influence of CI on the verbal working memory, we are recruiting and running a cohort of adult CI candidates, who will form the basis for a future longitudinal study.

## AMERICAN NEUROLOGY SOCIETY PAST PRESIDENTS

1965-69 Fred Harbert, MD  
1969-70 Richard E. Marcus, MD  
1970-71 Wallace Rubin, MD  
1971-72 Malcolm H. Stroud, MD  
1972-73 Martin Spector, MD  
1973-74 Nicholas Torok, MD  
1974-75 Cecil W. Hart, MD  
1975-76 Sidney N. Busis, MD  
1976-77 Brian F. McCabe, MD  
1977-78 Bruce Proctor, MD  
1978-79 David A. Dolowitz, MD  
1979-80 Fred H. Linthicum Jr., MD  
1980-81 Harold Schuknecht, MD  
1981-82 Hugh Barber, MD  
1982-83 Kenneth H. Brookler, MD  
1983-84 Richard Gacek, MD  
1984-85 Derald Brackmann, MD  
1985-86 Robert J. Keim, MD  
1986-87 Jack D. Clemis, MD  
1987-88 Malcolm Graham, MD  
1988-89 Robert A. Jahrsdoerfer, MD  
1989-91 Shokri Radpour, MD  
1992-92 Antonio De La Cruz, MD  
1992-93 Fredric W. Pullen II, MD  
1993-94 Charles M. Luetje II, MD  
1994-95 Sam E. Kinney, MD  
1995-96 Joseph DiBartolomeo, MD  
1996-97 Jack M. Kartush, MD  
1997-98 Bruce J. Gantz, MD  
1998-99 John W. House, MD  
1999-00 Richard J. Wiet, MD  
2000-01 Richard T. Miyamoto, MD  
2001-02 Stephen G. Harner, MD  
2002-03 Newton J. Coker, MD  
2003-04 Paul R. Lambert, MD  
2004-05 Robert K. Jackler, MD  
2005-06 Debara L. Tucci, MD  
2006-07 Joel A. Goebel, MD  
2007-08 D. Bradley Welling, MD, PhD  
2008-09 Karen J. Doyle, MD, PhD  
2009-10 Samuel H. Selesnick, MD  
2010-11 J. Douglas Green Jr., MD  
2011-12 Jeffrey T. Vrabel, MD  
2012-13 Clough Shelton, MD  
2013-14 Hilary A. Brodie, MD, PhD  
2014-15 Anil K. Lalwani, MD  
2015-16 John T. McElveen, Jr., MD  
2016-17 Lawrence R. Lustig, MD  
2017-18 Moisés A. Arriaga, MD, MBA

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1974-76 Jack Pulec, MD  
1976-79 Michael Glasscock III, MD  
1979-85 Robert Keim, MD  
1985-88 Shokri Radpour, MD  
1988-92 Charles M. Luetje II, MD  
1992-95 Jack M. Kartush, MD  
1995-98 Richard J. Wiet, MD  
1998-01 Newton J. Coker, MD  
2001-04 Debara L. Tucci, MD  
2004-07 Karen J. Doyle, MD, PhD  
2007-10 Jeffrey T. Vrabec, MD  
2010-13 Anil K. Lalwani, MD  
2013-16 Moisés A. Arriaga, MD, MBA  
2016- Bradley W. Kesser, MD

**AMERICAN NEUROTOLOGY SOCIETY**

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*(in alphabetical order)*

*(includes new members inducted at  
2018 Spring meeting)*

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*Baltimore, MD*

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Kyle P. Allen, MD - Fellow  
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*Georgetown, TX*

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*Manhattan Beach, CA*

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*Metairie, LA*

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*Celebration, FL*

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*Kansas City, KS*

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*Saint Louis, MO*

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*Marina Del Rey, CA*

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Sanjay Bhansali, MD - Fellow  
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*Chapel Hill, NC*

J Dale Browne, MD - Fellow  
*Winston Salem, NC*

Craig A. Buchman, MD - Fellow  
*St. Louis, MO*

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*Hawthorne, NY*

Hana T. Bui, MD - Associate  
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A Julianna Gulya, MD - Senior Fellow  
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*Aiea, HI*

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S George Lesinski, MD - Emeritus  
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*Hailey, ID*

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William H. Merwin, MD - Associate  
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Thomas Meyer, MD - Affiliate  
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Mendell Robinson, MD - Emeritus  
*Rehoboth, MA*

Joseph Roche, MD - Associate  
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Jay T. Rubinstein, MD, PhD - Fellow  
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Jeffrey T. Vrabec, MD - Fellow  
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Richard J. Wiet, MD - Emeritus  
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Thomas O. Willcox, MD - Fellow  
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Mark L. Winter, MD - Senior Fellow  
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Robert J. Wolfson, MD - Emeritus  
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Marc Wong, MD - Associate  
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Charles I. Woods, MD - Fellow  
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*Millburn, NJ*

Nancy Young, MD - Fellow  
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John W. Youngblood, MD - Senior Fellow  
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Heng-Wai Yuen, MD - Associate  
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John J. Zappia, MD - Fellow  
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Daniel M. Zeitler, MD - Fellow  
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Michael Zoller, MD - Senior Fellow  
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## TRAINEE MEMBERS

*include Neurology Fellows and OTO-HSN Residents*

(in alphabetical order)

Ksenia A. Aaron, MD  
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Sameer Alvi, MD  
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Scott Brown, MD  
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Melissa C. Bustamante, MD  
*Buenos Aires, Argentina*

Si Chen, MD  
*Miami, FL*

Baishakhi Choudhury, MD  
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Matthew G. Crowson, MD  
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Nicholas L. Deep, MD  
*Phoenix, AZ*

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*St. Louis, MO*

Susan D. Emmett, MD  
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Walter J. Florez Guerra, MD  
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Tammy Wang, MD  
*Cleveland, OH*

Elizabeth H. Wick, MD  
*Seattle, WA*

Amit Wolfowitz, MD  
*Miami, FL*

**IN MEMORIUM**  
*(in alphabetical order)*

The ANS Administrative office was notified of the following  
members death since the last Spring meeting.

*Please take a moment of silence to remember these outstanding colleagues & friends.*

*Bobby R Alford, MD*

*Michael E Glasscock III, MD*

*Robert Kimura, PhD*

*Anthony Maniglia, MD*

*Gregory J. Matz, MD*

*J Gail Neely, MD*

*Shokri Radpour, MD*