American Otological Society, Inc.
Mission Statement

Purpose

The American Otological Society, created in 1868, is dedicated to fostering a dialog on and dissemination of, information pertaining to advances in evidence based diagnosis and management of otologic and neurotologic disorders. The focus on otologic and neurotologic disorders and scientific advances are translated to the provision of quality care that is consistent with the ACGME general competency areas and the Institute of Medicine competencies.

Target Audience

The primary target audience for the educational efforts of the American Otological Society is the current and potential members of the society. These members are physicians, otologists, residents, fellows, and researchers in the fields of otology and neurotology. Educational activities are also open to nurses, occupational and speech therapists and other healthcare professionals who are involved in the care of patients with otologic and neurotologic conditions.

Activities

The primary activity of the American Otological Society is the Annual Meeting that focuses on the advancement of the scientific and clinical evidence that supports advances in otologic and neurotologic care to patients. Additionally, non certified educational support and resources include the publication and dissemination of peer reviewed and evidence based content through the Otology & Neurotology Journal and support for research in otology/ neurotology and lateral skull base surgery and related disciplines.

Content

The content for the Annual Meeting and other related educational efforts are limited to the otologic and neurotologic evidence based science, clinical standards of care, and effects on communication.

Expected Results

The expected results are focused on enhancing knowledge translation and promoting competence for the membership and other identified target audiences. The Annual Meeting, the CME certified annual activity of the society, and the other scholarly activities such as the publication of the Journal and support for research provide a rich and robust environment for self assessment and reflection, access to resources for lifelong learning and opportunities for discussion and re-evaluation

2016 AOS Spring Meeting CME Activity Planning

Practice gaps in Otology are identified through polling the AOS attendees at the close of each CME activity by way of an exit evaluation at the close of the activity; this evaluation is required to receive CME credit, so the response rate is good. The response rate from the 2015 American Otological Society meeting was 67%. The responses of the attendees are discussed in meetings of the AOS Council and Program Advisory 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 Council prior to the next meeting to assist the Program Committee in developing future AOS Continuing Medical 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 response, the following data regarding professional practice gaps among attendees were noted:

- Optimum cochlear implant performance and patient outcomes are not achieved in some circumstances. Identifying the factors that impact performance is critical for patient outcomes.
- The risk of progressive sensorineural hearing loss and hydrops after surgery for otosclerosis is not routinely recognized. Lack of knowledge impacts informed consent and patient satisfaction with surgical treatment of hearing loss.
- The cost-benefit of serial imaging during treatment of necrotizing otitis externa is not optimal. Consequently, nuclear imaging is obtained that does not alter patient management.

The AOS chose these education formats because they have proven to be the optimal approaches that engage learners with direct impact on their knowledge and practice patterns. Panel discussions with experts in the field has been requested by attendees and highly rated as an effective format in previous meetings. Didactic presentations are focused on medical topics of high impact and interest to our attendees. Post-presentation question and answer periods facilitate knowledge and clarification for the participants.

The 149th Annual Meeting of the American Otological Society will begin Friday afternoon, May 20th. AOS President, Dr. Debara L. Tucci will honor the following individuals with a Presidential Citation.

Karen J. Enright, MD, PhD
Paul R. Lambert, MD
John K. Niparko, MD
Steven A. Telian, MD
David L. Witsell, MD, MHS
Nancy M. Young, MD

Dr. Tucci, selected Dr. Blake Wilson as the AOS Guest of Honor of the 149th AOS annual meeting. Dr. Wilson will kick off the scientific program on Friday at 1:40 P.M. with his presentation entitled, *"The Development of the Modern Cochlear Implant and the First Substantial Restoration of a Human Sense Using a Medical Intervention"*.

Program highlights include the Saumil Nalin Merchant Memorial Lecture entitled, "*30 Years of Hair Cell Regeneration: Promising Progress or Pie in the Sky*?" by Dr. Andy Groves. In addition to, a Special Invited Lecture presented by Dr. Frank R. Lin on *"Hearing Loss in Older Adults-A Public Health Perspective"*. We would like to acknowledge and thank the Triological Society for their generous donation to sponsor this lecture and honor the David & Shirley Gossard family.

The 2016 Panels will address *"Implantable Hearing Devices: The Economics of How, Why, and Who*" led by Michael E. Hoffer, MD and *"Etiology of Cholesteatoma: Controversies and Implications for Treatment"* moderated by Sujana S. Chandrasekhar, MD.

Dr. Jameson K. Mattingly and Dr. Brendan P. O'Connell were selected as recipients of an *AOS Resident Research Travel Award,* each will receive a $2000 honorarium. In addition, there are a vast number of oral presentations exploring the latest otological research and findings.

Be sure to visit Riverside Exhibit Hall (East Tower) where you will find an outstanding display of AOS poster submissions. Posters will be available for viewing on Friday & Saturday, 9:00-4:00. Recipients of the AOS poster awards will be announced at the close of the AOS Scientific program on Friday, May 20th at 5:00 P.M. The Combined Poster Reception/ Meet the Authors will take place Friday evening, May 20th in the Exhibit Hall from 5:30-7:00 P.M.

The AOS President's Reception and Dinner/Dance will take place on Saturday evening, May 21st from 6:30 - 10:30 PM. Don't miss this opportunity to join your colleagues for an evening packed with fun, fellowship and a few surprises! Please be sure to purchase your tickets in advance. (Members and invited guests only).

The American Otological Society (AOS) is committed to improving public health care through the provision of high-quality continuing medical education (CME) to our members.

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

- Attendees will be aware of the surgical factors that positively and negatively impact implant performance outcomes.
- Attendees will understand the potential for postoperative hearing loss and hydrops after stapes surgery.
- Attendees will appreciate the optimum timing for diagnostic imaging tests during treatment of necrotizing otitis externa.

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

- Order imaging tests at the most appropriate times to manage necrotizing otitis externa.
- Discuss the impact of hearing loss on cognition in the elderly.
- Distinguish between different types of cholesteatoma and recognize how pathology can impact treatment decisions.

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

- This activity will increase the practitioner's knowledge of optimum surgical techniques for cochlear implant insertion.
- This activity will increase the practitioner's knowledge of the impact of hearing loss on cognition in older adults.
- As a result of this activity, practitioners will have increased ability to discuss risks of hearing loss after stapes surgery.

Patient outcomes will be improved in the following ways:

- Practitioners will modify their surgical techniques to minimize factors that negatively impact cochlear implant performance.
- Practitioners will choose the surgical approach to repair superior canal defects that minimizes risk of hearing loss and effectively eliminates symptoms related to the defect.
- Practitioners will obtain nuclear imaging tests for following necrotizing otitis externa at time points that optimize patient management and disease control.

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 Otological 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 AOS Continuing Medical Education program.

In compliance with 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.

AOS is also required, through our joint providership partnership with ACS, 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 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.
Disclosure Information

PUBLICATION STATEMENT
The material in this abstract, (Name of 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.

*****Disclosures *****

American Otological Society, Inc. Statement

All authors, presenters, panelists, guest lecturers, Council members, Program Advisory Committee members, Administrative staff and any other contributing individuals who may be in a position to control content of a CME activity were required to complete a Disclosure/Conflict of Interest/Attestation declaration prior to consideration for presentation or appointment to a CME planning Committee. All potential conflicts of interest were resolved prior to participation in the planning of this activity.

Authors were instructed to read and sign the following Attestation statement.

1. I will disclose all relevant financial relationships to the AOS. disclose this information to learners verbally (for live activities) and in print.
2. The content and/or presentation of the information with which I am involved will promote quality or improvements in healthcare and will not promote a specific proprietary business interest of a commercial interest. Content for this activity, including any presentation of therapeutic options, will be well - balanced, evidence - based and unbiased.
3. I have not and will not accept any honoraria, additional payments or reimbursements beyond that which has been agreed upon directly with the AOS.
4. If I am presenting at a live event, I am aware that a CME monitor will attend the event to ensure that my presentation is educational, and not promotional, in nature. If presentation is found to be promotional in any way, I understand I will be ineligible to participate in an *AOS/ACS* joint provided CME accredited activity for a period up to two years.
5. If I am providing recommendations involving clinical medicine, they will be based on evidence that is accepted within the profession of medicine as adequate justification for their indications and contraindications in the care of patients. All scientific research referred to, reported or used in CME in support of justification of a patient care recommendation will conform to the generally accepted standards of experimental design, data collection and analysis.
6. If I am discussing specific healthcare products or services, I will use generic names to the extent possible. If I need to use trade names, I will use trade names from several companies when available, not just trade names from any single company.
7. If I am discussing any product use that is off label, I will disclose that the use or indication in question is not currently approved by the FDA for labeling or advertising.
8. If I have been trained or utilized by a commercial entity or its agent as a speaker (e.g., speaker's bureau) for any commercial interest, the promotional aspects of that presentation will not be included in any way with this activity.
9. If I am presenting research funded by a commercial company, the information presented will be based on generally accepted scientific principles and methods, and will not promote the commercial interest of the funding company.

DISCLOSURES
(In alphabetical order)

AOS Executive Council – 2015-2016

The following Council Members disclose:
John P. Carey, MD
Otonomy – Site PI – Grant

The following Council Members have nothing to disclose:
Carol Bauer, MD
Roberto A. Cueva, MD
John W. House, MD
Samuel H. Selesnick, MD
Steven A. Telian, MD
Debara L. Tucci, MD, MS, MBA
D. Bradley Welling, MD, PhD

AOS Program Advisory Committee – 2016

The following Program Committee Members disclose:
Rick Friedman MD, PhD
Otonomy – Stockholder – Stocks
Timothy E. Hullar, MD
Advanced Bionics – Medical Advisory Board - honorarium
Abraham Jacob, MD
Cochlear Americas – Principal Investigator – Research Funds
Cochlear Americas – Sugary Advisory Board – none
Advanced bionics - Principal Investigator – Research Funds
MED-EL – Speaker – Funds for travel, lodging, meals
Olympus – Consultant – Funds for meeting
Michael D. Seidman, MD
Visalus Sciences –Developed Products – Royalty
Body Language Vitamins – Founder
Patents – Patent I developed – Intellectual Property
NIH – Stimulation Study – Research/Grant
Auris Medical – AM 101 Tinnitus Study - Research/Grant
MicroTransponder, Inc. – Board of Directors – Leadership Role
AAO – HNS – Board of Directors – Leadership Role
George J. Wanna, MD
MED-EL- Consultant- Travel Expenses
Advanced Bionics- Consultant- Honorarium
Cochlear Corp- Consultant- Nothing
Oticon Medical- Consultant- Honorarium
Nancy M. Young, MD
Resonance- Stockholder- Purchased Stock
Cochlear Corp- Medical/Surgical Advisory Board – Consulting fee
MED-EL- Medical/Surgical Advisory Board – Consulting fee
Advanced Bionics- Medical/Surgical Advisory Board – Consulting fee

The following Program Committee Members have nothing to disclose:
Carol A. Bauer, MD
Joni K. Doherty, MD, PhD
Karen Jo Doyle-Enright MD, PhD
Andrew J. Griffith, MD, PhD
David M. Kaylie, MD

The following Program Committee Members have nothing to disclose: *(cont.)*
Brian A. Neff, MD
Brian P. Perry, MD
Konstantina M. Stankovic, MD, PhD

The following Poster judges have nothing to disclose:
Abraham Jacob, MD
Brian P. Perry, MD
Michael D. Seidman, MD
George J. Wanna, MD

ANS Administration
The following individuals have nothing to disclose:
Kristen Bordignon
Ashley Westbrook

DISCLOSURES
Oral Presentations
Primary Authors/Presenters/Panel Participants/Guest Disclosures
(listed in order of presentation)
Friday May 20, 2016

1:40 **GUEST OF HONOR LECTURE**
"The Development of the Modern Cochlear Implant and the First Substantial Restoration of a Human Sense Using a Medical Intervention"
The following individual discloses:
Blake Wilson, PhD, DSc, DEng, Dr.med.hc (mult.)
MED-EL- Consultant– Consultant fees

2:18 **Moving Beyond GDP: Cost Effectiveness of Cochlear Implantation and Deaf Education in Latin America**
The following individual has nothing to disclose:
Susan D. Emmett, MD, MPH

2:26 **Implementation of Image-Guided Cochlear Implant Programming at a Distant Site**
The following individual has nothing to disclose:
Theodore R. McRackan, MD

2:34 **Performance Plateau in Prelingually and Postlingually Deafened Adult Cochlear Implantees**
The following individual has nothing to disclose:
Cristen Cusumano, BA

3:15 **Oligodendrocyte Migration and Myelination during the Formation of the Peripheral-Central Transitional Zone of the Postnatal Mouse Cochlear Nerve**
The following individual has nothing to disclose:
Dennis Bojrab, II, MD

3:23 **Cochlear Implantation in Patients with Intracochlear and Intralabyrinthine Schwannomas**
The following individual has nothing to disclose:
Matthew L. Carlson, MD

3:31 **Minimizing Insertion Trauma with a Novel Shape Memory Polymer Cochlear Implant Array**
The following individual has nothing to disclose:
Kenneth H. Lee, MD, PhD

3:39 **Broad Spectrum Amplification with a Light Driven Hearing System**
The following individual discloses:
Bruce J. Gantz, MD
Earlens Corporation-Medical Advisory Board - None
Primary Investigator-Trial Study Data Reported in this Presentation

3:47 **Steerable Robot Assisted Micro-Manipulation in the Middle Ear: Preliminary Feasibility Evaluation**
The following individual has nothing to disclose:
Brendan P. O'Connell, MD

3:55 **Preliminary Study of the Design of a Custom Middle Ear Prosthesis**
The following individual has nothing to disclose:
Brandon Kamrava, BS

4:03 **National Utilization and Forecasting of Ototopical Antibiotics Medicaid Data versus "Dr. Google"**
The following individual has nothing to disclose:
Matthew G. Crowson, MD

4:15 **PANEL – "Etiology of Cholesteatoma: Controversies and Implications for Treatment"**
The following individual discloses:
Sujana S. Chandrasekhar, MD - Moderator
Otodyne, Inc - subsid of Scientific Development & Research Inc.- Board Member, Chief Medical Officer-Owns Shares
Otic Pharma, Inc. – Consultant – Consultant fees
The following individuals have nothing to disclose:
Robert K. Jackler, MD
Richard A. Chole, MD, PhD
Dennis S. Poe, MD

Saturday May 21, 2016

7:35 **Predictors of Individual Differences in Hearing-Aid Benefit for Speech Recognition**
The following individual has nothing to disclose:
Theodore R. McRackan, MD

7:43 **RESIDENT RESEARCH TRAVEL AWARD**
Analysis of 220 Cochlear Implants: Factors That Influence Intrascalar Electrode Translocation and Audiologic Outcomes
The following individual has nothing to disclose:
Brendan P. O'Connell, MD

7:51 **Tip Fold Over In Cochlear Implantation**
The following individual has nothing to disclose:
M. Geraldine Zuniga MD

7:59 **Reduction of the Harmonic Series Influences Musical Enjoyment with Cochlear Implants**
The following individual has nothing to disclose:
John S. Nemer, BS, BA

8:07 **Flat-Panel CT for Cochlear Implant Electrode Imaging: Comparison to Multi-Detector CT**
The following individual has nothing to disclose:
Nathaniel Connell, MS

8:15 **Post Hybrid Cochlear Implant Hearing Loss and Endolymphatic Hydrops**
The following individual has nothing to disclose:
Akira Ishiyama, MD

8:30 **SAUMIL NALIN MERCHANT MEMORIAL LECTURE**
"30 Years of Hair Cell Regeneration: Promising Progress or Pie in the Sky?"
The following individual has nothing to disclose:
Andy Groves, PhD

9:00 RESIDENT RESEARCH TRAVEL AWARD
Air-Bone Gaps Contribute to Functional Hearing Preservation in Cochlear Implantation
The following individual has nothing to disclose:
Jameson K. Mattingly, MD

9:08 Long Term Incidence and Degree of Sensorineural Hearing Loss in Otosclerosis
The following individual has nothing to disclose:
Reuven Ishai, MD

9:16 How Often Does Stapedectomy for Otoclerosis Result in Endolymphatic Hydrops?
The following individual has nothing to disclose:
Reuven Ishai, MD

9:24 SPECIAL INVITED LECTURE
"Hearing Loss in Older Adults-A Public Health Perspective"
The following individual discloses:
Frank R. Lin, MD, PhD
Amplifier – Speaker – Speaker Honorarium
Autifony – Consultant – Consultant fees
Pfizer – Scientist - Consultant fees
Cochlear Americas - Consultant – Consultant fees

10:15 The Impact of Smoking on Ossiculoplasty Outcomes
The following individual has nothing to disclose:
Matthew D. Cox, MD

10:23 Appropriate Timing of Nuclear Imaging for Necrotizing Otitis Externa
The following individual has nothing to disclose:
Graham T. Whitaker, MD

10:31 Anatomic Variations in Temporal Bones Affect the Intensity of Nystagmus during Warm Caloric Irrigation
The following individual has nothing to disclose:
Aniruddha U. Patki, MD

10:39 Fluctuations in Vestibular Afferent Excitability in Meniere's Disease
The following individual discloses:
Jay T. Rubinstein, MD, PhD
Cochlear, Ltd - IP rights
Advanced Bionics Corp - Medical Advisory Council - none
Shanghai Lishengte - Royalty interest

10:47 Vestibular Function is Impaired in Individuals with Dementia
The following individual has nothing to disclose:
Aisha Harun, MD

11:00 PANEL – "Implantable Hearing Devices: The Economics of How, Why, and Who"
The following individual has nothing to disclose:
Michael E. Hoffer, MD - Moderator
Joni K. Doherty, MD, PhD
Sumit Agrawal, MD
The following individuals disclose:
Brian J. McKinnon, MD, MBA
Oticon Medical LLC – Presenter - Honoraia, Travel Support
Cochlear America – Consultant - Travel Support
Resonance Medical – Consultant – Stock
hearLIFE Clinic Nassau (Med-EL) – Surgeon - Fee for Service-Salary
Craig A. Buchman, MD
Cochlear – Surgical Advisor – Consultant fee

Posters

F001 - Older Individuals Meeting Cochlear Implant Candidacy Criteria in Noise but Not in Quiet: Are Such Patients Improved by Surgery?
The following individual has nothing to disclose:
Jordan A. Mudery, BS

F002 - Incidence of Bony Cochlear Nerve Canal Stenosis in Pre-Lingually Deaf Cochlear Implant Recipients
The following individual has nothing to disclose:
Calvin H. Knapp, III

F003 - Effect of Acute Between-Ear Frequency Mismatches on Speech Understanding in Users of Bilateral Cochlear Implants
The following individual has nothing to disclose:
Ksenia A. Aaron, MD

F004 - Feasibility Study: Measurement of Cochlear Length Using the a Value for Cochlea Basal Diameter
The following individual has nothing to disclose:
Nicholas L. Deep, MD

F005 - Consideration for Routine Outpatient Pediatric Cochlear Implantation: A Retrospective Chart Review of Immediate Post-operative Complications
The following individual has nothing to disclose:
Sunthosh Sivam, MD

F006 - Effect of Hearing Aids and Cochlear Implants on Older Adults' Communicative Function
The following individual has nothing to disclose:
Carrie L. Nieman, MD, MPH

F007 - Partnering with Community Audiologists for Decentralized Cochlear Implant Programming Maintains Quality and Enhances Patient Satisfaction: A Hub and Spoke Model
The following individual has nothing to disclose:
Erynne A. Faucett, MD

F008 - Accuracy of Mobile-Based Audiometry in the Evaluation of Hearing Loss in Quiet and Noisy Environments
The following individual has nothing to disclose:
Joe Saliba, MD

F009 - Hearing Loss in Rural Adults: A Geographic Comparison of Access to Care in Hearing Aid Recipients
The following individual has nothing to disclose:
Stephen Chan, BS

F010 - Third-Generation Bisphosphonates for Cochlear Otosclerosis Stabilizes Sensorineural Hearing Loss in Long-Term Follow Up
The following individual has nothing to disclose:
Taha A. Jan, MD

F011 - Risk of Hearing Loss Progression is Higher in Children with Bony Cochlear Nerve Canal Stenosis than in Children with Other Temporal Bone Anomalies
The following individual has nothing to disclose:
Patricia L. Purcell, MD, MPH

F012 - Risk of Progressive Hearing Loss in Untreated Superior Semicircular Canal Dehiscence
The following individual has nothing to disclose:
Neil S. Patel, MD

F013 - Long-Term Results of the Treatment of Idiopathic Sudden Sensorineural Hearing Loss
The following individual has nothing to disclose:
Robert A. Battista, MD

F014 - The Inner Ear Manifestations of Neurosarcoidosis and its Management
The following individual has nothing to disclose:
Jacqueline J. Greene, MD

F015 - High-Throughput Assay of Zebrafish Swimming Behavior for Drug Development Targeting Hearing Loss
The following individual has nothing to disclose:
Douglas W. Todd, BS

F016 - Hypertension, Diuretic Use, and Risk of Hearing Loss
The following individual has nothing to disclose:
Brian M. Lin, MD

F017 - Migraine-Related Aural Fullness: A New Clinical Entity
The following individual has nothing to disclose:
Yaser Ghavami, MD

F018 - Delayed Intravenous Contrast-Enhanced Inner Ear MRI for Evaluation of Endolymphatic Hydrops: The Use of a Novel Computer-Assisted Volumetric Analysis Tool
The following individual has nothing to disclose:
Jacob L. Wester, MD

F019 - A Computational Study of the Relationship between Temporal Bone Anatomy and Caloric Asymmetry
The following individual has nothing to disclose:
Erin G. Piker, PhD

F020 - Incidence of Labyrinthine Concussion in Trauma Patients with Otic-Capsule Sparing Temporal Bone Fractures
The following individual has nothing to disclose:
Lilun Li, BA

F021 - Intracochlear and Extracochlear Acoustic Responses during Insertion of a Cochlear Implant
The following individual has nothing to disclose:
Christopher K. Giardina, BS

F022 - Identification of the Sensory Auricular Branch of the Facial Nerve and Its Relationship to Landmarks of the Facial Recess
The following individual has nothing to disclose:
Michael S. Harris, MD

F023 - The Role of Intraoperative Auditory Brainstem Response Monitoring in Predicting Hearing Outcomes during Vestibular Schwannoma Surgery
The following individual has nothing to disclose:
Sonya Marcus, MD

F024 - Endoscopic Management of Middle Ear Paragangliomas: A Case Series
The following individual has nothing to disclose:
Daniel E. Killeen, MD

F025 - Epidemiology of Tumors of the External Auditory Canal and Middle Ear: Experience with 2415 Pathological Samples at a Tertiary Referral Center
The following individual has nothing to disclose:
Lukas D. Landegger, MD

F026 - Inflammatory Pseudotumor of the Temporal Bone: Case Series
The following individual has nothing to disclose:
Timothy E. Ortlip, MD

F027 - The Human Round Window Niche: A Microanatomic Three Dimensional Analysis
The following individual has nothing to disclose:
J. Eric Lupo, MD, MS

F028 - Customized Lateral Skull Base Repair in Temporal Bones with 3-D Printed Models
The following individual has nothing to disclose:
Kyle K. VanKoevering, MD

F029 - Creating an Ideal 3D Printed Model for Temporal Bone Dissection Training
The following individual has nothing to disclose:
Kuniyuki Takahashi, MD

F030 - Transcutaneous versus Percutaneous Osseointegrated Auditory Implants - Surgical and Audiologic Outcomes
The following individual discloses:
Darius Kohan, MD
Sophono -Unrestricted Research Grant

F031 - Soft Tissue Driven Transcutaneous Bone Anchored Hearing Implants: A Systematic Review of the BAHA Attract and Sophono Alpha
The following individual has nothing to disclose:
Timothy Cooper, MD

F032 - Feasibility of the Transcanal Endoscopic Approach for Visualizing and Accessing the Anatomy in the Supratubal Recess
The following individual has nothing to disclose:
Seiji Kakehata, MD, PhD

F033 - Endoscopic Ossicular Chain Reconstruction: Impact on Audiometric Outcomes
The following individual has nothing to disclose:
Robert J. Yawn, MD

F034 - Use of 2-Octylcyanoacrylate in Cartilage Interposition Adherence during Ossiculoplasty
The following individual has nothing to disclose:
Kyle P. McMullen, MD

F035 - Novel Device for Measuring Ossicular Chain Compliance Before and After Surgical Repair
The following individual has nothing to disclose:
Justin T. Casey, MD

F036 - Tympanoplasty Outcomes for Blast-Induced Perforations from Iraq and Afghanistan 2007-2012
The following individual has nothing to disclose:
Sungjin A. Song MD

F037 - Acquired Soft Tissue External Auditory Canal Stenosis: A Review of AlloDerm Grafting versus Split Thickness Skin Graft
The following individual has nothing to disclose:
Michel A. Evans, DO

F038 - Reduction in Canal Stenosis Complications in Congenital Aural Atresia Repair Surgery
The following individual has nothing to disclose:
Caroline M. Schlocker, MD

F039 - Iatrogenic Cholesteatoma Arising from the Vascular Strip
The following individual has nothing to disclose:
Alex D. Sweeney, MD

Combined Poster Reception
AOS/ANS/ASPO/TRIO
Friday, May 20, 2016
5:30 pm - 7:00 pm
Exhibit Hall
Riverside Center

AOS President's Reception & Banquet
Saturday, May 21, 2016

Reception - 6:30 pm
Crystal Ballroom/North Foyer
West Tower - Green Level

Dinner/Dance - 7:00 pm
Crystal Ballroom

Formal attire/Black tie optional
{Advanced ticket purchase required
Members & Invited Guests only}

UPCOMING MEETINGS

150th AOS Spring Meeting
(in conjunction with COSM)
April 28-30, 2017
Manchester Grand Hyatt, San Diego, CA

AAO-HNSF Annual Meeting & OTO EXPO
September 18-21, 2016
San Diego Convention Center, San Diego, CA

The Abstract deadline for the AOS 150th Annual meeting is Saturday, October 15, 2016.

Abstract Instructions and submission form will be available on website in July.
Website - www.americanotologicalsociety.org

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 Program Advisory Committee.

Journal Requirements/Instructions to Primary Authors
Manuscripts are required of ALL ORAL 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 Otological Society and the O&N Journal will result in the disqualification of your presentation.

For Society business, please forward all inquiries to:

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The following ACGME competency areas will be addressed throughout this CME activity.

Patient Care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health.

Medical Knowledge about established and evolving biomedical, clinical, and cognate (e.g. epidemiological and social-behavioral) sciences and the application of this knowledge to patient care.

Practice-Based Learning and Improvement that involves investigation and evaluation of their own patient care, appraisal and assimilation of scientific evidence, and improvements in patient care.

Interpersonal and Communication Skills that result in effective information exchange and teaming with patients, their families, and other health professionals.

Professionalism as manifested through a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population.

Systems-Based Practice as manifested by actions that demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value.

THE AMERICAN OTOLOGICAL SOCIETY WOULD LIKE TO THANK THE FOLLOWING MEMBERS FOR THEIR CONTRIBUTION TO THE 2016 AOS SCIENTIFIC PROGRAM

Debara L. Tucci, MD, MS, MBA – Chair
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Nancy M. Young, MD

POSTER JUDGE
Abraham Jacob, MD
Brian P. Perry, MD
Michael D. Seidman, MD
George J. Wanna, MD

AMERICAN OTOLOGICAL SOCIETY
149th Annual Meeting
Scientific Program

FRIDAY, MAY 20, 2016

1:00 **Business Meeting** (*AOS new member introduction/ All member photo*)
(*Members Only*)

1:30 **Scientific Program**
(*Open to registered Members and Non-members – Badge required for admittance*)

1:30 **Welcome & Opening Remarks by the President**
Debara L. Tucci, MD, MS, MBA

Presidential Citations
Karen J. Enright, MD, PhD
Paul R. Lambert, MD
John K. Niparko, MD
Steven A. Telian, MD
David L. Witsell, MD, MHS
Nancy M. Young, MD

1:40 **GUEST OF HONOR LECTURE**
"The Development of the Modern Cochlear Implant and the First Substantial Restoration of a Human Sense Using a Medical Intervention"
Blake Wilson, PhD, DSc, DEng, Dr.med.hc (mult.)
Introductory comments by John W. House, MD

2:18 **Moving Beyond GDP: Cost Effectiveness of Cochlear Implantation and Deaf Education in Latin America**
Susan D. Emmett, MD, MPH
Debara L. Tucci, MD, MBA
Ricardo F. Bento, MD, PhD
Juan M. Garcia, MD
Solaiman Juman, FRCS
Juan A. Chiossone-Kerdel, MD
Ta J. Liu, MD
Howard W. Francis, MD, MBA
James E. Saunders, MD

2:26 **Implementation of Image-Guided Cochlear Implant Programming at a Distant Site**
Theodore R. McRackan, MD
Erik P. Wilkinson, MD
Dawna M. Mills, AuD
Jack H. Noble, PhD
Rene H. Gifford, PhD
Robert F. Labadie, MD, PhD
Benoit M. Dawant, PhD

NOTES

2:34 **Performance Plateau in Prelingually and Postlingually Deafened Adult Cochlear Implantees**
Cristen Cusumano, BA
David R. Friedmann, MD
J. Thomas Roland, Jr., MD
Susan B. Waltzman, PhD

2:42 **DISCUSSION**

2:45 **BREAK WITH EXHIBITORS**

3:15 **Oligodendrocyte Migration and Myelination during the Formation of the Peripheral-Central Transitional Zone of the Postnatal Mouse Cochlear Nerve**
Dennis Bojrab, II, MD
Baofu Zhang
Hui Jiang
Lei Zhang
Xin Deng
David S. Cohen, MD
Zhengqing Hu, MD, PhD

3:23 **Cochlear Implantation in Patients with Intracochlear and Intralabyrinthine Schwannomas**
Matthew L. Carlson, MD
Brian A. Neff, MD
Michael J. Link, MD
Colin L. W. Driscoll, MD

3:31 **Minimizing Insertion Trauma with a Novel Shape Memory Polymer Cochlear Implant Array**
Kenneth H. Lee, MD, PhD
Walter Voit, PhD
Radu Reit, BS
Roxanne Lee, BS
Tiffany Pham, BS
Hans Ajieren
Dongmei Shao, MD

3:39 **Broad Spectrum Amplification with a Light Driven Hearing System**
Bruce J. Gantz, MD
Rodney Perkins, MD
Michael T. Murray, MD
Suzanne Carr Levy, PhD
Sunil Puria, PhD

3:47 **Steerable Robot Assisted Micro-Manipulation in the Middle Ear: Preliminary Feasibility Evaluation**
Brendan P. O'Connell, MD
Haoran Yu, BS
Alejandro Rivas, MD
Jacob B. Hunter, MD
Rashid M. Yasin, MA
George B. Wanna, MD
Nabil Simaan, PhD

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3:55 **Preliminary Study of the Design of a Custom Middle Ear Prosthesis**
Brandon Kamrava, BS
Jonathan Gerstenhaber, PhD
Yah-el Har-el, PhD
Pamela C. Roehm, MD, PhD

4:03 **National Utilization and Forecasting of Ototopical Antibiotics Medicaid Data versus "Dr. Google"**
Matthew G. Crowson, MD
Kristine Schulz, DrPH
Debara L. Tucci, MD, MS, MBA

4:11 **DISCUSSION**

4:15 **PANEL – "Etiology of Cholesteatoma: Controversies and Implications for Treatment"**
Sujana S. Chandrasekhar, MD - Moderator
Robert K. Jackler, MD
Richard A. Chole, MD, PhD
Dennis S. Poe, MD

5:00 **ADJOURNMENT**

5:30 **COMBINED POSTER RECEPTION AOS/ANS/TRIO/ASPO**

SATURDAY, MAY 21, 2016

7:00 **Business Meeting/Committee Reports**
(*Members Only*)

7:30 **Scientific Program**
(*Open to registered Members and Non-members Badge required for admittance*)

7:30 **Remarks by the President**
Debara L. Tucci, MD, MS, MBA

7:35 **Predictors of Individual Differences in Hearing-Aid Benefit for Speech Recognition**
Theodore R. McRackan, MD
Ted A. Meyer, MD, PhD
William Clinkscales, BS
Judy R. Dubno, PhD

7:43 **RESIDENT RESEARCH TRAVEL AWARD**
Analysis of 220 Cochlear Implants: Factors That Influence Intrascalar Electrode Translocation and Audiologic Outcomes
Brendan P. O'Connell, MD
Cakir Ahmet, MRes
Jacob B. Hunter, MD
Jack H. Noble, PhD
Alejandro Rivas, MD
Robert F. Labadie, MD PhD
Benoit M. Dawant, PhD
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7:51 **Tip Fold Over In Cochlear Implantation**
M. Geraldine Zuniga MD
Alejandro Rivas MD
Andrea Hedley-Williams, AuD
Rene H. Gifford, AuD, PhD
Robert Dwyer, AuD
Benoit Dawant, PhD
Jack Noble, PhD
Robert F. Labadie, MD, PhD

7:59 **Reduction of the Harmonic Series Influences Musical Enjoyment with Cochlear Implants**
John S. Nemer, BS, BA
Gavriel D. Kohlberg, MD
Dean M. Mancuso, AuD
Brianna M. Griffin, BS
Michael V. Certo, BFA, MM
Anil K. Lalwani, MD

8:07 **Flat-Panel CT for Cochlear Implant Electrode Imaging: Comparison to Multi-Detector CT**
Nathaniel Connell, MS
Tabassum Kennedy, MD
Timothy P. Szczykutowicz, PhD
Sebastian Schafer, PhD
Kevin Royalty, MS
Brian C. Gartrell, MD
Samuel P. Gubbels, MD

8:15 **Post Hybrid Cochlear Implant Hearing Loss and Endolymphatic Hydrops**
Akira Ishiyama, MD
Joni K. Doherty, MD, PhD
Alicia M. Quesnel, MD
Ivan Lopez, PhD
Fred H. Linthicum, MD

8:23 **DISCUSSION**

8:30 **SAUMIL NALIN MERCHANT MEMORIAL LECTURE**
"30 Years of Hair Cell Regeneration: Promising Progress or Pie in the Sky?"
Andy Groves, PhD

9:00 **RESIDENT RESEARCH TRAVEL AWARD**
Air-Bone Gaps Contribute to Functional Hearing Preservation in Cochlear Implantation
Jameson K. Mattingly, MD
Kristen M. Uhler, PhD
Stephen P. Cass, MD, MPH

9:08 **Long Term Incidence and Degree of Sensorineural Hearing Loss in Otosclerosis**
Reuven Ishai, MD
Christopher Halpin, PhD
Michael J. McKenna, MD
Alicia M. Quesnel, MD

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9:16 **How Often Does Stapedectomy for Otoclerosis Result in Endolymphatic Hydrops?**
Reuven Ishai, MD
Christopher Halpin, PhD
Michael J. McKenna, MD
Alicia M. Quesnel, MD

9:24 **SPECIAL INVITED LECTURE**
Sponsored by the Triological Society in memory of the Gossard family
"Hearing Loss in Older Adults-A Public Health Perspective"
Frank R. Lin, MD, PhD

9:45 **BREAK WITH EXHIBITORS**

10:15 **The Impact of Smoking on Ossiculoplasty Outcomes**
Matthew D. Cox, MD
Shane R. Anderson, MBBS, FRACS
J. Shep Russell, MD
John L. Dornhoffer, MD

10:23 **Appropriate Timing of Nuclear Imaging for Necrotizing Otitis Externa**
Graham T. Whitaker, MD
Patrick J. Antonelli, MD
Matthew R. O'Malley, MD

10:31 **Anatomic Variations in Temporal Bones Affect the Intensity of Nystagmus during Warm Caloric Irrigation**
Aniruddha U. Patki, MD
Ofri Ronen, MD
David M. Kaylie, MD, MS
Dennis O. Frank-Ito, PhD
Erin G. Piker, PhD

10:39 **Fluctuations in Vestibular Afferent Excitability in Meniere's Disease**
Jay T. Rubinstein, MD, PhD
James O. Phillips, PhD
Kaibao Nie, PhD
Christopher Phillips, BS
Leo Ling, PhD

10:47 **Vestibular Function is Impaired in Individuals with Dementia**
Aisha Harun, MD
Robin Bigelow, BS
Esther S. Oh, MD
Yuri Agrawal, MD

10:55 **DISCUSSION**

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11:00 PANEL – "Implantable Hearing Devices: The Economics of How, Why, and Who"
Michael E. Hoffer, MD - Moderator
Joni K. Doherty, MD, PhD
Sumit Agrawal, MD
Brian J. McKinnon, MD, MBA
Craig A. Buchman, MD

12:00 INTRODUCTION OF INCOMING AOS PRESIDENT
Samuel H. Selesnick, MD

12:05 CLOSING REMARKS/ADJOURNMENT

6:30 AOS PRESIDENT'S RECEPTION AND DINNER/DANCE
(*Members and Invited Guests Only*)

Saturday, May 21, 2016 - *during ANS Scientific Program*

4:00 COMBINED ANS/AOS PANEL

"Current Controversies in Superior Canal Dehiscence Syndrome"
John P. Carey, MD - Moderator

Advantages of Middle Fossa Repair
Daniel J. Lee, MD

Advantages of Transmastoid Repair
Shakeel R. Saeed, MD, MBBS

Role of Round Window Reinforcement
Seilesh C. Babu, MD

Plugging, Resurfacing and Round Window Reinforcement: What Do These Procedures Do to Inner Ear Dynamics?
Hideko Heidi Nakajima, MD, PhD

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ABSTRACTS - ORAL PRESENTATIONS

Moving Beyond GDP: Cost Effectiveness of Cochlear Implantation and Deaf Education in Latin America

Susan D. Emmett, MD, MPH; Debara L. Tucci, MD, MBA
Ricardo F. Bento, MD, PhD; Juan M. Garcia, MD
Solaiman Juman, FRCS; Juan A. Chiossone-Kerdel, MD
Ta J. Liu, MD; Howard W. Francis, MD, MBA
James E. Saunders, MD

Hypothesis: Cochlear implantation (CI) and deaf education are cost-effective management strategies of childhood profound sensorineural hearing loss in Latin America.

Background: CI has been widely established as cost-effective in North America and Europe and is considered standard of care in those regions, yet cost effectiveness in other economic environments has not been explored. With 80% of the global hearing loss burden existing in low- and middle-income countries, developing cost-effective management strategies in these environments is essential. This analysis represents the continuation of a global assessment of CI and deaf education cost effectiveness.

Methods: Brazil, Columbia, Ecuador, Guatemala, Paraguay, Trinidad and Tobago, and Venezuela participated in the study. A Disability Adjusted Life Years (DALY) model was applied with 3% discounting and 10-year length of analysis. Experts from each country supplied cost estimates from known costs and published data. Sensitivity analysis was performed to evaluate the effect of device cost, professional salaries, annual number of implants, and failure rate. Cost effectiveness was determined using the World Health Organization standard of cost effectiveness ratio/gross domestic product per capita (CER/GDP) <3.

Results: Deaf education was cost-effective in all countries (CER/GDP 0.07–0.93). CI was cost-effective in all countries (CER/GDP 0.69–2.96), with borderline cost effectiveness in the Guatemalan sensitivity analysis (Max CER/GDP 3.21).

Conclusions: Both cochlear implantation and deaf education are widely cost-effective in Latin America. In the lower- middle income economy of Guatemala, implant cost may have a larger impact. GDP is less influential in the middle- and high-income economies included in this study.

Define Professional Practice Gap & Educational Needs: 1. Lack of awareness of the inequitable distribution of the global burden of hearing loss. 2. Unknown cost effectiveness of management strategies for profound hearing loss in low- resource settings.

Learning Objective: 1. To improve understanding of the disproportionate burden of hearing loss in low- and middle- income countries. 2. To evaluate cost-effectiveness of cochlear implantation and deaf education in Latin America.

Desired Result: Attendees will better understand the variation in hearing loss prevalence by geographic region. They will be familiar with the results of a DALY model evaluating the cost effectiveness of cochlear implantation and deaf education in Latin America.

IRB - Exempt

Implementation of Image-Guided Cochlear Implant Programming at a Distant Site

Theodore R. McRackan MD; Erik P. Wilkinson MD
Dawna M. Mills, AuD; Jack H. Noble PhD
Rene H. Gifford, PhD; Robert F. Labadie, MD PhD
Benoit M. Dawant, PhD

Objective: To prospectively evaluate the implementation of image-guided cochlear implant programming (IGCIP) at a distant site.

Study design: Prospective clinical trial

Setting: A central image-processing center and a tertiary-care center.

Patients: Seventeen adult CI recipients.

Interventions/Main outcomes measured: Process for reprogramming and audiological results.

Results: Over a two-year period, 17 ears in 15 patients underwent IGCIP at a distant site. To accomplish this, pre (if available) and post-operative CT scans were obtained and electronically transferred to the central image-processing center where the images were processed to determine the relationship between the electrode array and the modiolus. Recommended programming changes consisting of deactivation of sub-optimally located electrodes were communicated back to the distant site. Audiologists implemented the programming changes and performed standardized testing after 1 month. On average, 9 electrodes were deactivated per patient. Overall, 64.7% of patients chose to keep their IGCIP map over their prior CI map created by an expert CI audiologist. There were no statistically significant differences in CNC words/phonemes, AzBio quiet/ +10SNR, BKB-SIN, or SMD scores between these two groups. All (100%) patients with pre-operative CTs chose to keep their IGCIP map compared to 53.8% without.

Conclusion: Distant IGCIP based on image processing at a central site is viable. Patients preferred the image-based CI maps to a greater degree than would be predicted by quantitative measures. Those with pre-operative CT scans appear to have improved outcomes compared to those without, but more data is needed.

Define Professional Practice Gap & Educational Needs: 1. Lack of awareness of how CT can be used to identify cochlear implant electrode position and be used to diminish channel interaction. 2. Lack of understanding of the improvement in cochlear implant function that can be achieved using image-guided cochlear implant programming. 3. Lack of awareness that image-guided cochlear implant programming can be successfully performed at a location distant to the host site.

Learning Objective: 1. Display how CT can be used to to identify cochlear implant electrode position and be used to diminish channel interaction. 2. Demonstrate the improvement in cochlear implant function using image- guided cochlear implant programming. 3. Describe how image-guided cochlear implant programming can be successfully performed at a location distant to the host site

Desired Result: Attendees will be better able to understand image-guided cochlear implant programming and consider applying it to their patient population

IRB - Approved

Performance Plateau in Prelingually and Postlingually Deafened Adult Cochlear Implantees

Cristen Cusumano, BA; David R. Friedmann, MD
J. Thomas Roland, Jr., MD; Susan B. Waltzman, PhD

Objectives: To compare the performance plateau post unilateral cochlear implantation (CI) in prelingually and postlingually deafened adults and to evaluate the effect of patient-specific variables on the plateau.

Study Design: Retrospective chart review.

Setting: Urban tertiary referral center.

Patients: Adults with prelingual or postlingual hearing loss who received a unilateral CI and completed a minimum of 2 years of follow-up.

Intervention: Unilateral CI.

Main outcome measures: Standard speech perception testing (Consonant-Nucleus-Consonant [CNC] monosyllabic word test and Hearing in Noise [HINT] or AzBio sentence test) were performed preoperatively and at 3 and 12 months postoperatively, and annually thereafter.

Results: In postlingually deaf patients (n=102), there was a highly significant improvement in word scores for 3 years post implantation ($p=.0016$). Beyond the 3 year postoperative time point, word scores reached a plateau. Sentence scores for postlingually deaf patients improved until the 1 year postoperative point ($p<.0001$) and then reached a plateau. In prelingually deaf patients (n=16), both word and sentence scores appear to improve throughout the entire follow-up period. Logistic regression analysis did not reveal a significant difference in the plateau in postlingually deaf patients based on age, duration of deafness, or preoperative speech perception scores.

Conclusions: Adults with postlingual deafness undergoing unilateral CI show significant improvement in speech perception for 3 years post implantation, at which point performance plateaus. The performance of adults with prelingual deafness improves for at least 6 years. These plateau points reflect a change to the currently reported 12 month period.

Define Professional Practice Gap & Educational Needs: The performance plateau post cochlear implantation in adults has not been studied since the expansion of the indications for implantation to include prelingually deafened adults and since the advent of advancements in cochlear implant technologies.

Learning Objective: We seek to characterize the timing of the performance plateau in both prelingually and postlingually deafened adults and to compare the plateau in the two patient populations.

Desired Result: A better understanding of the timing of the performance plateau will influence preoperative counseling of cochlear implant candidates and is necessary in order to appropriately manage patients' expectations. This knowledge will also be utilized to guide the duration of postoperative speech therapy.

IRB - Approved

Oligodendrocyte Migration and Myelination during the Formation of the Peripheral-Central Transitional Zone of the Postnatal Mouse Cochlear Nerve

Dennis Bojrab, II, MD; Baofu Zhang Hui Jiang
Lei Zhang; Xin Deng David S. Cohen, MD
Zhengqing Hu, MD, PhD

Hypothesis: To better understand oligodendrocyte migration and initiation of myelination along the cochlear nerve in early postnatal days until the mature pattern is reached

Background: In vertebrates, the central nervous system (CNS) and peripheral nervous system (PNS) interface in a region called the PNS-CNS transitional zone (PCTZ). The PCTZ is where sensory axons enter and motors axons exit the CNS. Oligodendrocytes and Schwann cells are the myelinating glia of the CNS and PNS, respectively. In studying the PCTZ, antibodies specific to proteins of these glial components have been widely used. Nuclear protein and myelin protein can be labeled separately, and this will be done to observe the location of the oligodendrocytes along with the location and timing of myelin expression.

Methods: Differential interference contrast (DIC) microscopy and immunofluorescence using antibodies specific to oligodendrocytes, Olig2 and MOG, and Schwann cells, P-zero, were used in order to study the cochlear nerve of Swiss Webster mice at certain postnatal days

Results: The myelination of CNS projections initiates in close proximity to the PCTZ, and oligodendrocytes in neonatal mice migrate peripherally to the DIC-PCTZ interface until the mature pattern was reached

Conclusions: As the PCTZ migrated from the brain to the cochlea, oligodendrocytes led this extension of the CNS tissue peripherally along the cochlear nerve. This understanding will aid stem cell transplantation into the spiral ganglion, with the goal of restoring a functional auditory nerve after spiral ganglion neuron degeneration.

Define Professional Practice Gap & Educational Needs: Understanding oligodendrocyte migration and initiation of myelination along the cochlear nerve in early postnatal days.

Learning Objective: The migration of oligodendrocytes was observed to precede the myelination of the CNS tissue.

Desired Result: Not only is this knowledge of PCTZ formation of the cochlear nerve critical to further research of myelination and experimental stem cell transplantation into the spiral ganglion, but there is also clinical relevance in nerve root disorders and regenerative therapies.

IRB - Approved

Cochlear Implantation in Patients with Intracochlear and Intralabyrinthine Schwannomas

Matthew L. Carlson, MD; Brian A. Neff, MD
Michael J. Link, MD; Colin L. W. Driscoll, MD

Objective: Schwannomas may arise primarily within the inner ear or invade the cochlea or labyrinth from the distal internal auditory canal through transmodiolar or transmacular extension, respectively. To date, very limited data exists regarding cochlear implant (CI) outcomes in this unique population.

Study Design: Retrospective case review

Patients: Ten ears (9 patients) with inner ear schwannomas that underwent CI at a single tertiary referral center

Intervention(s): Cochlear implantation

Main Outcome Measure(s): Surgical approach, postoperative radiological surveillance, CI performance

Results: Ten ears (9 patients) were implanted with a conventional array. Three cases had primary inner ear schwannomas, while 7 were in patients with NF2 having transmodiolar invasion of the inner ear from a vestibular schwannoma. In all cases, intracochlear tumor was left-in situ to preserve cochlear anatomy and a full electrode insertion was achieved. Use of a styleted electrode with late deployment aided advancement through the soft intracochlear tumor. In all cases, the ipsilateral inner ear could be visualized on postoperative MRI for tumor surveillance. Eight ears achieved good open-set word recognition (median CNC 57%; range 28-88%); 2 patients with NF2 and prolonged deafness (15 & 30 years) received limited benefit.

Conclusion: Cochlear implantation in patients with inner ear schwannomas and an intact cochlear nerve is feasible. Leaving intracochlear schwannoma in-situ preserves cochlear architecture and use of a styleted electrode may aid in achieving a full insertion. The ipsilateral inner ear can be adequately visualized on postoperative MRI and a high percentage of patients achieve good open-set speech perception performance.

Define Professional Practice Gap & Educational Needs: Lack of contemporary knowledge regarding the feasibility and clinical outcome of cochlear implantation in patients with intracochlear and intralabyrinthine schwannomas

Learning Objective: To describe the surgical approach and clinical outcome of cochlear implantation in patients with intracochlear and intralabyrinthine schwannomas

Desired Result: Attendees will understand the feasibility and potential benefit of cochlear implantation in select patients with intracochlear and intralabyrinthine schwannomas

IRB - Approved

Minimizing Insertion Trauma with a Novel Shape Memory Polymer Cochlear Implant Array

Kenneth H. Lee, MD, PhD; Walter Voit, PhD
Radu Reit, BS; Roxanne Lee, BS Tiffany Pham, BS
Hans Ajieren; Dongmei Shao, MD

Hypothesis: Reduced insertion trauma can be achieved with a novel self-coiling cochlear implant electrode array utilizing shape memory polymers.

Background: Substantial advances in cochlear implant electrode array design have been made over recent decades. Specifically, efforts have been directed at avoiding trauma during insertion to minimize the resulting fibrosis that may significantly limit functional performance outcomes. Shape memory polymers belong to a class of smart materials that can change shape in response to a stimulus. With these polymers, we have developed a cochlear implant electrode array that is straight at room temperature, but change its shape to self navigate the turns of the cochlea once inserted and warmed to body temperature.

Results: We have coupled our shape memory polymer cochlear implant electrode array with a linear actuator for robotic insertion of the array at a controlled constant velocity. We have inserted our self-coiling arrays into cochlear models to demonstrate that full insertion can be achieved without contact with the walls of the cochlea. In addition, we have implanted our shape memory polymer array in the cochleae of rats, and with histological analysis, show less tissue trauma resulting with insertion of the self-coiling arrays compared to insertion of standard straight cochlear implant arrays.

Conclusions: We have demonstrated that shape memory polymers can be used in a novel approach to develop a self- coiling cochlear implant array that can be inserted with minimal tissue trauma.

Define Professional Practice Gap & Educational Needs: Lack of awareness of available smart materials technologies for advancing cochlear implant function.

Learning Objective: Understand that biocompatible shape memory polymers can be used to develop self-coiling cochlear implant electrode arrays that allow atraumatic insertion for optimal function.

Desired Result: Become aware that new technologies are available that may ultimately lead to advancement in cochlear implant hardware design for improved patient outcomes.

IRB - Approved

Broad Spectrum Amplification with a Light Driven Hearing System

Bruce J. Gantz, MD; Rodney Perkins, MD
Michael T. Murray, MD; Suzanne Carr Levy, PhD
Sunil Puria, PhD

Objective: Demonstrate safety and efficacy of the non-surgical Light-Driven Hearing System (Earlens®).

Study Design: A single-arm, open-label investigational device clinical trial.

Setting: Two private practice and one hospital-based ENT clinics.

Patients: Mild-to-severe bilateral sensorineural hearing loss.

Intervention: Bilateral amplification to treat hearing impairment delivered via light-driven system comprising: 1) a Tympanic Lens (Lens) with a customized platform to directly drive the umbo; 2) a behind-the-ear Processor which encodes sound into electrical pulses sent to a widely vented ear tip with a laser diode that converts the signal into light to wirelessly deliver signal and power to the Lens.

Main Outcome measures: The safety endpoint was determination of 'no change' (PTA4 <10 dB) in residual hearing at 120-day measurement interval. Efficacy endpoints included functional gain from 2-10 kHz and APHAB.

Results: The results on the 82 ears (41 subjects) determined a mean change of -0.37 dB in PTA4, indicating no change in residual hearing ($p<0.0001$) after device removal at the 120-day measurement interval. There were no serious device- or procedure-related adverse events, or unanticipated adverse events. Users experienced average functional gain improvement of up to 68 dB, with 31 dB averaged in the 2-10 kHz range, 30-40 dB above 6 kHz, and a maximum of 68 dB at 9-10 kHz. The global APHAB with the Earlens was a 28-point improvement over unaided.

Conclusions: The Earlens was shown to be safe and effective over the 4-month period tested. The functional gain with the Earlens is not achieved with conventional acoustic hearing aids.

Define Professional Practice Gap & Educational Needs: Current acoustic hearing aids are limited in bandwidth and functional gain.

Learning Objective: To discuss the limited bandwidth and functional gain of acoustic hearing aids and how a new light based hearing aid, recently approved by the FDA, addresses these limitations by directly vibrating the umbo.

Desired Result: Methods that directly stimulate the eardrum have the potential to overcome some of the limitations of acoustic hearing aids.

IRB - Approved

Steerable Robot Assisted Micro-Manipulation in the Middle Ear: Preliminary Feasibility Evaluation

Brendan P. O'Connell, MD; Haoran Yu, BS
Alejandro Rivas, MD Jacob B. Hunter, MD
Rashid M. Yasin, MA; George B. Wanna, MD
Nabil Simaan, PhD

Objective: 1) Demonstrate feasibility of accessing anatomic regions of the middle ear using a steerable robot micro- manipulator; 2) Compare surgeon manual manipulation precision to a new otology micromanipulator via telemanipulation and robotic cooperative control.

Methods: An 8 degree of freedom(DoF) modular robot arm comprised from a custom-designed 6 DoF parallel robot, and a two DoF dexterous steerable robot were used for preliminary evaluation of feasibility performing manipulation tasks at different middle-ear anatomical zones. The robot controlled a gripper customized from an ophthalmic surgical forceps with a steerable distal end. Three tasks were demonstrated using a 4mm endoscope for visualization: 1) touch the forceps' tips to the round window niche and Eustachian tube orifice, 2) place a stapes prosthesis, and 3) follow the path along 1mm grid. For the third task, performance between robot, cooperative, and manual manipulation modes was compared.

Results: Using a cadaveric temporal bone, the robotic gripper was steered to demonstrate reachability of the round window niche and Eustachian tube orifice. 4.5 mm piston prosthesis was successfully placed. A significant difference in tracking error of robotic, cooperative, and manual manipulation for tracing a rectangle was observed($p<0.0001$).
Specifically, robot telemanipulation was associated with significantly reduced error(0.09Â±0.08mm) when compared to both cooperative (0.10Â±0.09mm) and manual manipulation(0.12Â±0.12mm).

Conclusion: This study demonstrates that robotic assistance using steerable tools with endoscopic visualization allows surgeons to access challenging regions of the middle ear. Coordinated manipulation is evidenced by our ability to place a stapes prosthesis. The robot outperformed manual manipulation on a simple motor task.

Define Professional Practice Gap & Educational Needs: There is no available steerable robot that can be used in middle ear otologic surgery.

Learning Objective: Present preliminary evaluation of feasibility performing manipulation tasks at different middle-ear anatomical zones.

Desired Result: We hope to demonstrate that robotic assistance using steerable tools with endoscopic visualization allows surgeons to access challenging regions of the middle ear. Coordinated manipulation is also possible and our results suggest a robot mat outperform manual manipulation.

IRB - Exempt

Preliminary Study of the Design of a Custom Middle Ear Prosthesis

Brandon Kamrava, BS; Jonathan Gerstenhaber, PhD
Yah-el Har-el, PhD; Pamela C. Roehm, MD, PhD

Hypothesis: Custom prostheses could be used to recreate the intact ossicular chain and improve hearing outcomes.

Background: Ossicular discontinuity or fixation occurs in 55% of cases of conductive hearing loss. The majority of ossicular chain disorders affect the incus. Reconstruction has been achieved by a variety of methods; however, overall, there has been little improvement in hearing outcomes after ossiculoplasty in decades.

Methods: Precise measurement of the length, weight, major anatomical features, articular surface, and center of gravity were made on 38 cadaveric incudes. These measurements were combined with measurements published in the literature and micro-computed tomography (microCT) of cadaveric temporal bones at 25 microns resolution to generate a rasterizable idealized incus model.

Results: Our cadaveric measurements corresponded well with those compiled from the medical literature. Using these measurements plus anatomical information from temporal bone microCT, critical features of the incus, including the center of gravity and articular surfaces, remained in incudal model. Incudal model features were modified to increase stability and facilitate synthesis, including broadening and thickening of the incudo-malleolar articulation surface and thickening of the lenticular process. Current 3D technology for direct printing of incudes in hydroxyapatite is limited at the lower bound of resolution.

Conclusion: We have generated a rasterizable model for custom 3D synthesis of incudal prostheses. While current 3D printing in biocompatible materials at the size required is limited, the technology available is rapidly advancing, and 3D printing of incudal replacements with polylactic acid (PLA) is of the correct size and shape.

Define Professional Practice Gap & Educational Needs: Lack of awareness of deficiencies in current ossicular replacement prostheses and need for development of customized prostheses

Learning Objective: Awareness of deficiencies in current ossicular replacement prostheses and needs for development of customized prostheses

Desired Result: Understanding of deficiencies in current ossicular replacement prostheses and needs for development of customized prostheses. Awareness of challenges in development of customized prostheses.

IRB - Approved

National Utilization and Forecasting of Ototopical Antibiotics Medicaid Data versus "Dr. Google"

Matthew G. Crowson, MD; Kristine Schulz, DrPH
Debara L. Tucci, MD; MS; MBA

Objectives: To forecast national Medicaid prescription volumes for common ototoptical antibiotics and validate prescription volumes with internet user search interest using Google Trends (GT).

Study Design: National United States Medicaid prescription and GT user search database analysis.

Methods: Quarterly national Medicaid summary drug utilization data and weekly GT search engine data for ciprofloxacin-dexamethasone (CD), ofloxacin (OF), and cortisporin (CS) ototopicals were obtained from January 2004 to July 2014. Time series analysis was used to assess for prescription seasonality, Holt-Winter's Method for forecasting quarterly prescription volumes, and Pearson correlations to compare GT and Medicaid data.

Results: Ofloxacin (r2=0.91), cortisporin (r2=0.71), and ciprofloxacin -dexamethasone (r2=0.62) Medicaid prescription volumes demonstrate sinusoidal seasonality with annual peaks in July, August, and September. In 2017, OF is forecasted to be most widely prescribed ototopical, followed by CD. Cortisporin use is the least prescribed and volumes will decrease by 9.0% in 2017 compared to 2014. GT user search interest demonstrated analogous sinusoidal seasonality with strong GT and Medicaid data correlations with CD (r=0.96, p=0.04), and CS (r=0.99, p=0.005).

Conclusions: We found that OF, CD and CS ototopicals have sinusoidal seasonal variation with Medicaid prescription volume peaks occurring in the summer. OF is the most commonly prescribed ototopical and this trend is forecasted to continue. Cortisporin use is forecasted to decrease. Google user search interest in these ototopical agents demonstrated near-identical seasonal variation. Analyses of Google Trends for interest in ototopical antibiotics may be useful for health care providers and administrators as a complementary method for assessing healthcare utilization trends.

Define Professional Practice Gap & Educational Needs: There is a lack of awareness of the utilization and seasonality of ototopical antibiotics on a national scale, and further investigation of their utilization is needed to inform discussion about guideline development and antibiotic stewardship. Moreover, this project illustrates a lack of contemporary knowledge on the novel utility of internet user search engine data to validate prescription utilization and seasonal trends.

Learning Objective: At the conclusion of this presentation, the participants should be able: To describe the utility of using a national quarterly Medicaid prescription data for evaluating trends and seasonality as well as forecasting ototopical antibiotic prescription volumes. To describe the novel use of correlating Google Trends internet user search data to validate ototopical antibiotic prescription trends and seasonality extracted from a national Medicaid prescription database.

Desired Result: It is the authors' hope that attendees will consider that fluoroquinolone antibiotics are amongst the most widely prescribed ototopical antibiotics in a national database. The popularity of these agents may also be illustrated by relative interest in internet users web search behavior.

IRB-Approved

Predictors of Individual Differences in Hearing-Aid Benefit for Speech Recognition

Theodore R. McRackan, MD; Ted A. Meyer, MD, PhD
William Clinkscales, BS; Judy R. Dubno, PhD

Objective: To determine sources of variability in pre-operative hearing-aid (HA) outcomes in patients seeking middle ear implants (MEIs)

Study design: Independent review of pre-surgical audiological data from an active MEI FDA trial

Setting: Multicenter prospective FDA trial

Patients: Ninety-five adult HA users

Interventions/Main outcomes measured: Pre-operative unaided and aided scores for word and sentence recognition in quiet and multitalker babble, pure tone thresholds, and self-report HA benefit questionnaires.

Results: We performed an independent review of pre-surgical audiological data from a MEI FDA trial and compared the unaided and aided outcomes with patients' HAs fit according to NAL-R algorithm. Paradoxically, 48 patients (50.5%) had worse aided word recognition scores compared to the unaided condition (mean difference 18.8%). Compared to patients with better aided than unaided scores, these patients' pure-tone thresholds at 500 and 1000 Hz were poorer ($p<0.0034$), but their unaided word recognition scores were better ($p<0.001$). There were no differences between the groups with regard to age, sex, hearing loss etiology, duration of hearing loss or HA use, or testing site (all $p>0.05$). Associations with other patient and device-related factors, including sentence recognition in babble, self-report HA benefit, and unaided and aided speech audibility, will be discussed.

Conclusion: These findings may represent a novel explanation for poor HA performance in a select group of patients. This study emphasizes the importance of measuring unaided and aided word recognition to assess HA benefit and determine if HA adjustments, different HAs, or alternative interventions, including MEIs or cochlear implantation, may be warranted.

Define Professional Practice Gap & Educational Needs: 1. Lack of understanding of why certain patients do not perform well with hearing aids. 2. Lack of understanding of which patients may benefit from a middle ear implant or cochlear implant over conventional hearing aids. 3. Lack of available testing that correlates with subjective hearing aid performance

Learning Objective: 1. To show that variability in word understanding in the unaided and aided conditions may be a marker of poor hearing aid performance. 2. To display that patients who have worse word recognition ability in the aided condition compared to the unaided condition may be candidates for a different hearing aid, middle ear implant, or even cochlear implant. 3. To show the importance of performing unaided and aided word recognition testing in the hearing aid population.

Desired Result: 1. Attendees will develop understanding of which audiological factors may predict hearing aid performance. 2. Attendees will be better able to guide patients on best hearing treatment. 3. Attendees will understand the importance of performing word recognition testing in the aided condition in hearing aid users and apply this to their practice.

IRB - Exempt

RESIDENT RESEARCH TRAVEL AWARD

Analysis of 220 Cochlear Implants: Factors That Influence Intrascalar Electrode Translocation and Audiologic Outcomes

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Jacob B. Hunter, MD; Jack H. Noble, PhD
Alejandro Rivas, MD; Robert F. Labadie, MD PhD
Benoit M. Dawant, PhD; George B. Wanna, MD

Objectives: 1) Determine the distribution of cochlear volume in patients undergoing cochlear implantation, and 2) Examine factors, including cochlear volume, that impact intrascalar electrode translocation and audiologic outcomes in a large series of patients.

Methods: Retrospective review. Intrascalar electrode translocation was analyzed using a validated CT algorithm.

Results: 220 deafened adults were included. Mean cochlear volume was 64.7 mm3(range 42.3-90.2,SDÂ±10.45). The overall rate of intrascalar electrode translocation was 32.2%(71/220). Multivariate logistic regression was used to analyze factors that may influence intracochlear electrode position; variables examined included gender, cochlear volume, surgical approach, and electrode type. Evaluating surgical approach, cochleostomy procedures had higher rates of intrascalar electrode translocation(54.2%,32/59) when compared to round window approaches (20.0%, 17/85)(OR=2.6,OR95%c.i.=10.4-6.4,p=0.04). The rate of electrode translocation in extended round window approaches did not differ from round window insertions (p=0.89). In regards to electrode type, perimodiolar (51.3%,59/115) and mid- scala electrodes(57.1%,8/14) had higher rates of intrascalar electrode translocation when compared to lateral wall electrodes (4.4%,4/91)(OR=21.1,OR95%c.i.=7.0-63.9,p<0.0001and OR=30.0,OR95%c.i.=6.8-132.6,p<0.0001, respectively). Multivariate regression was then performed to assess variables that impact post-operative CNC scores. Electrode translocation was associated with worse performance on CNC testing(p=0.008). Cochlear volume was not associated with electrode translocation or audiologic outcomes (>0.05).

Conclusions: In the largest series to date examining factors that influence intracochlear electrode excursion, we demonstrated a significantly higher rate of intrascalar electrode translocation with a cochleostomy approach, and both perimodiolar and mid-scala electrode arrays. Intrascalar electrode translocation was associated with worse performance on post-operative CNC testing. Cochlear volume did not impact electrode position or audiologic outcomes.

Define Professional Practice Gap & Educational Needs: The impact of cochlear volume on intrascalar electrode translocation and audiologic outcomes is unknown. In addition, further understanding of other factors (surgical approach, electrode type) that impact both electrode translocation and audiologic outcomes is needed.

Learning Objective: Examine factors that impact intrascalar electrode translocation and audiologic outcomes.

Desired Result: Attendees will be able to apply the knowledge to their cochlear implant practices in regards to electrode choice and surgical approach.

IRB - Approved

Tip Fold Over In Cochlear Implantation

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Robert Dwyer, AuD; Benoit Dawant, PhD; Jack Noble, PhD
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Objective: To describe the incidence, clinical presentation, and performance of cochlear implant (CI) recipients with tip fold-over.

Study design: Retrospective case series.

Setting: Tertiary referral center.

Patients: CI recipients who underwent postoperative CT scanning.

Intervention(s): Tip fold-over was identified tomographically using previously-validated software that identifies the electrode array. Spread of excitation (SOE) or electric field imaging (EFI) was measured on those with fold-over.

Main outcome measure(s): Location of the fold-over; audiological performance pre and post selective deactivation of fold-over electrodes.

Results: 327 ears of 252 CI recipients had postoperative CTs available for review. Five (1.5%) had tip fold-over with 4/5 right-sided ears. Tip fold-over occurred predominantly at 270Â° and was associated with a perimodiolar electrode selection (4/5). Patients did not report audiological complaints during initial activation. In one patient, the electrode array remained within the tympani with preserved residual hearing despite the fold-over. SOE supported tip fold-over, but the predictive value was not clear. EFI predicted location of the fold-over with clear predictive value in one patient. At an average follow-up of 11 months, three subjects underwent deactivation of the overlapping electrodes with two of the three showing marked audiological improvement.

Conclusions: In a large academic center with experienced surgeons, tip fold-over occurred at 1.5% but was not immediately identifiable clinically. CT imaging definitively showed tip fold-over. Deactivating involved electrodes may improve performance, avoiding revision surgery. EFI may be highly predictive of tip fold-over and can be run intraoperatively, potentially obviating the need for intra-op fluoroscopy.

Define Professional Practice Gap & Educational Needs: The concept of better hearing outcomes associated with atraumatic cochlear implantation (CI) continues to gain popularity but little is known regarding the incidence and clinical impact of tip-fold over of the electrode array.

Learning Objective: To describe the incidence and clinical presentation of cochlear implant (CI) recipients with tip fold- over.

Desired Result: At the end of this activity, participants will be able to recognize the incidence of CI tip-fold over as well as the postoperative clinical presentation of patients with such finding. Participants will be able to recognize the roll of different diagnostic tests in identifying CI tip fold-over.

IRB - Approved

Reduction of the Harmonic Series Influences Musical Enjoyment with Cochlear Implants

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Dean M. Mancuso, AuD; Brianna M. Griffin, BS
Michael V. Certo, BFA, MM; Anil K. Lalwani, MD

Objective: Cochlear implantation is associated with poor music perception and enjoyment. Reducing music complexity may enhance the enjoyment of music in cochlear implant (CI) recipients. In this study, we assess the impact of harmonic series reduction on music enjoyment.

Study Design: Prospective analysis of music enjoyment in normal-hearing individuals.

Patients: Normal hearing adults (N=20) were asked to rate the "Happy Birthday" song on three validated enjoyment modalities - musicality, pleasantness, and naturalness.

Main outcome measures: Participants listened to seven different instruments play the melody, each with five levels of harmonic series reduction (full, f3, f2, f1, f0), both with and without CI simulation processing. Linear mixed effect model analysis was used to assess the impact of harmonic series reduction on music enjoyment.

Results: Without CI simulation, music samples with minimal harmonic reduction that included frequencies up to the third harmonic (f3) were rated most pleasant and natural ($p<0.001$, $p<0.05$). With CI simulation, music samples with maximal reduction in the harmonics that included only the fundamental frequency (f0) were rated most pleasant and natural ($p<0.001$, $p<0.05$). Furthermore, samples with CI simulation showed a positive linear relationship between harmonic level reduction and both pleasantness and naturalness ($p<0.001$, $p<0.001$). Thus, maximal harmonic series reduction is preferred under the CI simulation condition.

Conclusion: Minimization of harmonics may be a useful strategy for increasing musical enjoyment among cochlear implantees.

Define Professional Practice Gap & Educational Needs: 1. Lack of qualitative and quantitative assessments of music enjoyment in patients with cochlear implants. 2. Delineation of factors that affect music enjoyment in cochlear implant users.

Learning Objective: 1. To understand factors that impact music enjoyment in patients with cochlear implants. 2. To identify ways to enhance music enjoyment in cochlear implant users.

Desired Result: To develop strategies to improve the music listening experience for the cochlear implant user.

IRB - Approved

Flat-Panel CT for Cochlear Implant Electrode Imaging: Comparison to Multi-Detector CT

Nathaniel Connell, MS; Tabassum Kennedy, MD Timothy Szczykutowicz, PhD; Sebastian Schafer, PhD Kevin Royalty, MS; Brian Gartrell, MD Samuel Gubbels, MD

Hypothesis/Objective: We sought to compare the image quality, radiation dosage, artifact and ability to resolve scalar and intra-scalar position of cochlear implant (CI) electrodes between flat-panel CT (FPCT) and conventional multi- detector CT (MDCT).

Background/Methods: Measurement of scalar position and intrascalar location of CI electrodes using CT is complicated by metallic image artifact and insufficient scalar resolution. Flat-panel CT (FPCT) has been shown to improve upon the resolution of MDCT while reducing artifact. Previous studies of FPCT imaging employed isolated temporal bones and did not directly compare FPCT to MDCT. We implanted a total of 11 CI electrodes intentionally into either the scala tympani or vestibuli in whole cadaver heads and imaged with MDCT and FPCT. The implanted cochleae were then explanted and imaged with micro-CT which we used as our gold standard for electrode position. Images were reviewed and scored by a panel of readers blinded to the imaging method and approach for electrode insertion.

Results: FPCT showed less metallic CI artifact ($p=0.0004$) as well as decreased radiation dosage when compared to MDCT. FPCT was able to identify the scalar compartment of all electrodes more accurately than MDCT ($3.0x10-5$). FPCT was significantly better at identifying the intra-scalar location of CI electrodes as well ($p= 0.0001$).

Conclusion: Flat-panel CT more accurately resolves the scalar and intra-scalar position of CI electrodes with reduced radiation exposure and metallic image artifact than conventional multi-detector CT.

Define Professional Practice Gap & Educational Needs: There is a lack of awareness among physicians regarding the utility of flat-panel CT for the imaging of cochlear implant electrodes.

Learning Objective: Attendees will gain an understanding of the benefits and limitations of flat-panel CT as applied to cochlear implant electrode imaging.

Desired Result: A more complete understanding of the utility of flat-panel CT imaging will allow physicians to choose the imaging platform that will best serve their cochlear implant patients.

IRB - Exempt

Post Hybrid Cochlear Implant Hearing Loss and Endolymphatic Hydrops

Akira Ishiyama, MD; Joni K. Doherty, MD, PhD
Alicia M. Quesnel, MD; Ivan Lopez, PhD
Fred H. Linthicum, MD

Objective: To provide and explanation for the gradual post-operative loss of the residual hearing that occurs with some hybrid cochlear implants.

Study design: Microscopic evaluation of 29 cochlear implant temporal bones.

Setting: Analysis of archival human temporal bone collection at our institution.

Subjects and methods: The temporal bones used in this project were from individuals who had cochlear implants and pledged their temporal bones for scientific research. The bones had been prepared in the usual manner. The sections were examined microscopically for evidence of hydrops and the presence of fibrosis and bone formation in the scala vestibuli and tympani.

Results: Seventeen of 29 bones had hydrops and fibrosis in the scala vestibuli and tympani and evidence of a cochleostomy involving the scala vestibuli that contains the ductus reunions. Ten of eleven bones without hydrops had no fibrosis in the scala vestibuli and the cochleostomy was limited to the scala tympani. One bone had some scala vestibuli fibrosis that did not involve the ductus reuniens. Another bone had a scala vestibuli insertion but the electrode ruptured Reissner's membrane so there was no hydrops.

Conclusion: Cochleostomies that involve the scala vestibuli can produce fibrosis that compromises the ductus reuniens and prevents movement of the endolymph out of the cochlea. The blockage of the endolymph egress results in hydrops that can produce an insidious post- operative loss hearing of residual low frequencies.

Define Professional Practice Gap & Educational Needs: When hearing preservation cochlear implantation is performed, round window electrode insertion should be performed to prevent formation of endolymphatic hydrops.

Learning Objective: Detailed analysis of human temporal bone specimens from patients who had cochlear implant surgery to understand the reason of delayed hearing loss after initial hearing preservation was achieved.

Desired Result: As it relates to your presentation: To provide histologic evidence to recommend round window electrode insertion to prevent formation of secondary endolymphatic hydrops when residual hearing is present in the low frequencies.

IRB - Approved

RESIDENT RESEARCH TRAVEL AWARD

Air-Bone Gaps Contribute to Functional Hearing Preservation in Cochlear Implantation

Jameson K. Mattingly, MD; Kristen M. Uhler, PhD
Stephen P. Cass, MD, MPH

Objective: To examine the incidence and effect of post-operative air-bone gaps in subjects who received cochlear implants for the purpose of hearing preservation.

Study Design: Prospective, multicenter, non-randomized, repeated measures within subject design.

Setting: Ten tertiary care institutions.

Patients: Fifty adults participating in a multicenter clinical trial of the Cochlear Nucleus Hybrid implant system.

Intervention(s): Cochlear implantation with Hybrid L24 electrode. Audiometric testing including air and bone conductive thresholds, and tympanometry pre-operatively and at multiple time points post-operatively for 1 year.

Main Outcome Measure(s): Average ABG and percentage of patients with ABGs (≥15 dB HL) measured for each time point for 1 year post-operatively at 250, 500 and 1000 Hz. Correlation of tympanograms and ABGs.

Results: The mean ABGs at 250, 500 and 1000 Hz increased post-operatively ($p<0.05$). The percentage of patients found to have an ABG (≥15dB HL) also increased post-operatively ($p<0.05$). ABGs persisted and were present at one year in 48% of patients at 250 Hz, in 24% at 500 Hz and in 18% at 1,000Hz. No significant relationships were found between abnormal tympanograms and ABG.

Conclusions: The incidence of ABGs post-operatively is higher than previously expected, and do not correlate to abnormalities on tympanometry. ABGs can adversely affect function hearing preservation by increasing thresholds, and different fitting strategies for the acoustic component may be useful. Intraoperative strategies should be used to potentially reduce ABGs and bone conduction thresholds should be measured postoperatively.

Define Professional Practice Gap & Educational Needs: Unclear incidence and patient impact of post-operative low frequency ABGs in those undergoing cochlear implantation for the purpose of hearing preservation.

Learning Objective: Understand the incidence of post-operative ABGs in those undergoing cochlear implantation for the purpose of hearing preservation, and its effect on final the air-conduction thresholds.

Desired Result: Improve intraoperative strategies to reduce ABGs, and routine measurement of bone-conduction thresholds post-operatively.

IRB-Exempt

Long Term Incidence and Degree of Sensorineural Hearing Loss in Otosclerosis

Reuven Ishai, MD; Christopher Halpin, PhD
Michael J. McKenna, MD; Alicia M. Quesnel, MD

Objective: 1) To evaluate the long term incidence and degree of the sensorineural component of hearing loss (SNHL) in patients with otosclerosis after accounting for expected age-related hearing loss. 2) To identify variables that might predict development of sensorineural hearing loss due to otosclerosis.

Study design: Retrospective review

Setting: Tertiary referral center

Patients: Consecutive patients with otosclerosis seen between 1994 and 2004, with ≥ 10 years follow-up, excluding patients with post-operative hearing loss or surgery prior to the initial audiogram.

Intervention: Bone conduction (BC) thresholds at 0.5KHz, 1KHz, 2KHz, and 4KHz.

Main outcome measure: BC threshold change (BCTC) over ≥10 years minus estimated age-related threshold change (ARTC) specific to age and gender for each patient (based on ISO 7029 reference population).

Results: Three-hundred seventy-five ears (304 patients) met study criteria, including 153 ears which had undergone stapedectomy during the study period. Mean follow-up was 14.0 years. The average BCTC after subtracting estimated ARTC was 4.6, 2.5, 3.1 and 2 decibels for 0.5, 1, 2 and 4 kilohertz frequencies, respectively. However, 34% of ears (102 patients) had clinically significant progression of SNHL during the study period (>10 decibel BCTC beyond expected ARTC at ≥ 2 frequencies). Multivariate analysis demonstrated that the probability of developing clinically significant SNHL was higher among females (p=0.0197) and non-operated patients (p=0.0062).

Conclusion: Although the change in BC thresholds was clinically insignificant when averaged across all patients, approximately one-third of patients with otosclerosis demonstrated a clinically significant progression of the sensorineural component of hearing loss.

Define Professional Practice Gap & Educational Needs: Lack of contemporary knowledge about the long term outcome in patients with otosclerosis, and what are the variables that predict significant hearing deterioration.

Learning Objective: To estimate the long term sensorineural hearing loss in patients with otosclerosis and to predict which variables can predict about significant hearing deterioration.

Desired Result: Long term hearing loss significantly change or not in otosclerotic patients by multivariate analysis we studied all the variables, of which can predict hearing deterioration. For instance, the operation group do better or not significantly in the long term hearing outcome. We will apply this result to know whether or not to operate this patients for a good hearing outcome in the long term.

IRB - Approved

How Often Does Stapedectomy for Otoclerosis Result in Endolymphatic Hydrops?

Reuven Ishai, MD; Christopher Halpin, PhD
Michael J. McKenna, MD; Alicia M. Quesnel, MD

Objectives: 1) To evaluate the long-term (≥10 year) clinical incidence of endolymphatic hydrops (EH) after stapedectomy for otosclerosis, using low frequency sensorineural hearing loss (LFSNHL) as a marker for EH. 2) To determine the histologic incidence of EH in human temporal bone specimens (TBS) with a history of stapedectomy for otosclerosis. 3) To determine the histologic incidence of EH in a control group of human TBS.

Study design: Retrospective review and temporal bone study

Setting: Tertiary medical center and temporal bone pathology laboratory

Patients: Patients with otosclerosis, human TBS with otosclerosis, and human TBS with presbycusis as the control group

Intervention: Pure-tone audiometry, temporal bone pathology

Main Outcome Measures: 1) LFSNHL, defined as >10 decibel elevation of bone conduction thresholds at 250 Hz and 500 Hz, after correcting for age-related hearing loss (per ISO 7029). 2) Histologic assessment of EH

Results: In patients with otosclerosis, 8 of 110 (7.3%) operated patients versus 3 of 123 (4.7%) non-operated patients developed LFSNHL (p=0.08). No patients with LFSNHL had other symptoms of EH. In TBS with otosclerosis, 12 of 94 (12.8%) operated TBS versus 2 of 155 (1.1%) non-operated TBS had evidence of EH (p=0.0001). In the control group of TBS with presbycusis, 12 of 256 (4.7%) had EH.

Conclusion: The long-term incidence of LFSNHL in patients with otosclerosis was not significantly higher in those who underwent stapedectomy. The histologic incidence of EH, however, was significantly higher in TBS that had undergone stapedectomy compared to non-operated TBS or a control population of TBS.

Define Professional Practice Gap & Educational Needs: Lack of awareness of the endolymphatic hydrous impact in stapedectomy patients over long time period

Learning Objective: The long term incidence of low frequency sensorineural hearing loss in otosclerosic patients after stapedectomy

Desired Result: The long term incidence of low frequency sensorineural hearing loss in patients with otosclerosis is not significantly higher after stapedectomy.

IRB - Approved

The Impact of Smoking on Ossiculoplasty Outcomes

Matthew D. Cox, MD; Shane R. Anderson, MBBS, FRACS
J. Shep Russell, MD; John L. Dornhoffer, MD

Objectives: To assess the impact of tobacco smoking on outcomes after ossiculoplasty. Study Design: Case series with chart review. Setting: Tertiary care center.

Patients: Adult patients (16 - 88 years of age) undergoing ossiculoplasty with cartilage tympanoplasty.

Outcome Measures: Patients were classified as smokers (TOB+) or non-smokers (TOBN). Comparisons were then made between these two groups with regard to change in PTA-ABG (pure-tone average air -bone gap), rate of cure of conductive hearing loss, rate of successful graft healing, and incidence of long-term complications after surgery.

Results: There was no statistically significant difference between the two groups with regard to ΔPTA-ABG (-14.39 dB hearing level [HL] vs. -14.60 dB HL for TOBN vs. TOB+, respectively, $p = 0.946$), cure of conductive hearing loss, defined as closure of the PTA-ABG to ≤ 20 dB HL (75.0% [129/172] for the TOBN group vs. 69.3% [52/75] for the TOB+ group, $p = 0.3547$), or incidence of successful graft healing (99.4% in the TOBN group vs. 98.7% in the TOB+ group, $p = 0.5443$). However, long-term complications were seen in 34.7% (26/75) of the TOB+ group and 14.5% (25/172) of the TOBN group, a statistically significant ($p = 0.0003$) difference.

Conclusions: Smoking is not a significant risk factor for anatomic failure of cartilage tympanic membrane graft or worsened audiometric outcome after ossiculoplasty. However, long-term complications were significantly more common in smokers, supporting the practice of primary tympanostomy tube placement at the time of ossiculoplasty.

Define Professional Practice Gap & Educational Needs: There exist inconsistencies among the practices of different surgeons when it comes to patients who smoke, with some surgeons refusing to perform middle ear surgery on smokers with chronic otitis media without an acute indication for surgery.

Learning Objectives: We feel that our results demonstrate that while smokers do experience more complications in the long-term, they do not universally have complications and they do have comparable hearing results to non-smokers. Further, we feel that primary myringotomy tube placement may prevent some of these complications. We feel that our results argue in favor of offering surgery to all patients with chronic middle ear disease regardless of whether they smoke or not. We introduce the idea of primary myringotomy tube placement in all smokers with the intent of investigating the efficacy of this practice in the future.

Desired Result: Our hope is to encourage all practitioners to offer middle ear surgery when indicated, regardless of smoking status. While there are more frequent complications, not all smokers will experience a complication and we believe that primary myringotomy tube placement may help to prevent complications in smokers who are unable or unwilling to quit. We further support the utility of surgery by demonstrating audiometric outcomes that are similar between smokers and non-smokers.

IRB - Approved

Appropriate Timing of Nuclear Imaging for Necrotizing Otitis Externa

Graham T. Whitaker, MD; Patrick J. Antonelli, MD
Matthew R. O'Malley, MD

Objective: To review our experience with gallium radionucleotide scanning in the management of necrotizing otitis externa (NOE), and attempt to identify the most efficient time interval between scans to help reduce unnecessary scanning.

Study Design: retrospective chart review

Setting: tertiary referral center

Patients: All patients >18 years of age treated at our center from 1995 -2013 with a diagnosis of necrotizing otitis externa and adequate follow up gallium imaging

Intervention: Patient charts were reviewed for age, gender, duration of treatment, risk factors, type of antibiotic therapy, treatment breaks, culture data, results of nuclear imaging, and cranial nerve palsies.

Main outcome measure: The time to disease resolution as well as the timing of nuclear medicine scans was measured in order to determine a time vs disease resolution model. This was then used to predict rates of cure for follow up gallium scan protocols.

Results: Sixty six patients were included for final data analysis. Patient data showed a linear relationship between cure and time over the course of weeks 6-16 of antibiotic therapy. Based on our calculated model, patients would be expected to undergo an average of 4.09 follow up gallium scans with a six week protocol versus 2.23 scans with a 12 week protocol. The expected duration of antibiotics with a six week protocol is 24.8 weeks versus 27.3 weeks with a 12 week protocol.

Conclusions: Given the small increase in expected antibiotic therapy duration, we recommend follow up gallium imaging at 10-12 week intervals in order to decrease the number of unnecessary gallium scans.

Define Professional Practice Gap & Educational Needs: The most appropriate timing of radionucleotide scans for determining the course and resolution of necrotizing otitis externa are inconsistent and without significant evidence within the literature.

Learning Objective: 1) Understand the utility and importance of radionucleotide imaging in the diagnosis and management of necrotizing otitis externa (NOE). 2) Review different imaging protocols for efficiency and cure rates for NOE.

Desired Result: Attendees will be better informed as to what an appropriate follow up imaging protocol is for NOE in order to reduce unnecessary imaging.

IRB - Approved

Anatomic Variations in Temporal Bones Affect the Intensity of Nystagmus During Warm Caloric Irrigation

Aniruddha U. Patki, MD; Ofri Ronen, MD
David M. Kaylie, MD, MS; Dennis Frank-Ito, PhD
Erin G. Piker, PhD

Hypothesis: Anatomic variables within the mastoid will correlate with intensity of caloric responses.

Background: During caloric irrigation, heat is transferred from the external auditory canal to the lateral semi-circular canal (LSCC) through aerated mastoid bone. Temporal bone airspace volume and bone volume vary widely but the effect of this variation on caloric irrigation testing is not well characterized. Understanding this effect is necessary to understand how mastoid surgery may alter caloric irrigation results.

Methods: Twenty two mastoid airspace and bones, as well as LSCC were reconstructed from computed tomography scans of 11 subjects with normal anatomy who underwent vestibular function evaluation. Respective surface area (SA) and volume (V) of the mastoid airspace, bones, LSCC and distance from LSCC to tympanic membrane (LSCC -TM) were calculated. In addition, computed values from these anatomic structures were correlated with the maximum velocity of slow phase nystagmus during warm caloric irrigation (MVwarm).

Results: Our results showed that the combined effect of airspace SA:V, bone SA:V, LSCC SA:V, and LSCC-TM distance accounted for 69.5% of the variation in MVwarm. Airspace SA:V (R2=0.22) and LSCC SA:V (R2=0.02) positively correlated with MVwarm; while bone SA:V (R2=0.17) demonstrated an inverse correlation with MVwarm.

Conclusions: Preliminary results from this pilot study suggest that a substantial amount of the variability in MVwarm can be explained by temporal bone anatomy. Results also indicate that the denser the bone, the more heat is transferred to the LSSC, whereas increased airspace serves as an insulator. A larger study is necessary to confirm our findings.

Define Professional Practice Gap & Educational Needs: Lack of contemporary knowledge about anatomic characteristics of the temporal bone which affect caloric testing results

Learning Objective: Attendees will be able to state how bone and air in the mastoid affect the results of caloric testing

Desired Result: Attendees will be able to use their knowledge to better interpret caloric irrigation results in the setting of patients with prior mastoidectomy.

IRB - Approved

Fluctuations in Vestibular Afferent Excitability in Meniere's Disease

Jay T. Rubinstein, MD, PhD; James O. Phillips, PhD
Kaibao Nie, PhD; Christopher Phillips, BS
Leo Ling, PhD

Objective: To determine if Meniere's disease is associated with fluctuations in afferent excitability in four human subjects previously implanted with vestibular stimulators.

Study design: Longitudinal repeated measures

Setting: Tertiary referral center, human vestibular research laboratory

Patients: Four human subjects with previously uncontrolled Meniere's disease unilaterally implanted in each semicircular canal with a vestibular stimulator

Intervention(s): Repeated measures of electrically-evoked slow phase eye velocity and vestibular electrically-evoked compound action potentials (vECAP) over two to four years.

Main outcome measure(s): Slow phase eye velocity and N1-P1 vECAP amplitudes as a function of time.

Results: There were statistically significant fluctuations in electrically evoked slow phase eye velocity over time in at least one semicircular canal of all four subjects. vECAP N1-P1 amplitudes measured at similar time intervals and stimulus intensities appear to show correlated fluctuations. One of the subjects had a single Meniere's attack during this time period. The others did not.

Conclusions: In these four subjects, Meniere's disease appears to be associated with fluctuating electrical excitability of the vestibular afferents to at least one canal in each subject. These fluctuations occurred independent of active symptoms of Meniere's disease.

Define Professional Practice Gap & Educational Needs: Lack of understanding of the pathophysiology of Meniere's disease Learning Objective:

Learning Objective: Demonstrate that vestibular afferents demonstrate fluctuating excitability in patients with Meniere's disease Desired Result:

Desired Results: Will learn clues to the pathophysiology of Meniere's Abstract

IRB - Approved

Vestibular Function is Impaired in Individuals with Dementia

Aisha Harun, MD; Robin Bigelow, BS
Esther S. Oh, MD; Yuri Agrawal, MD

Objective: Recent evidence suggests an association between vestibular and cognitive function. To further characterize this association, we investigated whether vestibular function is impaired in individuals with dementia (including Alzheimer's Disease).

Study Design: Cross-sectional evaluation of vestibular function.

Setting: Ambulatory dementia clinic.

Patients: Older individuals ≥ 60 years with a diagnosis of dementia. Age, gender and education-matched controls were drawn from the Baltimore Longitudinal Study of Aging comprising normative older adults.

Intervention: Otolith function was assessed with cervical and ocular vestibular-evoked myogenic potentials (VEMPs) and semicircular canal function with video head impulse testing.

Main Outcome Measures: VEMP amplitude and vestibular ocular reflex (VOR) gain were measured.

Results: Forty-three patients with dementia (25.6% with Alzheimer's Disease) underwent testing and were matched with 129 controls. Compared with controls, individuals with dementia had a lower mean cervical VEMP amplitude (0.96 versus 1.4 μV, p=0.027) and a lower mean ocular VEMP amplitude (10.10 versus 13.66 μV, p=0.030). Higher VEMP amplitude was associated with significantly decreased odds of dementia for both cervical (OR 0.3, 95% CI 0.13-0.80) and ocular (0.9, 95% CI 0.87-0.99) VEMPs in adjusted analyses. There was no significant difference in VOR gain between groups.

Conclusions: These findings confirm and extend emerging evidence of an association between vestibular loss and cognitive decline. Peripheral sensory loss has been shown to lead to atrophy of central afferent pathways and in turn a decline in cognitive function. Future work will be needed to establish whether the association between vestibular and cognitive function is causal.

Define Professional Practice Gap & Educational Needs: 1. There is a lack of awareness of the association between vestibular dysfunction and cognitive impairment. 2. Little is known about the prevalence of vestibular dysfunction in individuals with dementia.

Learning Objective: To understand the association between vestibular dysfunction and cognitive impairment and review the prevalence of vestibular dysfunction in a dementia population.

Desired Result: Attendees will have a higher index of suspicion for vestibular dysfunction when evaluating individuals with dementia for dizziness and/or balance disorders and will consider screening for vestibular dysfunction in these patients.

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ABSTRACTS OF SELECTED POSTERS

F001

Older Individuals Meeting Cochlear Implant Candidacy Criteria in Noise but Not in Quiet: Are Such Patients Improved by Surgery?

Jordan A. Mudery BS; Ross Francis, BA, BS
Hilary McCrary, MPH; Abraham Jacob, MD

Objective: To determine postoperative hearing outcomes in older patients who qualify for cochlear implantation (by AZBio sentence tests) in noise but fail to qualify in quiet.

Study Design: Retrospective chart review

Setting: University-based tertiary care center

Patients: A total of 149 cochlear implants (CI) were performed by the senior author between February 2012 & September 2015. Starting late 2013, CI evaluation included AZBio sentence testing both in quiet and in noise. For the current study, older patients with preoperative AZBio scores > 40% in quiet but < 40% in noise (+10 or +5 dB SNR) and follow up >/= 6 months were included.

Intervention(s): Cochlear implantation in one ear

Main outcome measure(s): Postoperative AZBio sentence test scores

Results: Fourteen patients (average age 72 years) met inclusion criteria. Preoperative AZBio scores for the implanted ear averaged 48% in quiet and 12 or 7% in noise (+10/+5 dB SNR respectively). Binaural (bimodal) condition AZBio scores averaged 75% in quiet and 43 or 16% in noise (+10/+5 dB SNR). Postoperative AZBio scores for the implanted ear improved an average of 27% in quiet and 48% in noise. Binaural (bimodal) testing revealed that AZBio scores improved 8% in quiet and 46% in noise.

Conclusions: Patients complaining of difficulty hearing in noisy environments should undergo CI candidacy testing both in quiet and in noise to simulate real world conditions. For those meeting Medicare CI criteria in noise but not in quiet, our results suggest that hearing (in quiet & in noise) is typically improved.

Define Professional Practice Gap & Educational Needs: Patients complaining of difficulty hearing in noisy situations may fail to qualify for cochlear implantation using AZBio testing in quiet. These patients should undergo CI candidacy testing in noise as our results demonstrate that they have improved speech understanding, both in quiet and noise, postoperatively.

Learning Objective: To demonstrate that patients qualifying for cochlear implantation by AZBio sentence tests in noise but not in quiet have improved hearing in quiet and in noise postoperatively.

Desired Result: Cochlear implant centers should test patients for candidacy both in quiet and in noise.

IRB - Approved

F002

Incidence of Bony Cochlear Nerve Canal Stenosis in Pre-Lingually Deaf Cochlear Implant Recipients

Calvin H. Knapp, III; Grace S. Phillips, MD Angelisa M. Paladin, MD; Erin Christianson, PhD Susan J. Norton, PhD; David L. Horn, MD, MS

Objective: To determine incidence of bony cochlear nerve canal (BCNC) stenosis in pediatric cochlear implant(CI) users and relationship of BCNC width to language outcomes.

Study Design: Retrospective chart review.

Setting: Pediatric Tertiary Care Facility.

Patients: Patients with initial CI stimulation before 36 months of age, and auditory testing data after 3 years old, were identified from a prospective patient database.

Intervention: Retrospective review of electronic medical records identified patients with pre-operative computerized tomography (CT) of the internal auditory canal. BCNC widths and other temporal bone abnormalities were evaluated independently by two radiologists blinded to patient outcomes.

Outcome Measures: Pre- and post-implantation auditory comprehension measures. BCNC stenosis criterion was width <1.6mm.

Results: 273 implanted ears from 139 children were included. Stenosis was observed in 5 patients (3.6%), far lower than the range reported for children with less significant hearing loss (11-17%). There were 4 instances of bilateral stenosis. Of the four implanted and stenotic ears, three had multiple instances of testing more than 1.5 standard deviations below age matched normal hearing peers on auditory comprehension as measured by Preschool Language Scores (PLS-5).

Conclusions: Children with severe-to profound sensorineural hearing loss appear to have a lower incidence of BCNC stenosis compared to other children with lesser degrees of hearing loss, or possibly were not implanted. This low incidence may make it difficult to study BCNC stenosis effects on outcome measures. It is likely that MRI is more sensitive than CT to find abnormalities of the auditory nerve in pediatric CI patients.

Define Professional Practice Gap & Educational Needs: Cochlear implant surgeons need to be aware of the incidence of cochlear nerve canal (CNC) stenosis in pediatric cochlear implant candidates and potential impact for clinical outcome.

Learning Objective: To understand the incidence of CNC stenosis in pediatric CI candidates and relationship of CNC width to clinical outcome.

Desired Result: Healthcare professionals will be more effectively able to counsel the family members of pediatric cochlear implant patients regarding expected outcomes based on CNC width. This will help families make a more educated decision about moving forward with cochlear implantation.

IRB - Approved

F003

Effect of Acute Between-Ear Frequency Mismatches on Speech Understanding in Users of Bilateral Cochlear Implants

Ksenia A. Aaron MD; Katelyn E. Glassman, AuD
Mario A. Svirsky, PhD; Matthew B. Fitzgerald, PhD

Objective: To identify how speech understanding is affected by acutely-imposed bilateral mismatches in users of bilateral cochlear implants (CIs).

Study design: Repeated measures.

Setting: Hospital setting research facility.

Patients: 15 sequentially- and 4 simultaneously-implanted recipients of bilateral CIs participated in this study. All had at least six months of bilateral device use at the time of testing.

Intervention(s): Bilateral mismatches of insertion depth were simulated by reprogramming one implant. The manipulated ear was either the poorer-performing ear, or the more recently-implanted ear if baseline performance was similar in each ear. The mismatches were simulated by deactivating 2 or 4 electrodes at the apical or basal position, and reprogramming the frequency table. These conditions simulated basalward or apicalward mismatches equivalent to 1.5 or 3 mm.

Main outcome measure(s): For each of the four simulated mismatch conditions, CNC word and vowel-identification scores were obtained bilaterally, and for each ear individually.

Results: Of the 19 participants, nine showed a significant decrease in speech understanding when an acute bilateral mismatch was imposed. The size of these decrements increased with larger bilateral mismatches. The remaining participants showed no effect of the mismatch.

Conclusions: Large bilateral mismatches may hinder performance in some recipients of bilateral CIs. These results are consistent with prior data demonstrating that bilateral benefit is reduced with large bilateral mismatches. However, the observation that bilateral mismatches had no influence on speech understanding in some patients suggests they are adept at monitoring their better ear to avoid interference from the contralateral CI.

Define Professional Practice Gap & Educational Needs: In recipients of cochlear implants, bilateral mismatches of insertion depth have long been suggested as a factor that can inhibit performance in these patients. However, very little is known about how patients behave in the presence of such mismatches, particularly with regard to performance on tests of speech understanding with use of clinical speech processors.

Learning Objective: To understand how speech understanding is affected when bilateral mismatches of insertion depth are simulated acutely.

Desired Result: Participants will understand that many recipients of bilateral cochlear implants may function essentially as a "better-ear" listener when presented with a bilateral mismatch. This can be one reason for the lack of bilateral benefit observed in many recipients of bilateral implants.

IRB - Approved

F004

Feasibility Study: Measurement of Cochlear Length Using the a Value for Cochlea Basal Diameter

Nicholas L. Deep MD; Brittany E. Howard MD
Joseph M. Hoxworth MD; David M. Barrs MD

Objective: Recent studies have demonstrated a linear relationship between the cochlear length and the distance between the round window and the lateral wall of the cochlea (A value). However, these studies have utilized expert radiologists with extensive experience to perform image reformatting and measurements. Thus, a feasibility study was performed to determine if the cochlea basal diameter (A value) measurement can be consistently and accurately obtained from routine temporal bone imaging for use in cochlear length estimation.

Study Design: Feasibility study

Setting: Tertiary referral center

Patients: The temporal bone CTs of 40 consecutive patients at a tertiary referral Neurotology clinic were reviewed.

Main Outcome measures: The distance from the round window to the lateral wall was measured for each cochlea by 2 independent reviewers, a neuroradiologist and an otologist. The interrater reliability was calculated using the intraclass correlation coefficient (ICC) and the Bland-Altman plot.

Results: 40 patients (19 males, 21 females) for a total of 80 cochlea were included. Interrater reliability on the same ear had a very high level of agreement by both the ICC and the Bland-Altman plot. ICCs were 0.9 (95% CI:0.82,0.94) for the left ear and 0.96 (95% CI:0.92,0.98) for the right ear. Bland-Altman plot confirmed interrater reliability with all 96% of measurements falling within the 95% limits of agreement. The estimated reliability between two ears for Reviewer 1 was 0.8 (95% CI:0.66,0.89) and 0.77 (95% CI:0.62,0.87) for Reviewer 2.

Conclusions: Measurement between the round window and lateral cochlear wall can be consistently and reliably obtained from routine temporal bone CT scans. Thus it is feasible to utilize this method to estimate the cochlear length of patients undergoing cochlear implantation.

Define Professional Practice Gap & Educational Needs: Cochlear length is important as anatomic variations may influence the insertion and functionality of cochlear implants. Unfortunately due to the coiling pattern of the cochlea simple, accurate measurement of its length has historically been limited to cadaveric studies and computer image modeling. Recent studies have demonstrated a linear relationship between the cochlear length and the distance between the round window and the lateral wall of the cochlea (A value). However, these studies have utilized expert radiologists with extensive experience to perform image reformatting and measurements. Therefore there is lack of contemporary knowledge regarding the feasibility of this measurement for the practicing otologist or otolaryngologist.

Learning Objective: A feasibility study was performed to determine if the cochlea basal diameter (A value) measurement can be consistently and accurately obtained from routine temporal bone imaging for use in cochlear length estimation.

Desired Result: Knowledge of this will allow for improved surgical planning and selection of the appropriate cochlear electrode length.

IRB - Exempt

F005

Consideration for Routine Outpatient Pediatric Cochlear Implantation: A Retrospective Chart Review of Immediate Post-operative Complications

Sunthosh Sivam, MD; Charles A. Syms III, MD
Susan Marenda King, MD; Brian P. Perry, MD

Objective: To establish pediatric cochlear implantation as a safe outpatient procedure.

Study design: Retrospective chart review

Setting: Private Neurotology practice

Patients: All children from ages 1 to 17 that underwent cochlear implantation from 2004 to 2014.

Intervention: Cochlear implantation

Main outcome measures: The rate of immediate post-operative complications, difference in complication rates by age, and the need for evaluation at an urgent/emergent care center (EC) or hospitalization after the procedure.

Results: A total of 579 cochlear implants were placed in children ages 1-17 from 2004 to 2014. After discharge from an outpatient procedure, 1.6% of unilateral, 1.0% of bilateral, and 3.2% of revision implant surgeries required unplanned evaluation in the EC or hospitalization. The complication rate of cochlear implantation in this population was 23% with nausea/vomiting or imbalance/dizziness comprising 50% and 32% of the total complication rate, respectively. The odds ratio of developing complications in the group ages 1-3 versus all other age patients was found to be statistically insignificant (OR 0.92, 95% CI 0.63 to 1.34, p=0.66). Complications in the youngest population required unplanned EC visit/hospitalization in 2 cases (0.61%).

Conclusions: This is the first large scale retrospective chart review detailing complication rates and the need for unplanned medical attention following outpatient pediatric cochlear implantation. Though the proportion of complications in all pediatric age groups was substantial, the nature of these complications were overwhelmingly mild, brief, and did not require treatment. Therefore, this data supports routinely performing pediatric cochlear implantation on an outpatient/ ambulatory basis even in the youngest patients.

Define Professional Practice Gap & Educational Needs: Lack of awareness regarding the favorable complication rates and highly infrequent need for unplanned medical attention following outpatient pediatric cochlear implantation.

Learning Objective: Complications following outpatient cochlear implantation in the pediatric population are mild and seldom require unplanned medical attention.

Desired Result: Practitioners will routinely perform pediatric cochlear implantation on an outpatient basis even in the youngest age groups.

IRB - Exempt

F006

Effect of Hearing Aids and Cochlear Implants on Older Adults' Communicative Function

Carrie L. Nieman MD, MPH; Joshua Betz MS
Lingsheng Li MHS; Yoon-kyu Sung MHS
Frank R. Lin MD, PhD

Objective: Age-related hearing loss is highly prevalent and independently associated with negative outcomes in social, emotional, cognitive, and physical functioning. We assessed the long-term effects of cochlear implantation and hearing aids on the communication functioning and hearing handicap of older adults with hearing loss.

Study design: Prospective, observational longitudinal study

Setting: Academic tertiary care medical center

Patients: Participants were aged 50 years or older, English-speaking adults who used verbal language as their primary mode of communication with minimal previous experience with hearing care.

Intervention: All participants were fitted with hearing aids or a cochlear implant.

Main outcome measures: The Hearing Handicap Inventory for the Elderly (HHIE) and the Quantified Denver Scale (QDS) were utilized as the primary outcome measures of hearing handicap and communication functioning.

Results: A total of 113 participants received hearing care (n=50 with cochlear implants, n=63 with hearing aids) with a mean pure tone average of 46.2 dB HL. Communication functioning improved by 2.33 points at 12 month follow-up among hearing aid users (p-value=0.002) and 4.22 points among cochlear implant users ($p \leq 0.001$). Hearing care improved hearing handicap for patients with hearing aids ($-6.92, p \leq 0.001$) and cochlear implants (-10.42, $p \leq 0.001$) at 12-months post-treatment, with greater improvements demonstrated among cochlear implant recipients and among those with more severe initial hearing handicap.

Conclusions: Hearing aids and cochlear implants improve communication and hearing handicap up to 12 months following fitting. Provision of hearing care to optimize communication may be an important low-risk intervention that supports healthy aging.

Define Professional Practice Gap & Educational Needs: Increasing evidence demonstrates the independent association of age-related hearing loss with poorer social, physical and cognitive functioning. Hearing care, as cochlear implants and hearing aids, may play an important role in improving older adults' well-being.

Learning Objective: Demonstrate the long-term improvements in social and communicative functioning of hearing care in older adults with hearing loss.

Desired Result: Understand the important role that hearing care plays in healthy aging, specifically the social and communicative well-being of older adults with hearing loss.

IRB - Approved

F007

Partnering with Community Audiologists for Decentralized Cochlear Implant Programming Maintains Quality and Enhances Patient Satisfaction: A Hub and Spoke Model

Erynne A. Faucett, MD; Hilary C. McCrary, BS, MPH
Saranya Reghunathan MD; Ross H. Francis BS
Treasure Peck AuD; Abraham Jacob MD

Objective: To evaluate audiometric and patient satisfaction outcomes of a cochlear implant (CI) program that employs university/community audiology partnerships to decentralize the identification of potential CI candidates and for postoperative programming.

Study design: Chart review.

Setting: Community-based audiology practices partnered with a tertiary CI center.

Patients: After appropriate training on current CI evaluation guidelines, 9 potential CI candidates (average age 75 years) identified by 3 community audiologists (March 2015 to September 2015) were referred for surgery. All 9 were implanted without complication; subsequent activation and programming were performed in the community setting.

Intervention(s): Cochlear implantation.

Main outcome measure(s): Pre- and postoperative AZBio scores in quiet and noise (+5 dB SNR); qualitative measures of patient satisfaction.

Results: Average preoperative AZBio scores for the implanted ear were 30.1% (range, 0%-65%) and 7.6% (range, 0%- 30%) in quiet and noise, respectively. Preoperative binaural AZBio scores averaged 41.3% (range, 5%-88%) in quiet and 10.8% (range, 0%-20%) in noise. Scores for the implanted ear three months after surgery increased 14.3% in quiet and 3.7% in noise, while binaural scores increased 14.7% in quiet and 19.9% in noise. Patients reported that they preferred to have their activation/ programming performed by their community audiologist - citing trust, continuity of care, decreased travel time, and convenience as primary determinants for satisfaction. Audiometric and satisfaction data continue to be collected longitudinally.

Conclusions: University/community partnerships for decentralized identification of CI candidates as well as activation/programming after implantation improves access to CI technology, maintains excellent audiometric outcomes, and results in improved patient satisfaction.

Define Professional Practice Gap & Educational Needs: Cochlear implant candidates are traditionally identified, operated on, and programmed at implant centers. This limits access for some patients to new technology and can be inconvenient to patients that have to travel for further care. Programs that decentralize the identification of cochlear implant candidates improve awareness of implantable hearing solutions, however, there is little information on the outcomes of this model. Our abstract aims to determine the audiometric and patient satisfaction outcomes of one university/community partnership and to provide a framework for future programs.

Learning Objective: At the conclusion of this presentation, the participants should be able to 1) Understand how a decentralized cochlear implant program creates a partnership between community-based audiologists and otolaryngologists, 2) Recognize that opportunities exist to identify patients eligible for cochlear implantation who may not be identified otherwise, and 3) Appreciate that decentralized programs lead to improved patient access to cochlear implant technology, equivalent or acceptable audiometric outcomes and patient satisfaction after cochlear implantation.

Desired Result: By demonstrating successful outcomes from a decentralized program model, we hope that other cochlear implant centers will employ this model.

IRB - Approved

F008

Accuracy of Mobile-Based Audiometry in the Evaluation of Hearing Loss in Quiet and Noisy Environments

Joe Saliba, MD; Mahmood Al-Reefi, MD
Junie S Carriere, BA; Neil Verma, MSc
Christiane Provencal, AuD; Jamie Rappaport, MD

Objectives: To assess the accuracy of two mobile-based hearing tests in (1) determining pure tone audiometry thresholds and (2) screening for moderate hearing loss, in quiet conditions and in noisy environments using active and passive noise cancellation.

Study design: Prospective study

Setting: Tertiary hospital

Patients: Thirty adults below 65 years of age, with or without hearing loss (mean age : 49.7 years, 42% females).

Interventions: Pure tone audiometry was assessed by conventional audiogram and by two mobile-based hearing tests on an iPad Air (EarTrumpet and ShoeBOX). Mobile-based audiometry was performed in normal and in noisy (50 dB of background white noise) sound booths. Noise cancellation was achieved by combining passive insert headphones to active noise-cancelling earmuffs.

Main outcome measure: Air-conduction thresholds measured at pure -tone average (PTA) and individual frequencies.

Results: On average, 89.3% (95% CI, 87%-92%) and 93.5% (95% CI, 91%-96%) of the threshold values obtained in a normal sound booth using EarTrumpet and ShoeBOX respectively were within 10 dB of the corresponding audiogram thresholds, compared to 85.5% (95% CI, 81%-89%) and 92.3% (95% CI, 89%-95%) in a noisy sound booth using noise cancellation. When screening for moderate hearing loss (PTA > 40 dB), EarTrumpet and ShoeBOX showed a sensitivity/ specificity of 85.5%/95.3% and 100%/95.3% respectively. Patients preferred mobile-based audiometry over conventional audiograms, with ShoeBOX being the preferred application (42%).

Conclusion: Mobile-based audiometry can correctly estimate pure tone thresholds and screen for moderate hearing loss, even in noisy environments.

Define Professional Practice Gap & Educational Needs: Lack of awareness about mobile-based audiometric tests - Limited low-cost audiometric tools available for research purposes. Certain remote areas and underserved populations have poor access to conventional audiometry

Learning Objective: To introduce the currently available mobile-based audiometric tests. To assess the accuracy of mobile-based audiometry in determining pure-tone thresholds and in screening for hearing loss, in quiet and noisy ("real- life") environments

Desired Result: Consider the use of mobile-based audiometry in future research applications. Consider the use of mobile- based audiometry in remote areas with underserved populations.

IRB - Approved

F009

Hearing Loss in Rural Adults: A Geographic Comparison of Access to Care in Hearing Aid Recipients

Stephen Chan, BS; Brian Hixon, MD Jennifer Shinn, PhD Matthew L. Bush, MD

Objective: Rural access to care and the impact of hearing loss are poorly understood. This study aims to determine socioeconomic status, timing of hearing aid (HA) acquisition, and impact of hearing loss in rural and urban adult HA recipients.

Study Design: Cross-sectional questionnaire survey

Settings: Tertiary referral center

Patients: Adult HA recipients

Intervention and Main Outcome Measures: Questionnaires assessed demographics, timing of HA fitting from onset of hearing loss, and effects of hearing impairment on employment/education. Amplification benefit was assessed using the International Outcome Inventory for Hearing Aids (IOI).

Results: Of 336 participants, 225 reside in urban areas and 111 in rural areas (48 rural and 63 very rural). Very rural participants experienced longer commutes to hearing specialists (68 versus 26 minutes, $p<0.001$), were less likely to achieve a degree beyond high school ($p<0.001$) and more likely to possess Medicaid coverage ($p=0.01$) compared to urban participants. There was a trend toward greater time delay for acquisition of HA for very rural participants compared to urban participants (10.9 versus 7.9 years, $p=0.226$). Hearing impairment caused job performance difficulty in 60% of all participants. Rural participants reported more hearing-related difficulty in job promotion compared to urban participants (14% versus 3%, $p =0.033$). All participants reported amplification benefit with a trend toward greater benefit in very rural participants.

Conclusions: Rural adults with HA differ in socioeconomic factors than urban adults. Distance from specialized care may impact timely access of hearing healthcare. Further research is indicated expand access to care for rural adults.

Define Professional Practice Gap & Educational Needs: Lack of awareness of timing of access to adult hearing healthcare in rural settings. Lack of knowledge of characteristics of rural adults with hearing loss and barriers to timely care. Lack of understanding of benefits from hearing aid amplification in rural adults

Learning Objective: Describe the differences in timing of access to hearing healthcare in urban and rural adults with hearing loss. Identify socioeconomic differences between urban and rural adults with hearing loss. Outline benefits of hearing amplification in urban and rural adults with hearing loss

Desired Result: Seek to improve access to timely hearing healthcare in rural adults with hearing loss. Tailor individualized hearing healthcare around the socioeconomic and geographic barriers for rural adults with hearing loss

IRB - Approved

F010

Third-Generation Bisphosphonates for Cochlear Otosclerosis Stabilizes Sensorineural Hearing Loss in Long-Term Follow Up

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Objective: To assess long-term hearing outcomes in patients treated with third generation bisphosphonates for otosclerosis related progressive sensorineural hearing loss (SNHL).

Study design: Retrospective case review

Setting: Tertiary referral center

Patients: Patients with otosclerosis and progressive SNHL treated with third-generation bisphosphonates

Intervention: Risedronate or zoledronate administration

Main outcome measures: Bone conduction pure tone threshold averages (BC-PTAs) and word recognition scores (WRS) before and after bisphosphonate administration in long-term follow up. Significant change in BC-PTA was defined as greater than 10dB or between 4% and 18% in WRS based on binomial variance.

Results: Sixteen patients were identified and 31 ears met inclusion criteria. One patient had pre-existing unilateral anacusis. Nine patients were female, and the mean age was 52 years Â± 10.3. The mean duration between initial audiometric testing, before bisphosphonate administration, and long-term follow up audiometry, after treatment, was 48.4 Â± 25.7 months, with a range of 5.5 â€“ 89.5 months and median of 49.9 months. Analysis using BC-PTA demonstrated that 24 ears remained stable while 4 improved and 3 worsened. Out of 29 ears with available WRS, 21 ears remained stable, 6 improved, and 2 worsened. No patient experienced any major complication as the result of bisphosphonate therapy.

Conclusion: Treatment with third-generation bisphosphonates is associated with stability in sensorineural hearing over the long-term. These results suggest that such medications may prevent the progression of SNHL in patients with otosclerosis.

Define Professional Practice Gap & Educational Needs: Many patients with clinical otosclerosis have coincident progressive sensorineural hearing loss thought to be related to intracochlear changes secondary to progressive cochlear bony remodeling. To date, only limited short-term data on bisphosphonate therapy for otosclerosis related sensorineural hearing loss is available. There is a need for long-term follow up with audiologic evaluation in patients who have received third generation bisphosphonates for sensorineural hearing loss.

Learning Objective: We report on our audiologic outcomes in a group of patients treated with bisphosphonates for otosclerosis related sensorineural hearing loss. We hope to educate the audience on the role of medical therapies for patients with otosclerosis related sensorineural hearing loss.

Desired Result: Our results in the short and long term lead us to recommend treatment with bisphosphonates for patients with otosclerosis related sensorineural hearing loss. We aim to present our data for the audience to independently analyze and interpret. We hope to encourage new thinking about treatments for sensorineural hearing loss in otosclerosis.

IRB - Approved

F011

Risk of Hearing Loss Progression is Higher in Children with Bony Cochlear Nerve Canal Stenosis than in Children with Other Temporal Bone Anomalies

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Objective: This study investigates whether children with unilateral sensorineural hearing loss associated with ipsilateral bony cochlear nerve canal (BCNC) stenosis have a greater risk of progression than children with other ipsilateral temporal bone anomalies.

Setting: Tertiary referral center

Patients: Children with unilateral sensorineural hearing loss who had computed tomography imaging of temporal bone and at least 6 months of follow-up were identified from audiological and radiographic databases.

Interventions: Two pediatric radiologists, blinded to affected ear, independently noted all temporal bone anomalies and measured BCNC width in the axial plane. All available audiograms were reviewed.

Main outcome measure: Progression of hearing loss was defined by a 10 dB increase in air conduction threshold in the affected ear.

Results: Of 128 children included, 54 (39%) had a temporal bone anomaly, and 24 (19%) had BCNC stenosis defined as width <1.4 mm. At 12 months, rates of progression were 14% among those without a temporal bone anomaly, 15% among those with a temporal bone anomaly, and 20% among those with BCNC stenosis. Overall, children with temporal bone anomalies had similar rates of progression compared to children with no anomalies: hazard ratio 1.36, 95% CI (0.71, 2.56), p-value 0.367. Children with BCNC stenosis had a greater risk of progression: hazard ratio 2.17, 95% CI (1.01, 4.66), p-value 0.046.

Conclusion: Children with BCNC stenosis may be at greater risk for progression of hearing loss in their affected ear than children with other temporal bone anomalies. Close follow-up for children with BCNC stenosis should be considered.

Define Professional Practice Gap & Educational Needs: 1. Lack of knowledge regarding natural history of hearing loss associated with many temporal bone anomalies, including bony cochlear nerve canal stenosis. 2. Lack of awareness regarding the importance of bony cochlear nerve canal stenosis as an etiology of unilateral sensorineural hearing loss.

Learning Objective: 1. To understand that temporal bone anomalies are quite common among children with unilateral sensorineural hearing loss, and that bony cochlear canal stenosis is one of the most common anomalies. 2. To understand that, when considering hearing loss progression, children with different types of temporal bone anomalies have different risk profiles. 3. To understand that children with BCNC stenosis may be a greater risk of progression than children with other anomalies.

Desired Result: 1. Attendees will be able to use this information when counseling patients with BCNC stenosis about the need for continued follow-up after diagnosis. 2. This study promotes interest in future research related to BCNC stenosis, and temporal bone anomalies in general.

IRB - Approved

F012

Risk of Progressive Hearing Loss in Untreated Superior Semicircular Canal Dehiscence

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Objective: Patients with incidental or minimally symptomatic superior semicircular canal dehiscence (SSCD) are usually observed, without surgical repair. However, it remains unknown whether a labyrinthine fistula of the superior semicircular canal is associated with progressive conductive or sensorineural hearing loss over time.

Study Design: Retrospective review.

Setting: Tertiary center.

Patients: Adults diagnosed with SSCD by high-resolution temporal bone CT and vestibular evoked myogenic potential (VEMP) testing, who were observed with a minimum of two sequential audiograms, were analyzed. Patients with other potential causes of hearing impairment were excluded.

Interventions: Conservative observation.

Main outcome measures: Serial audiometry.

Results: A total of 40 ears, in 30 adult patients (median age 59 years; 48% female) were analyzed. The median audiometric follow up was 23 months (range 1-136 months). None experienced a sudden hearing loss over the follow up period. In patients with audiometric follow up of at least 24 months (median 47 months), the mean decline in PTA and ABG was 0.82 dB/year (95% CI 0.22-1.42) and 0.58 dB/year (95% CI -0.07-1.22), respectively. Speech discrimination scores did not differ when comparing initial (92.6%) and final (90.3%) audiograms ($p = 0.07$). There was no statistically significant change in bone conduction thresholds at 0.5, 1, 2, and 4 kHz over the period of observation.

Conclusions: The risk of progressive hearing loss with observed SSCD is low during short- and intermediate-term follow- up. Further studies are necessary to assess the risk of delayed late hearing loss. Such information may be critical towards patient counseling regarding the need for and timing of surgery.

Define Professional Practice Gap & Educational Needs: 1. Lack of studies to guide otolaryngologists in managing this condition 2. Need to improve patient counseling

Learning Objective: 1. Understand the effect of superior semicircular canal dehiscence on hearing 2. Be able to counsel patients effectively when recommending observation

Desired Result: 1. Physician will gain knowledge about an incompletely described condition and be able to safely manage patients

IRB - Approved

F013

Long-Term Results of the Treatment of Idiopathic Sudden Sensorineural Hearing Loss

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Objective: To better determine at what point in time, hearing levels plateau after completion of medical intervention for idiopathic sudden sensorineural hearing loss (ISSNHL).

Study Design: A combination of retrospective chart review and prospective participation

Setting: Tertiary referral center

Patients: Records from April 2007 to October 2014 for patients treated for ISSNHL were reviewed. Patients were asked to return for repeat audiometric testing if a one-year or greater post treatment audiogram was not documented.

Interventions: Oral steroids and intratympanic steroids

Main outcomes measures: Change in audiometric pure-tone average (PTA) and word recognition score (WRS) between one month and one year or greater after start of treatment. Patients were grouped into two treatment groups: oral steroid alone or oral steroid plus intratympanic steroids.

Results: A total of fifty-seven patients were identified. Twenty-three patients had sufficient data to be included in the study. Five were in the oral steroid group and eighteen in the oral/intratympanic steroid group. The average PTA improvement was 1 dB and 11.04 dB in the oral steroid, oral/intratympanic steroid groups, respectively. There was no significant difference in PTA or WRS between the one-month and one year or greater follow up.

Conclusions: The PTA and WRS remained statistically unchanged between one month and one year or greater after treatment for ISSNHL. These results do not differ based on treatment of oral vs. oral and intratympanic steroids. The information regarding recovery pattern after treatment for ISSNHL is helpful to determine the appropriate time for hearing intervention.

Define Professional Practice Gap & Educational Needs: Historically, there has not been many studies to review the long-term prognosis for patients treated for ISSNL. Previous studies typically have used six months as the longest duration of follow up. Longer term follow up is necessary to determine long-term hearing prognosis as to better counsel patients regarding hearing loss treatment options, if necessary.

Learning Objective: To acquire a better understanding of the point in time patients, treated for ISSNL, will not regain hearing to baseline levels.

Desired Result: More knowledge of when to no longer expect improvements in hearing levels to better counsel patients on treatment options for those with sustained hearing deficits.

IRB - Approved

F014

The Inner Ear Manifestations of Neurosarcoidosis and its Management

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A rare subset of sarcoidosis, neurosarcoidosis is reported to occur among 5-7 % of sarcoid patients and can manifest in a variety of ways; the most common being facial paralysis followed by optic neuritis, cochleovestibulopathies, blindness, anosmia and other cranial nerve palsies. The sensory deficit may be severe and psychiatric symptoms may result from the effects of the disease or steroid treatment. The management of complete hearing loss, even with SYNCHRONY (the latest MRI compatible cochlear implant), presents challenges for future disease monitoring due to artifact. We present two recent cases from different institutions 1) a 39-year old man with a history of progressively worsening hearing loss, followed by visual loss, dementia, agitation, ataxia, and musical auditory hallucinations consistent with Charles Bonnet syndrome, diffuse leptomeningeal enhancement on MRI with a normal serum ACE level however elevated CSF ACE levels suggesting neurosarcoidosis, currently undergoing consideration for cochlear implantation and 2) a 36-year old woman with rapid onset horizontal diplopia, left mixed severe sensorineural hearing loss and tinnitus, diffuse leptomeningeal enhancement on MRI and progressive left cranial nerve IV, VI, VII, IX, X and XI palsies with concurrent psychotic exacerbation requiring admission. Both patients' symptoms have fluctuated and partially responded to steroids. Careful consideration and appropriate treatment of psychiatric symptoms is critical. The role of cochlear implantation for deafened patients presents a treatment dilemma for fluctuating disease monitoring and management.

Define Professional Practice Gap & Educational Needs: 1. lack of awareness regarding the presentation and treatment dilemmas for a rare disease, neurosarcoidosis.

Learning Objective: To recognize the treatment dilemma inherent in steroid treatment for neurosarcoidosis which can also contribute to concurrent psychiatric symptoms as well as to recognize how cochlear implantation could prevent disease monitoring with MRI.

Desired Result: Discuss with patients and families the risk of psychiatric symptoms associated with neurosarcoidosis as well as discuss the implications of cochlear implantation with regards to decreased efficacy of MRI-safe cochlear implantation due to artifact.

IRB - None reported

F015

High-Throughput Assay of Zebrafish Swimming Behavior for Drug Development Targeting Hearing Loss

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Hypothesis: A high-throughput assay of zebrafish swimming behavior, correlated with anatomic evidence of lateral line hair cell damage, will facilitate screening large numbers of otoprotective drugs.

Background: Zebrafish have hair cells on their body surfaces that are similar to the human inner ear. They help fish to sense water flow and orient head-to-current in a behavior called Rheotaxis. Rheotaxis Index (RI) deteriorates in a dose- dependent manner with increasing exposure to the ototoxin cisplatin, and decreased RI correlates directly with cisplatin- induced hair cell damage. Over the past year, we have made dramatic improvements to our previously published 6-lane assay that analyzes changes in fish swimming behavior as a means of drug discovery against hearing loss.

Methods: We have constructed a next-generation, extensible behavioral assay system consisting of multiple tanks, each with 16 swimming lanes, video cameras, infrared lighting, network infrastructure, control software, high-performance computing, and automated video analysis (detection, segmentation, & fish orientation).

Results: More swimming lanes and improved optical design have expanded assay scale & delivered high quality video. New tank designs facilitate fish handling & high performance computing with automated image processing has increased throughput for near real-time Rheotaxis Index computations. Increased system fidelity provides more distinction in RI between test and control zebrafish populations. This expandable drug discovery platform now facilitates high-throughput screening of potentially otoprotective drugs.

Conclusions: There are currently no FDA-approved pharmacological treatments for hearing loss. Using our high- throughput biological assay to test a standardized ototoxic dose of cisplatin against varying doses of compounds that protect or regenerate hair cells may facilitate rapid translation of novel drugs into preclinical mammalian models.

Define Professional Practice Gap & Educational Needs: There are currently no pharmacological treatments for the prevention or restoration of hearing.

Learning Objective: Describe the rationale for using zebrafish swimming behavior as a biological platform for drug discovery targeting hearing loss. Understand the importance of scale, quality video, high-performance computing, and automated image analysis for improving throughput in screening otoprotective drugs.

Desired Result: Improve physician knowledge regarding small molecule drug discovery efforts for the treatment of hearing loss.

IRB - Approved

F016

Hypertension, Diuretic Use, and Risk of Hearing Loss

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Objective: Hypertension may increase the risk of hearing loss by decreasing vascular supply to the stria vascularis. Use of thiazides and furosemide have been reported to be associated with hearing loss, but scant data are available. We investigated the relation between hypertension, diuretic use, and hearing loss.

Setting: Prospective cohort with biennial follow-up.

Patients: Eligible participants were 49,924 women in Nurses' Health Study I aged 48-73 years in 1994 who provided information on thiazide diuretic and furosemide use in 1994, answered the question on hearing loss over their lifetime in 2012, and did not report hearing loss with date of onset before date of onset of hypertension or medication use.

Intervention(s): None

Main outcome measure(s): The primary outcome was self-reported hearing loss as ascertained by questionnaire. Cox proportional hazards regression was used to adjust for potential confounders.

Results: During 774,096 person-years of follow-up, 19,296 cases of hearing loss were reported. History of hypertension was independently associated with a modestly higher risk of hearing loss (multivariable adjusted relative risk (MVRR) =
1.04 [1.01, 1.07]). Among women with a history of hypertension, neither thiazide diuretic (MVRR= 1.07 [0.99, 1.16]) nor furosemide use (MVRR = 0.91 [0.75, 1.09]) was significantly associated with risk of hearing loss, when compared with women not taking anti-hypertensive medications.

Conclusions: History of hypertension was associated with a small increased risk of hearing loss. Thiazide diuretic use and furosemide use were not associated with risk of hearing loss among women with a history of hypertension.

Define Professional Practice Gap & Educational Needs: There are no published prospective studies investigating the relation between regular use of thiazide diuretics and furosemide and risk of hearing loss.

Learning Objective: To examine if regular use of thiazide diuretics and furosemide are independently associated with increased risk of hearing loss.

Desired Result: To increase understanding of the relation between hypertension, thiazide diuretics, furosemide, and risk of hearing loss.

IRB - Approved

F017

Migraine-Related Aural Fullness: A New Clinical Entity

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Objective: To describe a newly described clinical entity of aural pressure related to migraine and its response to migraine prophylactic therapy and lifestyle changes.

Study Design: Retrospective chart review.

Setting: Outpatient clinic, tertiary medical center.

Intervention: Patients with isolated aural fullness unrelated to Eustachian tube dysfunction were thoroughly evaluated. The patients presented with aural pressure that did not respond to valsalva or a myringotomy and had a negative CT and MR imaging. Patients with a history of episodic vertigo or Meniere disease were excluded. The patients were treated with dietary and lifestyle changes as well as migraine prophylaxis therapy.

Results: Eleven patients with over six months of aural pressure were included. There was a predominance of females (82%), with a mean age of 52Â±13 years. Eight patients (73%) responded to lifestyle and pharmacologic treatment instituted for migraine prophylaxis with complete resolution of symptoms (P value< 0.05).

Conclusions: Patients with aural pressure unrelated to Eustachian tube dysfunction, unrelieved with valsalva or myringotomy, and with imaging negative for tumors or canal dehiscence may suffer from a condition related to the migraine spectrum. Such patients will often have a history of migraine headaches or signs and symptoms related to migraine, and often respond well to migraine lifestyle changes and medications used for migraine prophylaxis.

Define Professional Practice Gap & Educational Needs: Sometimes there are inconsistencies in diagnosis of patients with aural fullness and clinically these patients may be mistakenly misdiagnosed as other entities such as Meniere's disease or eustachian tube dysfunction, etc.

Learning Objective: Describe a newly described clinical entity of aural pressure related to migraine and its response to migraine prophylactic therapy and lifestyle changes.

Desired Result: To correctly diagnose patients with migraine-related aural fullness and improving their response to migraine lifestyle changes and medications used for migraine prophylaxis.

IRB - Approved

F018

Delayed Intravenous Contrast-Enhanced Inner Ear MRI for Evaluation of Endolymphatic Hydrops: The Use of a Novel Computer-Assisted Volumetric Analysis Tool

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Objective: Dilation of the vestibular endolymphatic space (VES), resulting in endolymphatic hydrops (EH), can be detected in patients with Meniere's disease (MD) using delayed intravenous contrast-enhanced 3D FLAIR MRI. We present a novel method of quantifying EH in the setting of MD using a semi-automated computer-assisted volumetric analysis tool.

Study Design: Retrospective review

Setting: Tertiary referral center

Patients: Patients previously imaged using delayed intravenous contrast-enhanced 3D FLAIR MRI

Intervention: 3D volumetric data sets from delayed intravenous contrast-enhanced inner ear MRIs were analyzed, including subjects with and without EH, employing novel software (Semi-automated Computerized Assessment of Labyrinthine Endolymph: SCALE).

Main outcome Measures: The accuracy of SCALE for identifying EH was compared to subjective identification of EH on MRI by an experienced neuroradiologist applying previously validated qualitative criteria. Additionally, SCALE measurements were compared against other quantifiable measures of auditory function in MD subjects.

Results: Twenty-seven ears with MD and 95 without MD were compared. Using SCALE, the average VES/vestibule ratio was 0.83 +/- 0.18 for affected MD ears compared with 0.56 +/- 0.14 in unaffected ears. A VES/vestibule ratio >0.77 was 69% sensitive and 100% specific for MD. Increased VES/vestibule ratio correlated with poorer auditory function in symptomatic ears of MD patients. There was no significant difference in the ability to detect EH between free hand technique and SCALE.

Conclusion: Computerized, semi-automated quantitative measurements of endolymphatic hydrops correlated well with clinical diagnoses and disease severity. SCALE may allow for standardized evaluation of EH and reduce inter-observer bias.

Define Professional Practice Gap & Educational Needs: 1. Non-standardized evaluation technique of endolymphatic hydrops in Meniere's disease 2. Variable measurement of vestibular endolymphatic space in the diagnosis of hydrops using MRI

Learning Objective: 1. How to accurately measure vestibular endolymphatic space using semi-automated computerized assessment of labrynthine endolymph (SCALE) 2. Correlation of endolymphatic hydrops in the diagnosis of Meniere's disease using MRI

Desired Result: 1. Standardization of radiographic assessment of endolymphatic hydrops in Meniere's disease

IRB - Approved

F019

A Computational Study of the Relationship between Temporal Bone Anatomy and Caloric Asymmetry

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Hypothesis: Patients with increased variation in bilateral temporal bone anatomy have greater caloric asymmetry.

Background: Caloric stimulation is the gold standard for distinguishing between central and peripheral vertigo; however, the mechanism underlying caloric stimulation is poorly understood. Test results are thus subject to considerable subjective interpretation, limiting both clinical utility and reliability. The present study explores the effects of temporal bone anatomy on the magnitude of the caloric response.

Methods: Eligible patients included those who were referred to an otology clinic complaining of dizziness with a head computed tomography (CT) scan and caloric stimulation results indicative of non-vestibular findings. Surface area (SA) and volume (V) of temporal bone anatomy were calculated from three-dimensional reconstructions of CT scans in 11 patients. Observed differences in left and right anatomic parameters were compared to the results of caloric testing. Statistical analysis was done using the nonparametric Wilcoxon Rank-Sum test.

Results: No significant relationships were found between temporal bone anatomy (mastoid bone SA and V, and airspace SA and V) and caloric asymmetry with the exception of the lateral semicircular canal (LSCC) volume and LSCC SA to V ratio ($p = 0.036$ for LSCC V; $p=0.023$ for LSCC SA:V). In contrast to our hypothesis, greater asymmetry in LSCC V and SA:V were observed in patients with a lower caloric asymmetry.

Conclusions: This pilot study suggests that the caloric asymmetry in subjects without vestibular impairments may be influenced more by patient state and end organ function rather than left-right differences in temporal bone anatomy.

Define Professional Practice Gap & Educational Needs: Lack of contemporary knowledge

Learning Objective: To demonstrate that asymmetric caloric stimulation test results are due to factors beyond temporal bone anatomy

Desired Result: Improved mechanistic understanding of caloric stimulation

IRB - Approved

F020

Incidence of Labyrinthine Concussion in Trauma Patients with Otic-Capsule Sparing Temporal Bone Fractures

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Objective: To identify the incidence of sensorineural hearing loss and vertigo in patients with otic-capsule sparing temporal bone fractures (i.e. labyrinthine concussion) and the percentage with sensorineural hearing loss improvement

Study design: Retrospective case review

Setting: Academic tertiary referral center

Patients: Trauma patients with CT scan-confirmed otic-sparing temporal bone fractures between June 2004 and June 2014

Interventions: Temporal bone or head CTs were performed to evaluate for otic capsule fractures. Patients were interviewed about the presence of vertigo at presentation. Hearing loss was assessed by audiograms at presentation and at follow-up.

Main outcome measure(s): Patient reports of vertigo at presentation. Audiogram findings at presentation and at follow-up were collected and coded by individual ear.

Results: In 28 patients with otic-sparing temporal bone fractures, 26.8% were found to have sensorineural hearing loss; 14.3% had mixed hearing loss and 21.4% had vertigo on presentation. 40% of patients with sensorineural hearing loss or mixed hearing loss at presentation had follow-up audiograms, with 20% showing resolution of hearing loss.

Conclusions: Labyrinthine concussion is a relatively common diagnosis in trauma patients. Hearing loss from labyrinthine concussion may be reversible.

Define Professional Practice Gap & Educational Needs: Current knowledge about labyrinthine concussion is limited. Given its relatively high incidence, labyrinthine concussion needs to be considered in the differential for trauma patients presenting with sensorineural hearing loss, mixed hearing loss, or vertigo.

Learning Objective: To understand the clinical presentation of labyrinthine concussion in trauma patients who do not have clear anatomic disruption of the otic-capsule on CT imaging.

Desired Result: To improve diagnosis of labyrinthine concussion in trauma patients by clinical presentation in conjunction with radiologic findings.

IRB-Approved

F021

Intracochlear and Extracochlear Acoustic Responses during Insertion of a Cochlear Implant

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Hypothesis: Electrocochleography (ECochG) using extracochlear and intracochlear electrodes can provide complementary information about trauma and electrode position during insertion of a cochlear implant.

Background: Surgeons currently have no intraoperative feedback on whether trauma is occurring or where the implant is located relative to surviving hair cell and neural elements. Reductions in trauma and better electrode placement should lead to improved outcomes. While ECochG has been utilized from both extracochlear and intracochlear locations during implantation, no study has compared the two approaches

Methods: In different subjects, Intraoperative electrocochleography (ECochG) was performed using 1) an extracochlear electrode at a fixed location on the promontory and 2) intracochlear recordings through the cochlear implant itself. Both sets of recordings were made to 500 Hz suprathreshold tones before, during, and after electrode insertion. Children and adult subjects were included.

Results: For the extracochlear recordings, the responses typically increased slightly after opening the round window, and remained stable or slowly dropped at the final position of implantation. For the intracochlear recordings, responses typically increased throughout insertion. In some cases with both types of recordings, the response decreased during the insertion but then recovered with further insertion.

Conclusions: The difference between pre- and post-insertion for the extracochlear recordings can be taken as a measure of the trauma to the basilar membrane and/or responding elements. The increase in response with intracochlear recordings reflects proximity to the responding elements. The decreases during insertion that later recovered means that a drop in response is not necessarily an indication of trauma.

Define Professional Practice Gap & Educational Needs: Lack of a thorough analysis comparing electrocochleography recording locations for detecting trauma during cochlear implant insertions.

Learning Objective: To understand the strengths and weaknesses of intracochlear and extracochlear recording during cochlear implant insertion

Desired Result: Appreciate the merit in using simultaneous intracochlear and extracochlear electrocochleography to monitor cochlear physiology during implantations

IRB - Approved

F022

Identification of the Sensory Auricular Branch of the Facial Nerve and Its Relationship to Landmarks of the Facial Recess

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Background: The sensory auricular branch of the facial nerve is clinically-suggested to play a role in early identification of vestibular schwannoma (i.e. Hitselberger sign) and in recalcitrant otalgia. Literature on the course of the sensory branch of the facial nerve is rudimentary, and the nerve's relationship to landmarks of the facial recess and middle ear is incompletely characterized.

Methods: A series of cadaveric dissections were performed to identify the course of the sensory auricular branch of the facial nerve.

Results: The course of the sensory auricular branch of the facial nerve is described. Based on this sample, the mean angle between the sensory auricular branch and the facial nerve, the mean angle between the sensory auricular branch and the chorda tympani, and distance measurements between the sensory auricular branch and the incus, round window, and chorda tympani are reported.

Conclusions: A more complete characterization of the sensory auricular branch of the facial nerve and its relationship to neighboring anatomy may be useful in identification and preservation of the vertical segment of the facial nerve and, potentially, in the identification of the sensory auricular branch for preservation or ablation in cases of recalcitrant otalgia.

Define Professional Practice Gap & Educational Needs: Lack of awareness Lack of contemporary knowledge To make the audience aware of the course of the sensory auricular branch of the facial nerve and its relationship to landmarks of the facial recess and middle ear. This branch receives little attention relative to the chorda tympani and the stapedial branch. The literature describing its course and relationship to neighboring anatomy is rudimentary.

Learning Objective: Attendees will be able to apply this knowledge to better identify the verticle segment of the facial nerve in challenging ears and become more cognizant of the sensory auricular branch for ablation or preservation purposes.

Desired Result: To further characterize the sensory auricular branch of the facial nerve and its relationship to landmarks of the facial recess and middle ear.

IRB - Cadaveric studies are Exempt

F023

The Role of Intraoperative Auditory Brainstem Response Monitoring in Predicting Hearing Outcomes during Vestibular Schwannoma Surgery

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Objective: To determine if intraoperative auditory brainstem response (ABR) monitoring is correlated with hearing preservation outcomes after vestibular schwannoma surgery

Study Design: Retrospective case review

Setting: Tertiary referral center

Patients: Twenty-two patients who underwent a hearing preservation approach for the resection of a vestibular schwannoma were included. Sixteen patients had Class A, and 6 had Class B hearing preoperatively as defined by the AAO classification scheme.

Intervention: Surgical resection using a hearing preservation approach for vestibular schwannomas in conjunction with intraoperative ABR monitoring.

Main outcome measure: To correlate audiometric pure-tone average (PTA) and speech discrimination score (SDS) with changes in wave III and V latency from baseline and during the course of tumor resection.

Results: Eight patients (36%) had a Class A/B outcome post-operatively. The average interaural latency difference at baseline for waves III and V was 0.73ms and 1.05ms for patients with Class A/B hearing, and 0.79ms and 1.58ms for patients with Class D hearing. The average intraoperative latency change for wave III and V for patients who had Class A/B hearing post-operatively was 1.32ms and 1.45ms, while in patients with Class D hearing those changes in latency were 1.70ms and 2.47ms.

Conclusions: Interaural latency difference at baseline for wave V may help predict likelihood of hearing preservation. Increased intraoperative change in wave V latency is correlated with worse postoperative hearing outcomes. Such factors may help predict which parameters of intraoperative ABR monitoring best correlate with hearing outcomes.

Define Professional Practice Gap & Educational Needs: At our institution, intraoperative auditory brainstem monitoring (ABR) is used during the resection of vestibular schwannomas; however, it remains unclear whether intraoperative ABR results have utility in predicting postoperative hearing outcomes.

Learning Objective: To determine if intraoperative auditory brainstem response (ABR) monitoring is correlated with hearing preservation outcomes after vestibular schwannoma surgery

Desired Result: To consider the utility of auditory brainstem response (ABR) during surgery for vestibular schwannomas, and further to consider whether ABR should be offered pre-operatively as a means to determine which surgical approach should be performed.

IRB - Approved

F024

Endoscopic Management of Middle Ear Paragangliomas: A Case Series

Daniel E. Killeen, MD; Cameron C. Wick, MD
George B. Wanna, MD; Alejandro Rivas, MD
João Flávio Nogueira, MD; Brandon Isaacson, MD

Objective: Investigate the efficacy and safety of endoscopic middle ear paraganglioma resection.

Study Design: Case series with chart review.

Setting: Tertiary university hospitals.

Patients: Adult patients (over 18 years of age) with middle ear paragangliomas treated via endoscopic approach between 1/2014 - 09/2015.

Intervention: All tumors were initially approached via a transcanal endoscopic technique. An operating microscope, was used only if the tumor could not be adequately visualized or resected with endoscopic techniques alone.

Main Outcome Measures: The main outcome measure was completeness of the resection via the endoscopic technique. Secondary measures were resolution of pulsatile tinnitus, audiometric outcomes, surgical duration, and surgical complications.

Results: Endoscopic resection was attempted on 13 middle ear paragangliomas (glomus tympanicum). Twelve patients (92.3%) were female with a mean age of 61.5 years. The mean tumor size was 5.7 mm (SD 2.3). Ten cases (76.9%) had complete resection via the endoscopic approach alone. The mean surgical duration was 118 minutes (SD 61.5). One paraganglioma required use of an operating microscope via a transcanal route, two cases required postauricular incisions with mastoidectomy. There were no significant post-operative complications. Two patients had tympanic membrane perforations repaired intraoperatively with only one residual perforation at follow-up. All patients had intact facial nerve function (HB I) post-operatively. Twelve patients had pulsatile tinnitus pre-operatively, all of which had resolution of their symptoms. The mean pure-tone average improved by 11.2.

Conclusions: Endoscopic management of tympanic paragangliomas is safe, feasible, and effective.

Define Professional Practice Gap & Educational Needs: Lack of knowledge about the safety and efficacy of endoscopic transcanal resection of middle ear paragangliomas

Learning Objective: Investigate the efficacy and safety of endoscopic middle ear paraganglioma resection.

Desired Result: Attendees will learn that endoscopic transcanal resection of middle ear paragangliomas is safe, effective, and an option to treat middle ear paragangliomas while potentially reducing operative morbidity.

IRB - Approved

F025

Epidemiology of Tumors of the External Auditory Canal and Middle Ear: Experience with 2415 Pathological Samples at a Tertiary Referral Center

Lukas D. Landegger, MD; Mehmet I. Sahin, MD
Brandon Barrett; Monica He; Anja Funk, MD
William C. Faquin, MD, PhD
Konstantina M. Stankovic, MD, PhD

Objective: Tumors of the ear comprise a diverse group of benign and malignant neoplasms. Due to the infrequence of these growths, surprisingly little epidemiological information is available and the sparse published data often come from large military or national databases with heterogeneous pathological criteria at different institutions.

Study Design: Retrospective clinical study

Setting: Tertiary referral center

Patients: 2046 subjects (14-106 yrs old) diagnosed with benign and malignant neoplasms of the external auditory canal and the middle ear between January 1990 and September 2014.

Intervention: Diagnostic

Main Outcome Measure(s): Collected information summarized patients' sex, age at time of diagnostic procedure, anatomical site of the tumor, type of specimen collection, pathological diagnosis and presence of recurrence. For a subset of patients, additional available information that was analyzed included presenting symptoms, frequency of subsequent visits, therapeutic and rehabilitative interventions.

Results: Hospital-based incidence rates were calculated for each neoplasm type. We evaluated pathological samples from 961 specimens of squamous cell carcinoma (792 patients), 1028 specimens of basal cell carcinoma (860 patients), 126 specimens of melanoma (103 patients), 72 specimens of paraganglioma, and 228 specimens of very rare tumors (including leiomyomas, hamartomas, xanthogranulomas, Kaposi's sarcomas and several forms of ceruminous gland tumors) in 219 patients. Subanalyses regarding interventions showed the importance of adhering to therapeutic guidelines.

Conclusions: To the best of our knowledge, this is the largest series of tumors of the ear from a single medical center. The analyzed data suggest future directions for diagnosis and therapy of these rare neoplasms.

Define Professional Practice Gap & Educational Needs: Tumors of the ear comprise a diverse group of benign and malignant neoplasms. Due to the infrequence of these growths, surprisingly little epidemiological information is available and the sparse published data often come from large military or national databases with heterogeneous pathological criteria at different institutions.

Learning Objective: To give physicians a methodically standardized insight into the epidemiology of ear tumors.

Desired Result: The presentation of this information might help to share valuable background information with clinicians, who should then be able to overcome diagnostic insecurities when confronted with a patient presenting with a tumor of the external auditory canal and middle ear.

IRB - Exempt

F026

Inflammatory Pseudotumor of the Temporal Bone: Case Series

Timothy E. Ortlip MD; Virginia Drake BA,
David J. Eisenman MD; John Papadimitriou MD
Prashant Raghavan MD; Ronna Hertzano MD, PhD

Objective: Inflammatory pseudotumor (IPT) is a benign, idiopathic inflammatory process that is locally invasive and a cause of significant morbidity. Involvement of the temporal bone is rare. The purpose of this study is to review our experience with five patients and compare it to the current literature.

Study design: Retrospective case review from January 1, 2014 - June 30, 2015.

Setting: Single tertiary medical center.

Patients: There were a total of five male patients (n = 5) all with a diagnosis of inflammatory pseudotumor of the temporal bone. The mean age at presentation was 53 years old. The most common presenting symptoms were headache (4/5) and hearing loss (5/5). Two patients experienced facial nerve paralysis.

Intervention(s): All patients underwent serial CT & MRI. Corticosteroids and antibiotics were the initial treatment of choice. Three patients also underwent surgery. Two patients received radiation therapy or Cellcept®.

Main outcome measure(s): Clinical courses were followed with focus on symptoms, disease recurrence, duration and modality of therapy. The mean follow up was 14 months.

Results: Tumor and involved structures showed T2 hypo-intensity and enhancement with diffuse dural thickening on MRI in 5/5 patients. Histopathology showed chronic inflammation in the setting of hyalinized fibrosis in 5/5 patients. All patients are symptomatically stable.

Conclusions: IPT of the temporal bone have devastating effects on neurological function and quality of life. Recognition of identifiable characteristics on imaging and histopathology can expedite appropriate treatment. Patients may require chronic steroid therapy. Adjunctive therapy with radiation and immunomodulation are currently being explored.

Define Professional Practice Gap & Educational Needs: Due to the low prevalence of inflammatory pseudotumor there is a lack of awareness and a paucity of literature leading to unorganized, inconsistent and delayed management.

Learning Objective: 1. Overview of inflammatory pseudotumor. 2. Present the clinical course of five patients to highlight presenting symptoms, pertinent diagnostic findings, disease course and response to treatment. 3. Review some of the current literature on diagnostic and treatment algorithms in comparison to our own experience.

Desired Result: The purpose of our study is to raise awareness, contribute our experience to the pool of data and characterize identifiable diagnostic criteria which may expedite appropriate treatment. Furthermore, we hope that attendees will recognize the limitations in our current treatment strategies and continue to explore adjunctive therapies.

IRB - Approved

F027

The Human Round Window Niche: A Microanatomic Three Dimensional Analysis

J. Eric Lupo, MD, MS; Fred H. Linthicum, MD

Hypothesis: A three-dimensional model of the anatomy of the Human round window niche (RWN) may be used to analyze the round window membrane (RWM) and surrounding hook region.

Background: The three dimensional anatomy of the RWN and surrounding cochlear hook region is difficult to conceptualize using two-dimensional histologic slides and photographs.

Methods: The right temporal bone of a 73-year-old female was used to create a three dimensional model of the RWN area. 10 micron thick sections were stained, digitized, and imported into a commercial three-dimensional analysis software program (Amira, version 5.6.0). Three-dimensional models of the RWM, scala vestibule/tympani, facial nerve and surrounding structures were generated. Histological sections through the RW of a second different human temporal bone were also analyzed.

Results: The saddle shaped RWM may be described mathematically as a hyperbolic paraboloid. A complex multifaceted relationship of the RW pseudomembrane to the RWM is observed. Detailed analysis of the 3D proximity of labyrinthine structures to the RWN is appreciated.

Conclusions: This 3D study is a valuable adjunct for the study of the RW and cochlear hook region with implications for mechanical stimulation of the round window, cochlear implantation and other procedures involving the round window niche.

Define Professional Practice Gap & Educational Needs: There is an educational need to appreciate the microanatomy of the round window membrane and adjacent labyrinthine structures from a 3 dimensional perspective. Anatomical studies have been documented regarding the round window membrane however 3D reconstruction of the area provides further appreciation of the relationships around the round window.

Learning Objective: Understand the 3 dimensional nature of the round window membrane and relationship of the round window membrane to the underlying adjacent labyrinthine structures

Desired Result: Attendees will be able to apply the knowledge from the presentation to the refine techniques of cochlear implantation as well as application of middle ear implants and other procedures around the round window niche.

IRB - Exempt

F028

Customized Lateral Skull Base Repair in Temporal Bones with 3-D Printed Models

Kyle K. VanKoevering, MD; Sameer Ahmed, MD
Stephanie Kline, MSE, MS; Scott J. Hollister PhD
Glenn E. Green, MD; H. Alexander Arts, MD

Hypothesis: We hypothesize that 3-D printing can be used to create customized biocompatible plates suitable for repair of tegmen defects.

Background: Increasingly, patients present with spontaneous cerebrospinal fluid leaks, temporal encephaloceles, and tegmen defects. These defects are currently repaired with autologous tissue such as bone or fascia or alloplastic material such as synthetic mesh or hydroxyapatite cement. These current techniques are crude, time-consuming, and sometimes unsuccessful.

Methods: Tegmen tympani and tegmen mastoideum defects were created in cadaveric temporal bones to mimic clinical defects. High resolution computed tomography was obtained for each bone. The images were then imported into computer aided design software, and tegmen defects were virtually identified. Repair plates were designed and manufactured with a high-resolution 3-D printer using materials suitable for human implantation. Subsequently, CT scans from real patients with tegmen defects were used to create 3-D printed repair plates and 3-D printed temporal bone models. The repair plates were then evaluated in their corresponding temporal bone models.

Results: Tegmen repair plates were produced with submillimeter precision. These plates precisely matched the skull base, covered the defects, and locked into place. Important anatomical structures, such as the geniculate ganglion and superior petrosal sinus were accounted for and spared.

Conclusion: 3-D printing can be used to create highly customized repair plates that are capable of spanning complex tegmen defects and nearly dehiscent bone while accommodating important anatomical structures in the lateral skull base. Their customized shape allows them to fit precisely into the floor of the middle cranial fossa with minimal fixation. Clinical use will be necessary to confirm this impression.

Define Professional Practice Gap & Educational Need: Current techniques for tegmen defect repair are difficult and sometimes unsuccessful. A customized prosthesis, based on the patient's defect as demonstrated by temporal bone CT imaging, is proposed and anticipated to be easier to place and resulting in a better fit.

Learning Objective: To introduce a novel application of personalized medicine using 3-D printing based on the patient's preoperative imaging in lateral skull base repair.

Desired Result: To demonstrate potential application of pre-printed customized repair plates for tegmen defects.

Indicate IRB or IACUC Approval: Exempt

F029

Creating an Ideal 3D Printed Model for Temporal Bone Dissection Training

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Shuji Izumi, MD; Yuka Morita, MD
Arata Horii, MD

Hypothesis: Three-dimensional (3D) printed temporal bone model, with a little manual modification, can be used for temporal bone dissection (TBD) training.

Background: The 3D printing technique has advanced and is being widely applied in surgical training recently. However, because some anatomical features of the temporal bone, such as pneumatized space, ossicles, facial nerve, and inner ear structure, are difficult to reproduce, the model has limitations in its ability to resemble bone density and render fine middle ear structures.

Methods: 3D data was converted from clinical CT data, and the ossicles, facial nerve, inner ear, sigmoid sinus-jugular bulb, and carotid canal, were represented by manual segmentation and coloring. Some drainage holes were designed to remove residual scaffolding materials. To confirm the anatomical facsimile, CT images of the model were obtained and compared with the original images. Twenty otolaryngologists assessed the fidelity of the model and evaluated its tactile impression and reproducibility on a five-point visual analogue scale.

Results: CT images of the model were consistent with the original images, except for the peripheral air cells and inner ear. The 3D model was quite similar to the real bone structure, and the overall scores indicated high anatomical reproducibility. Although the lumens of cochlear, vestibule, semicircular canals, and blood vessels were not represented, these structures were well compensated for by coloring.

Conclusion: Our 3D model represented the anatomy of the temporal bone well. This model could be a valuable training tool for TBD.

Define Professional Practice Gap & Educational Needs: Lack of optimal tools

Learning Objective: Creation of the optimal model for temporal bone surgery

Desired Result: Attendees will be able to know the advance of 3D printing technique and how to create the optimal model for temporal bone surgery

IRB - Approved

F030

Transcutaneous versus Percutaneous Osseointegrated Auditory Implants - Surgical and Audiologic Outcomes

Darius Kohan, MD; David R. Friedmann, MD

Study design: Retrospective review

Setting: Single neurotologist's practice in implantable auditory devices

Patients: Adult patients (n=27) who fulfilled criteria for surgical placement of an implantable auditory device.

Intervention: insertion of an implantable auditory device of patient's choosing, and available processor, with postoperative minimum 6 months follow up.

Main outcome measure: 1. Surgical and postoperative complications 2. Standard objective audiologic testings' QuickSIN test. 3.Subjective patient data from validated surveys (APHAB). All data was used to determine relative benefits in safety, performance and reliability among implantable auditory devices.

Results: All surgeries were uncomplicated and less than 30 minutes. All device options provide patient benefit but more local complications with the percutaneous device. Percutaneous BAHA 5 processor provided on average PTA4 gain of 49dB versus 31dB with the BAHA 4 processor. The transcutaneous BAHA Attract # 5 processor on average attained PTA4 gain of 35dB versus 22dB with the #4 processor. The latest transcutaneous processors Sophono-Alpha 2MPO provides better gain at all frequencies versus the BAHA Attract- #5. The Sophono Alpha 2 and Alpha 2/MPO processors respectively achieved 76% and 86% of maximum potential gain in PTA4. Gain at high frequencies drops off for all devices, among transcutaneous devices the least decline for Sophono.

Conclusions: All devices provide patient benefit, but there are differences related to the range of optimal performance that should be discussed during preoperative counseling/device selection. There were significant improvements with newer generation processors on the same internal component. Cost and other patient factors such as need for further MRI imaging may also direct patients to a particular manufacturer or model.

Define Professional Practice Gap & Educational Needs: The indications for implantable auditory devices and options available are increasingly more numerous and include both percutaneous and transcutaneous osseointegrated devices. Multiple manufacturers have conflicting claims as to their product efficacy and safety. There is a lack of contemporary knowledge on which device to implant relative to the risks and benefits associated with surgery and anticipated auditory outcomes.

Learning Objective: 1- improve knowledge on what options are available for osseointegrated auditory implants relative to indications; 2 - understand the surgical risks associated with the most commonly implanted transcutaneous versus percutaneous osseointegrated auditory devices; 3- understand the efficacy in improving auditory function relative to the different osseointegrated auditory implants

Desired Result: Attendees will be better able to select appropriate options among osseointegrated auditory devices relative to: surgical risks, postoperative complications, consequences on post implant imaging modalities/limitations, and most importantly the auditory benefits associated with them.

IRB - Exempt

F031

Soft Tissue Driven Transcutaneous Bone Anchored Hearing Implants: A Systematic Review of the BAHA Attract and Sophono Alpha

Timothy Cooper MD
Allan Ho MBBS, MSc, FRCSEd (ORL-HNS)

Background: Conventional percutaneous bone conduction devices offer excellent hearing rehabilitation but their use may be limited by soft tissue complications and patient concern regarding cosmesis. Passive transcutaneous soft tissue driven devices including the BAHA Attract and Sophono Alpha are potential abutment free alternatives. To our knowledge, this is the first systematic review of these two devices.

Objectives: To systematically review the literature on soft tissue-driven transcutaneous bone conduction hearing implants (Sophono Alpha and BAHA Attract) with regards to audiological and quality of life outcomes and complications.

Data Sources: A systematic review of the literature was performed using the MEDLINE, EMBASE, and Cochrane Library databases in October 2015.

Study Selection: All identified English language articles documenting clinical audiological, quality of life outcomes, or complications of implanted BAHA Attract and Sophono Alpha hearing implants were included. Both pediatric and adult cases were included. No limitation was placed on study design or level of evidence.

Results: 283 patients implanted with the BAHA Attract or Sophono Alpha have been reported in the literature. The weighted mean PTA gain with these two devices was 28.9Â±6.9 dB. Major complications including skin breakdown, hematoma, and seroma were rare and occurred in 4% of cases. Minor complications including pain and self-resolving erythema at the implant site occurred in 12%. Patients reported significant quality of life improvement with use of their device.

Conclusions: Soft tissue driven transcutaneous bone anchored hearing implants are a viable alternative to percutaneous devices with good audiological outcomes, low morbidity, and high patient satisfaction.

Define Professional Practice Gap & Educational Needs: Lack of knowledge or experience with use of devices.

Learning Objective: 1. Describe the audiological and quality of life outcomes reported in the literature on these devices
2. Describe the common complications encountered and their frequency. 3. Evaluate the advantages and disadvantages of use of the BAHA Attract and Sophono Alpha

Desired Result: To educate attendees regarding the benefits and limitations of these bone conduction hearing implants. This knowledge could be applied to patient evaluation and education of those meeting criteria for these devices

IRB - Approved

F032

Feasibility of the Transcanal Endoscopic Approach for Visualizing and Accessing the Anatomy in the Supratubal Recess

Seiji Kakehata, MD, PhD; Tomoo Watanabe, MD, PhD
Tsukasa Ito, MD, PhD; Toshinori Kubota, MD, PhD
Takatoshi Furukawa, MD, PhD; Kazunori Futai, MD, PhD

Background: The supratubal recess (STR) is clinically important for anatomical and functional reasons. The STR is often the main anatomical site of residual disease because its location anterior to the cog is difficult to directly visualize microscopically. The STR also plays a functional role in ventilation.

Objective: To evaluate the feasibility of the transcanal endoscopic approach for visualizing and accessing the anatomy in the STR, especially the tensor tympani fold based on both dissection of cadavers and clinical cases.

Study design: Prospective case study.

Subjects: Fresh cadavers without pathologies and patients who had successfully undergone cholesteatoma surgery.

Intervention: A small transcanal atticotomy was first performed and the incus and malleus head were removed. The anatomy of the STR was then examined with the endoscope superiorly via the attic and inferiorly from the mesotympanum. The tensor folds were then subsequently removed. These endoscopic views were compared to microscopic views for some clinical cases.

Main outcome measure: Visibility and accessibility of the STR, especially the tensor fold.

Results: The endoscope allowed for visualization of the entire STR which is not possible via the microscope. Endoscopy provided clear views of the STR upper region from the superior and inferior aspects in both cadaver and clinical cases. The tensor fold was observed to run from the supratubal ridge to the tensor tympani tendon and was removed under direct visualization. An additional fold was observed in some cases.

Conclusions: The transcanal endoscopic approach facilitates visibility and access to the STR, a hitherto anatomical dead corner.

Define Professional Practice Gap & Educational Needs: The supratubal recess is difficult to directly visualize microscopically although it is clinically important for anatomical and functional reasons.

Learning Objective: To confirm that the transcanal endoscopic approach facilitates visibility and access to the supratubal recess, a hitherto anatomical dead corner.

Desired Result: The transcanal endoscopic approach will be employed in visualizing and accessing the anatomy in the supratubal recess.

IRB - Approved

F033

Endoscopic Ossicular Chain Reconstruction: Impact On Audiometric Outcomes

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Daniel Killeen, MD; Cameron Wick, MD
Brandon Isaacson, MD; Alejandro Rivas, MD

Objective: To compare endoscopic and microscopic ossicular chain reconstruction (OCR) on audiometric outcomes

Study Design: Retrospective series

Setting: Two tertiary referral centers

Patients: 179 patients with 180 ears with ossicular discontinuity

Intervention(s): Endoscopic and microscopic OCR in patients with ossicular discontinuity

Main Outcome Measures: Bone and air pure-tone averages, air-bone gap (ABG) and word recognition scores (WRS).

Results: 180 ears were analyzed [median age 32 years, 60% female, median follow-up 17 months (range 2-35)]. The mean (SD) preoperative ABG and WRS were not significantly different between endoscopic OCR, 34.4 (12.5) dB HL and 94% (8.7), and microscopic OCR, 35.5 (11.8) dB HL and 91% (10.5), p=0.79 and 0.31, respectively. 33% of patients had endoscopic OCR compared with 66% microscopic OCR. 35% of ears were reconstructed during a second look procedure. The mean (SD) postoperative WRS and ABG were 97 (5.5) and 14 (5.4) dB HL in patients who underwent secondary OCR versus 92 (15.0) and 19 (9.5) dB HL in patients who underwent primary OCR, p=0.32, 0.29. There was no significant difference in ABG change in patients with primary versus secondary OCR (p=0.73).

Conclusions: Endoscopic OCR yields comparable audiometric results in this series when compared to microscopic OCR. In this series, there was no significant difference in audiometric outcomes between patients that are reconstructed primarily versus secondarily.

Define Professional Practice Gap & Educational Needs: Lack of understanding of the differences between endoscopic ossicular chain reconstruction and microscopic ossicular chain reconstruction.

Learning Objective: Understand the impact of endoscopic ossicular chain reconstruction on audiometric outcomes.

Desired Result: Understand advantages and disadvantages of endoscopic ossicular chain reconstruction. Investigate application in appropriately selected patients.

IRB - Approved

F034

Use of 2-Octylcyanoacrylate in Cartilage Interposition Adherence during Ossiculoplasty

Kyle P. McMullen MD; Michael S. Harris MD
Edward E. Dodson MD

Objective: Cartilage interposition is a well-described and almost universally utilized technique during allograft ossiculoplasty to prevent prosthesis extrusion through the tympanic membrane. Traditionally, the prosthesis and graft are inserted as separate structures. Although hearing outcomes are generally good, there is risk for intraoperative or early post-operative displacement of the prosthesis as well as long-term prosthesis extrusion. Additionally, inserting the prosthesis and cartilage graft as separate structures can be technically difficult, resulting at times in an increased operative time. We describe the novel use of 2-octycyanoacrylate (Dermabond) for improved cartilage interposition adherence during allograft ossiculoplasty and review long term safety profile by measuring extrusion and complication rate.

Study Design: Retrospective chart review

Setting: Otologic practice in a tertiary referral center

Patients: Inclusion criteria includes both pediatric and adult patients who underwent allograft ossiculoplasty +/- tympanoplasty for conductive hearing loss using the Dermabond-assisted technique between 2010-2015.

Intervention: The intervention was the use of Dermabond to affix cartilage interposition grafts to the lateral head of allograft prostheses at the time of ossiculoplasty. The cartilage graft is fashioned and attached to the titanium prosthesis and then placed as a unit into the middle ear space.

Main outcome measure: Safety profile of Dermabond as measured by long term extrusion/complication rate and maintenance of hearing.

Results/Conclusion: The use of Dermabond during ossiculoplasty provides for easier delivery of the prosthesis-cartilage graft unit into the middle ear, reduces the risk of prosthesis displacement, and provides similar hearing outcomes with low risk of extrusion relative to traditional ossiculoplasty.

Define Professional Practice Gap & Educational Needs: There is a lack of awareness regarding this technique to ossiculoplasty. Using this technique, there is an opportunity for a more efficient surgery with equal or improved outcomes.

Learning Objective: The objective is to describe a novel technique for allograft ossiculoplasty and review the results.

Desired Result: The attendees should be able to understand how to perform this surgical technique have the ability to utilize it in their practice.

IRB - Approved

F035

Novel Device for Measuring Ossicular Chain Compliance Before and After Surgical Repair

Justin T. Casey, MD; Nathaniel T .Green, PhD
Herman A. Jenkins, MD

Hypothesis: We have developed a device that is unique in its process of measuring ossicular chain compliance, which we hypothesize can be used intra-operatively both before and after surgical repair to measure the stiffness of the ossicular chain.

Background: Conductive hearing loss is a very common surgically treated entity. However, no commonly accepted objective measure to assess stiffness and motion of the ossicular chain intraoperatively exists. This is a problem both for diagnostic purposes when considering surgical repair, and for assessing the integrity of surgical repair. Ossicular chains of human cadaver heads with well preserved auditory anatomy were fixed with poly(methyl methacrylate) to simulate ossicular fixation. Finally, ossicular chain reconstructions were performed to restore normal function. Our device was used to measure ossicular chain compliance at each step. Laser Doppler Vibrometry was utilized to confirm normal middle ear function prior to the experiment, to confirm ossicular fixation, and finally to test the integrity of the surgically repaired ossicular chain.

Results: Stapes and lateral chain fixation significantly increased ossicular chain stiffness at all locations tested. After ossicular chain reconstruction, chain compliance tested with our device returned to the "pre-fixation" level.

Conclusion: Early results demonstrate feasibility for assessing changes in stiffness between normal and disease-simulated ears, as well as the ability to measure the improvement of ossicular chain compliance following surgical repair. Further testing is needed to determine its true diagnostic utility in different forms of conductive hearing loss, as well as its predictive capacity following surgical repair of conductive hearing loss.

Define Professional Practice Gap & Educational Needs: There is a lack of objective measures for determining ossicular chain stiffness during middle ear surgery. Be it a stapedectomy for otosclerosis, suspected lateral chain fixation, or just a hearing loss that is out of proportion to a small perforation; our only way to approximate ossicular chain compliance is by palpating the chain and relying on the surgeon's hand to sense extremely small forces.

Learning Objective: 1) Understand the basic physiology of the ossicular chain, including the forces and displacement of the ossicles. 2) Understand how best to measure ossicular chain compliance, and the potential importance in surgical decision making

Desired Result: Attendees may begin to think about the overall subjective nature of a large portion of middle ear surgery, and how their surgical decision making can be made more objective.

IRB - Exempt

F036

Tympanoplasty Outcomes for Blast-Induced Perforations from Iraq and Afghanistan 2007-2012

Sungjin A. Song, MD; Shankar K. Sridhara, MD
Philip D. Littlefield, MD

Objective: To describe the characteristics of blast-induced tympanic membrane perforations that do not heal, evaluate the outcomes of tympanoplasty techniques, and to understand which factors are associated with surgical success.

Study Design: Retrospective case series.

Setting: Tertiary referral center

Patients: Blast-induced tympanic membrane perforations repaired by one military neurotologist from 2007 to 2012.

Intervention(s): Tympanoplasty.

Methods: Surgical success and associated perioperative factors were examined to include; size, location, time until surgery, mechanism of injury, and bilateral involvement.

Results: Fifty-five patients (68 ears) met inclusion criteria. Thirty-six (53%) were total or near-total perforations, and the most common locations were near-total (34%), total (19%), and anterior-inferior (10%). Of the total and near-total perforations, 25 (69%) were repaired with lateral grafts, with an 84% success rate. This compared to 73% with medial grafts. Age was a significant factor with a failure rate of 44% for ages 25-34, compared to 10% for 20-24 and >34. Patients who had bilateral sequential tympanoplasties also had higher failure rates than those who only needed unilateral surgery (63% vs. 14%, p=0.002). Ossicular disruptions were found in five, and cholesteatoma was discovered in eight. Surgical timing did not predict success, with an average time until repair of 153 days for successful outcomes and 151 days for failures. There were no major complications. The mean conductive hearing improvement was 10.4 dB.

Conclusions: Tympanoplasty is challenging in this population. Age and bilateral involvement were the only independent variables that showed significance.

Define Professional Practice Gap & Educational Needs: Lack of awareness of traumatic blast-induced tympanic membrane perforations from military personnel deployed to Iraq and Afghanistan.

Learning Objective: Determine the characteristics of blast-induced tympanic membrane perforations and evaluate the outcomes of tympanoplasty technique as related to successful repair and hearing outcomes.

Desired Result: Apply and incorporate the factors associated with higher success tympanoplasties in the blast-induced population.

IRB - Exempt

F037

Acquired Soft Tissue External Auditory Canal Stenosis: A Review of AlloDerm Grafting versus Split Thickness Skin Graft

Michel A. Evans, DO; Eleanor Y. Chan, MD

Objective: To compare the results of AlloDerm grafting vs split thickness skin graft (STSG) for repairing acquired external auditory canal stenosis. To date, there are no published studies for this application of AlloDerm.

Study Design: Retrospective Chart Review.

Setting: Tertiary Referral Center, ambulatory

Patients: 26 patients included with acquired soft tissue or mixed soft tissue/bony EAC stenosis, 18 undergoing STSG and 8 AlloDerm grafts from 2007 to present. Patients with only bony stenosis or congenital stenosis/atresia were excluded.

Intervention: Therapeutic - Surgical canalplasty with STSG or AlloDerm graft.

Main Outcome Measures: 1) Restenosis rate. 2) Hearing outcomes based on preoperative and postoperative audiograms.

Results: One patient (13%) in the AlloDerm and two patients (11%) in the STSG had restenosis. Both groups had significant improvement in closure of air bone gap from preoperative levels. There was no significant difference in hearing improvement between groups.

Conclusions: AlloDerm grafting is a reasonable alternative to STSG in patients requiring coverage to EAC defect after canalplasty for soft tissue stenosis. Potential benefits include lack of donor site morbidity and shorter operative time.

Define Professional Practice Gap & Educational Needs: Lack of awareness or contemporary knowledge. Currently, there are no studies published using AlloDerm grafting to the external auditory canal after canalplasty. To our knowledge this will be the first study to review this application of AlloDerm.

Learning Objective: The objective of this activity to is fill the knowledge gap that many clinicians may have regarding options for coverage after canalplasty procedure. Specifically, to review the functional outcomes of split thickness skin graft and AlloDerm techniques.

Desired Result: Attendees will have an understanding of an additional therapeutic option and its outcomes for external auditory canal grafting after canalplasty. Clinicians may choose to add this technique to their surgical armamentarium.

IRB - Approved

F038

Reduction in Canal Stenosis Complications in Congenital Aural Atresia Repair Surgery

Caroline M. Schlocker, MD; Joseph B. Roberson, MD

Objective: To compare the incidence of postoperative complication of ear canal stenosis following primary surgical correction of Congenital Aural Atresia (CAA) with two separate protocols designed to minimize the incidence of the complication.

Study Design: Retrospective case review

Setting: Tertiary Otology referral center.

Patients: 216 sequential cases of pediatric CAA surgery from Jul 2009- Oct 2014 with 106 sequential ears under Protocol A and 110 sequential ears under Protocol B. Follow-up time ranged from 12-75 months.

Interventions: Protocol A: stenosis-reducing surgical technique + postoperative intervention with clobetasol 0.05% gel and foam plugs for impending stenosis as needed. Protocol B: identical surgical technique + a customized canal mold made by the surgeon 3-4 weeks post-op with nightly use for 4 months with two drops of 0.3% Tobramycin prior to mold insertion.

Main Outcome Measure: Post-operative stenosis requiring revision surgery.

Results: Protocol A - 12 of 106 (11.3%) ears experienced postoperative stenosis requiring surgical revision with a time to revision of 53.1 +/-28.6 weeks. Protocol B - 2 of 110 (1.8%) patients experienced postoperative stenosis requiring surgical revision with a time to revision of 37.5 +/-12.0 weeks.

Conclusion: Inclusion of a customized canal mold for nighttime wear in our current protocol achieves significant reduction in the incidence of postoperative canal stenosis requiring surgical revision following CAA repair.

Define Professional Practice Gap & Educational Needs: A recent meta-analysis by Li et al (2015) listed neo-canal stenosis after congenital aural atresia (CAA) repair occurring in 5-30.3% of operated ears followed for >12 months. Since 2012, this high-volume CAA repair practice has used a protocol with a 1.8% stenosis rate at >12 month follow-up.

Learning Objective: Describe protocol used in high-volume congenital aural atresia repair practice to greatly reduce post-operative stenosis requiring operative revision.

Desired Result: Clinical application of the presented protocol may help practitioners reduce the incidence of canal stenosis after CAA repair.

IRB - Approved

F039

Iatrogenic Cholesteatoma Arising from the Vascular Strip

Alex D. Sweeney, MD; Matthew L. Carlson, MD
Jacob B. Hunter, MD; David S. Haynes, MD
Alejandro Rivas, MD; Jeffrey T. Vrabec, MD

Objective: To highlight the diagnosis and management of iatrogenic cholesteatoma associated with vascular strip malpositioning and proliferation into the ear canal and mastoid.

Study Design: Retrospective chart review

Setting: Patient data was analyzed from three separate tertiary referral centers.

Patients: Consecutive adult and pediatric patients evaluated between 2001 and 2015 with an acquired cholesteatoma arising from the skin of the vascular strip were identified. Patients with evidence of cholesteatoma at another site in the middle ear or mastoid were excluded.

Intervention: Review of patient evaluation and management

Main Outcome Measures: Clinical presentation, imaging findings and outcome of revision surgery.

Results: 10 cholesteatomas (100% female, 60% right-sided) were identified, and the mean age at presentation was 30 years. Patients presented on average 9.4 years following prior otologic surgery, which was most commonly tympanoplasty without mastoidectomy (70%). The most common presenting symptom was otorrhea (70%). All patients were found to have a mastoid cholesteatoma, and three patients exhibited associated tegmen defects. The middle ear was not involved in any case. A canal wall down procedure was performed due to extensive bony canal erosion in 40% of cases.

Conclusions: The vascular strip is an uncommon and preventable source of iatrogenic cholesteatoma that can present years following an otherwise uncomplicated otologic surgery. To the authorsâ€™ knowledge, this rare cause of acquired cholesteatoma has not been previously studied. The findings presented herein highlight the importance of careful vascular strip orientation at the conclusion of otologic surgery.

Define Professional Practice Gap & Educational Needs: Lack of awareness of the vascular strip as an uncommon and preventable source of iatrogenic cholesteatoma that can present years following an otherwise uncomplicated otologic surgery

Learning Objective: To highlight the diagnosis and management of iatrogenic cholesteatoma associated with vascular strip malpositioning and proliferation into the ear canal and mastoid.

Desired Result: The knowledge should underscore the importance of careful vascular strip orientation at the conclusion of otologic surgery.

IRB - Approved

AMERICAN OTOLOGICAL SOCIETY RESEARCH FUND
RESEARCH GRANT AWARDS
& TRAINING FELLOWSHIPS

The purpose of the American Otological Society (AOS) Research Grant is to encourage and support academic research in sciences related to the ear. All of the AOS grant awards may involve research on any topic related to ear disorders. The research need not be directly on an otological disease but may explore normal functions of the cochlea, labyrinth or central auditory or vestibular systems. However, the applicant must describe how the proposed research will benefit our understanding, diagnosis or treatment of otological disorders.

These grant awards and fellowships are for work conducted in *United States or Canadian institutions only*, July 2017 – June 2018. Additional details may be found on the AOS website at www.americanotologicalsociety.org

SAVE THE DATE
NEW IN 2017

A letter of intent must be submitted by November 1st of the year *prior* to funding (funding begins July 1, 2017). The letter must state the grant mechanism for the proposal, the Principal Investigator and Institution(s) for the work, provide a working title, and abstract. This should contain the Specific Aims and summarize the proposal in no more than 2 pages.

Complete applications will be invited from selected applicants based on our review of the letters of intent. Applicants will be notified whether they are invited to submit a full application by December 1st. Completed applications must be received by January 31st.

Applications are reviewed by members of the Board of Trustees of the AOS Research Fund. The Board makes recommendations regarding funding to the AOS Council. Final funding decisions are made by the AOS Council, which typically meets during the Combined Otolaryngology Spring Meetings, yielding decisions in May. Applicants are notified regarding a funding decision after the AOS Council has met.

Information may be obtained from:

Kristen Bordignon, Assistant to
John S. Oghalai, MD
Executive Secretary, Research Fund of the
American Otological Society, Inc.
Professor, Otology, Neurotology, and Skull Base Surgery
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AOS Clinician-Scientist Award Progress Report
Project Title: Multi-Sensory Modulation of Tinnitus Correlates in Primary Auditory Cortex
Primary Investigator: Gregory J. Basura, MD, PhD
Mentor: Susan Shore, PhD

Our central hypothesis is that spike-timing-dependent plasticity (STDP) induced by paired (auditory-auditory) and/or bimodal (auditory-somatosensory; Sp5) stimulation underlies changes in primary auditory cortex (A1) neural correlates of tinnitus following noise damage; an effect that is cholinergic-dependent. To test this hypothesis, two aims were formulated for the 3-year AOS award.

Specific Aim 1 is testing the hypothesis that STDP following paired (auditory-auditory) and/or bimodal (auditory-Sp5) stimulation modulates tinnitus neural correlates (spontaneous firing rates; SFRs and neural synchrony; NS) in A1. Using a gap-detection model of tinnitus in noise-exposed guinea pigs, multi-channel recording electrodes measure extracellular SFRs and NS across A1. To assess plasticity, SFRs and NS is measured before and after paired, bimodal or unimodal (control) stimulation at varied pairing intervals and orders. We predicted that stimulus timing-dependent changes analogous to STDP in SFRs and NS in A1 are influenced by paired and bimodal stimulation.

Scientific Progress: Our progress on this aim has been substantial. We recently published portions of Aim 1 in the Journal of Neurophysiology (see publication list below) that acknowledged current AOS funding. This publication was integral in demonstrating that in noise-damaged A1 with and without tinnitus that plasticity following bimodal stimulation is pairing order and interval dependent. From this data we determined optimal bimodal intervals (0ms; simultaneous pairing and +10ms; Sp5 preceding tone by 10ms) for maximal neural suppression and enhancement, respectively.

We also completed paired (tone at best frequency – tone at non-best frequency) stimulation studies modeled after Dahmen et al. (2008). Those data revealed no significant changes in tone-evoked or SFRs as compared to bimodal stimulation as recently published. These data led us to focus only on bimodal paradigms and specifically 0ms and +10ms intervals going forward. We are finalizing NS data and have a second manuscript in preparation.

A sub-aim of Aim 1 utilizes current source density (CSD) to ascertain A1 layer specificity where most neurophysiologic change is occurring. We have implemented coding algorithms into our analysis and preliminary data will be presented at the Association for Research in Otolaryngology (ARO) in February 2016 (Abstract: Bimodal Stimulation Leads to Long-Term Changes in Neural Firing Rates in Primary and Anterior Auditory Cortex After Noise Exposure)

For the remaining 6-months of the second year, we are on schedule to complete aim 1. In addition we have also demonstrated that the anterior auditory field (AAF), a known modulator of A1 function, shows considerable plasticity to bimodal stimulation and may be contributing to tinnitus neural correlates in A1. We have recently found increased NS between A1 and AAF neurons after noise exposure and this data will be

presented at the 10th annual International Tinnitus Research Initiative; Nottingham, UK; March 2016 (Abstract: Noise Exposure Leads to Increased Synchrony Between Primary Auditory Cortex and Anterior Auditory Field Neurons).

Specific Aim 2 is testing the hypothesis that STDP induced following paired and bimodal stimulation in A1 is cholinergic dependent. The same gap-detection methods and pairing protocols from aim 1 will be used to generate timing rules before and after atropine (mAChR antagonist) or mecamylamine (nAChR antagonist) infusion via drug-delivery probes.

Scientific Progress: While this aim is scheduled for completion in years 2 and 3 of AOS funding, we have made excellent progress within the first 6 months of year 2. The neuropharmacology studies are underway and we have completed preliminary recordings with atropine in noise-exposed animals and are analyzing data now. Mecamylamine studies will begin within 3 months. For the remaining 1.5 years of AOS funding we will be completing the neuropharmacology studies in noise-exposed animals with and without tinnitus following gap detection.

A sub aim of Aim 2 is to map Ach receptor expression in A1 after noise exposure with and without tinnitus. We are utilizing radioligand binding with [3H]-scopolamine (mAChR) and [18F]-Flubatine (nAChR) to label these receptors in A1 brain slices following physiology recordings. Interestingly, preliminary findings show a significant down-regulation in both receptors in A1 and we will be presenting these preliminary results at ARO in February 2016. We are concurrently running IHC experiments alongside the radioligand binding studies to further characterize the expression of both AChRs in sham and noise-exposed A1 and also AAF.

Training Progress: My progress in my training under the AOS grant has been excellent. I continue to meet with Dr. Susan Shore the mentor on this project on a weekly basis. My data is presented at weekly lab meetings as well where open feedback and discussions are generated. I continue to extend my knowledge and skills with MatLab, single unit processing and advanced statistical analysis.

Budget: No new requests or changes to existing budget.

Publications attributed to AOS funding:

Basura, GJ, Koehler SD, Shore SE. Bimodal stimulus timing-dependent plasticity in primary auditory cortex is altered after noise exposure with and without tinnitus. Journal of Neurophysiology, 2015; 114: 3064-3075; doi: 10.1152/ jn.00319.2015

Progress Report - AOS Research Training Fellowship Grant
Project Title: A study of the "third window" phenomenon using inner-ear pressure measurements
Primary Investigator: Yew Song Cheng, BM BCh
Mentor: Hideko Heidi Nakajima, MD, PhD, Daniel J. Lee, MD, FACS.

Superior canal dehiscence (SCD) is a defect of the superior canal (SC) otic capsule that can be associated with vestibular and/or auditory symptoms. For patients with severe symptoms, surgical repair of the SCD can provide effective relief, but conventional techniques involve invasive approaches. Recently, round window (RW) reinforcement (RWR) has emerged as a minimally invasive surgical treatment for SCD. However, the efficacy of RWR is unclear and while good outcomes have been reported, some patients have experienced worsening of symptoms. Opinions about RWR are polarized, but the debate has been limited by the lack of scientific knowledge regarding this controversial technique.
Based on the current understanding of SCD as a pathological "third window" of the inner ear, it is possible that RWR may worsen symptoms (e.g. hearing loss and sound-induced vertigo) by shunting more "acoustic flow" towards the SCD. We have measured SCD-related changes in intracochlear pressures in fresh human temporal bones, which provided evidence supporting the "third window" hypothesis for SCD. Using this experimental model, we have been testing the hypothesis that RWR exerts an influence on inner ear fluid mechanics. For the 1-year AOS Research Fellowship we proposed two aims -

Aim 1: Determine the mechanical consequences of RW surgery for SCD.
RWR increase RW impedance, but the consequential effect on intracochlear pressures is unknown. Simultaneous measurements of sound pressures in the vestibule (PV) and scala tympani (PST) allow calculations for cochlear input drive (ΔP). ΔP is the complex difference (difference considering real and imaginary parts) between PV and PST, and has been shown to be a good estimate of passive hearing.

Progress:
With the first 6 months of funding, we have been successful at simulating RWR on fresh human temporal bones and quantifying the effect on intracochlear sound pressures.

Normal condition
In addition to investigating the effect of RWR in SCD, we explored the influence on normal/intact ears (no SCD). We found that RWR caused a marked increase in PV and PST, the effect of RWR on hearing, determined by calculating ΔP, was small and frequency dependent. Between ~200 and 1000 Hz, a small (<10 dB) decrease in ΔP was observed, but an increase in ΔP was seen below 200 Hz. The effect was consistent throughout the specimens tested successfully (n=5), but the effect size was small and further experiments are necessary. Occlusion of the RW (e.g. in obliterative otosclerosis) is thought to cause a significant conductive hearing loss. Our preliminary finding suggests that contrary to classical teaching, RWR may have only a small, frequency-dependent effect on hearing. We plan to examine this further as a secondary aim, to quantify the effect of RWR on hearing in normal intact ears.

SCD condition

The creation of an SCD resulted in a significant drop in PV, PST and ΔP below 2 kHz. RWR in SCD condition had small and variable effects on PV and PST magnitudes. ΔP magnitude dropped ~10 dB in two specimens (below 2 kHz), and RWR caused either a small decrease or had no effect in another specimen. Because the changes are small and variable, we are planning to test more specimens to investigate the significance of this effect and investigate inter-ear variations.

Aim 2: Quantify the effect of SCD on fluid flow through the ampulla of the semicircular canal.

It is hypothesized that vestibular symptoms in SCD are caused by abnormal flow of sound via the SC ampulla. We can study the influence of SCD on SC fluid mechanics by measuring pressure on either side of the ampulla directly.

Progress:

We have been successful in measuring PV and PSC (SC sound pressure) simultaneously. In normal ears (without SCD), PV and PSC were similar. With an SCD, a drop in both PV and PSC was observed, but the resultant magnitudes of PV and PSC were unexpectedly similar. Sound pressure (an alternating pressure) at the vestibule (PV) is expected to be higher than in PSC because the SCD, which is exposes the SC to the static pressure of the external environment, is expected to set PSC to ≈0. It is possible that our measurements in the SC were influenced by the proximity to the membranous labyrinth, which has been theorized to have a travelling wave in SCD. We are currently performing further analysis of our data and more experiments are planned over the next 6 months to determine the significance of this finding. Through understanding the mechanics within the SC in physiological and diseased state, we hope to advance fundamental knowledge about semicircular canal physiology and help refine surgical techniques for SCD.

American Otological Society - Clinician Scientist Award
Annual Progress Report
PI: Richard K. Gurgel, MD
Grant Title: Exploring the Impact of Hearing Loss on Impaired Cognition in Older Adults
Reporting Project Period: 07/01/2015 – 06/30/2016

A. Introduction

Hearing loss is associated with the development of dementia in older adults. While multiple epidemiologic studies have established the association between hearing loss and dementia, the mechanistic underpinnings of the association require further elucidation. Our overall research goal is to determine if hearing loss is a remedial risk factor for dementia. To further understand the association between hearing loss and dementia, we are working to address the following hypotheses and aims:

1. Hypothesis: The auditory cortex is an area of selective vulnerability in AD.

AIM 1. Correlate the extent of auditory cortical damage as determined with FDG-PET imaging with the degree of hearing loss in patients with AD, controlling for severity of cognitive impairment.

2. Hypothesis: Music processed through the auditory cortex activates other cortical domains and the hippocampus in older adults with AD.

AIM 2. Characterize auditory cortical connectivity to brain networks activated during music-listening session in subjects with AD.

3. Hypothesis: Restoring hearing in profoundly deaf older adults by means of cochlear implantation will improve cognitive function.

AIM 3. Evaluate pre- and post-operative cognitive function in older cochlear implant patients and determine which measures are most sensitive to inform future clinical trials.

B. Results

Aim 1

We have identified 26 subjects who have had FDG-PET to evaluate their dementia since the funding period began on 7/1/15. Of these 14 are female, and 12 are male. Within this group, 5 have been diagnosed with probable Alzheimer's disease dementia, 3 have fronto-temporal dementia, 10 have dementia of multifactorial or undetermined cause, and 8 have mild cognitive impairment or memory loss. The next step of the study will be to evaluate the hearing in these patients and correlate it to imaging findings.

Aim 2

Five patients who were seen in the Cognitive Neurology clinic and diagnosed with Alzheimer's disease dementia met inclusion criteria. After selecting a personalized play list of familiar music, each subject listened to the music for at least a half an hour per day for one month. Once they had become accustomed to the familiar music therapy, we performed audiometric testing. Five subjects were tested. One subject did not meet inclusion criteria after audiotry testing. The results for this group include the following averages: pure tone average: 34dB (range 14-37.5dB); word recognition score 97.5% (range 92-100%); dichotic sentence 72.8% (range 0-100%); dichotic digits 98.75% (range 95-100%); Synthetic Sentence Identification-Ipsilateral Competing Message signal-to-noise ratio +20dB = 85% (range 70-100%), +10 dB = 77.5% (range 40-100%), 0dB 51.25% (range 10-100%); -10dB = 41.25% (range 0-100%); -20dB = 28.75% (range 0-70%).

The four patients who completed audiometric testing also underwent complete cognitive behavioral assessments (data not shown) as well as functional MRI testing with previously chosen familiar music played in 30 second epochs cycling between forward and reverse (unintelligible) for 10 minutes. The

differential brain activity in forward and reverse cycles was then quantified. A preliminary review shows that subjects with better central auditory function had increased global cortical activity, though we do not have enough patients enrolled yet to determine statistical significance. We are continuing to enroll patients with an overall study goal of 20 participants.

Aim 3

Based on newly published literature and with input from our neuropsychologist, we have developed a protocol that includes the following cognitive tests: Mini-mental state exam, D2 test of attention, Hopkins Verbal Learning Test (HVLT), Digit Span vs. Spatial Span, Hayling Senence Completion, Stroop Color Word test, Brief Visuospatial Memory Test, Trails A/B test. We have also included the Geriatric Depression Scale to assess psychosocial function before and after cochlear implantation. We have 3 patients enrolled in the study. As this is early in the funding period, none of the subjects have completed the 6- or 12-month post-operative testing, so we do not have any preliminary results to analyze. These will be available at the next progress report.

We are actively enrolling new patients in the study with a target of at least 15 per year.

Career development

The career development training portion of the grant is proceeding as scheduled with the awardee enrolled in formal coursework through a master of science in clinical investigation program and applying for NIH funding as well as working regularly with the study mentoring team.

American Otologic Society Research Grant Progress Report
Title: Mechanisms of synergistic anti-cancer drug ototoxicity
Principal Investigator: Henry Ou, M.D.

Cancer patients receive complex regimens of cytotoxic drugs. Certain chemotherapy drugs, such as cisplatin, are known to cause hair cell death in the inner ear and lead to hearing loss. There is known to be significant variability in the amount of hearing loss in patients treated with chemotherapy regimens. Traditionally, ototoxic injury has been studied primarily from the standpoint of individual drugs. We hypothesize that combinations of drugs can interact to cause hair cell death and that these synergistic effects may account for some of the variability. We have demonstrated that synergistic hair cell injury occurs in the zebrafish lateral line and are now investigating mechanisms of these interactions.

Using transgenic zebrafish, we can study intracellular levels of reactive oxygen species (ROS) and calcium. ROS is studied using transgenic zebrafish expressing cytoplasmic HyPER, a hydrogen peroxide sensor. Calcium is studied using transgenic zebrafish expressing calcium indicator GCaMP3 in various subcellular compartments. We can also use vital dyes such as tetramethyl-rhodamine ethyl ester (TMRE) to study mitochondrial membrane potential.

Our initial studies are focused on the cisplatin and doxorubicin combination. This is a common chemotherapy combination, and one that we previously found to have synergistic hair cell toxicity. Using the zebrafish lateral line for in vivo imaging, we have completed studies measuring HyPER and TMRE levels in living and dying cells treated with doxorubicin alone, cisplatin alone, or doxorubicin plus cisplatin.

For zebrafish treated with doxorubicin alone, in cells that survive, we first see a slow rise in TMRE levels (indicating increasing mitochondrial activity with resultant accumulation of TMRE). This is followed by a steady rise in HyPER levels (reflecting ROS level) that peaks at about a ratio (signal:baseline) of approximately 1.8. In cells that die from doxorubicin treatment, we see a larger increase in HyPER levels with wider fluctuation of TMRE levels, prior to a sudden drop TMRE as the mitochondrial potential is lost and the cells die.

When we add cisplatin to doxorubicin, we see much more fluctuation in mitochondrial membrane potential (as reflected by TMRE) and much more rapid cell death. Within 30 minutes of treatment, mean TMRE levels approximately double (signal:baseline ratio of 1.9) with cell death occurring shortly after. In contrast, for cells treated with doxorubicin alone, TMRE levels increase more modestly (ratio of 1.3) before declining. Interestingly, in contrast, HyPER levels increase at similar rates and to similar levels in both conditions (cisplatin plus doxorubicin versus cisplatin). These findings would suggest that the addition of cisplatin to doxorubicin leads to more fluctuation at the level of the mitochondrial membrane potential, but don't show a clear difference in the amount of reactive oxygen species that are generated. It is known in the zebrafish lateral line that mitochondrial membrane potential changes then lead to changes in intracellular calcium levels that appear to be associated with cell death. We are now investigating how these changes affect cytoplasmic and mitochondrial calcium levels by using the mito and cytoGCaMP3-expressing transgenic zebrafish and are in the process of analyzing this data. In addition, we will soon be examining the effects of different chemotherapy drugs on cisplatin uptake into hair cells using a fluorescent cisplatin analogue that we previously described.

American Otologic Society Reseach Grant Progress Report
Title: Optimized 3-Dimensionally Printed Tympanic Membrane Prosthesis
Principle Investigators: Aaron K. Remenschneider MD & Elliott D. Kozin MD

As a result of chronic ear infections, trauma and blast injury, millions of pediatric and adult patients suffer from tympanic membrane (eardrum) perforations. Patients with perforations experience pain, ear drainage and debilitating hearing loss, leading to challenges in the work environment, as well as loss of quality of life. The repair of the tympanic membrane (tympanoplasty) is a common surgical procedure that typically utilizes the patient's own tissue to repair the eardrum. Given intrinsic defects and variability in autologous tissue - poor wound healing, graft failure and re-perforation are possible surgical outcomes. In the absence of viable alternatives, autologous graft materials, such as temporalis fascia and cartilage, have been used for several decades without significant changes in patient outcomes.

Advances in the field of 3-dimensional (3D) printing allow for "real-time" tissue engineering and the creation of readily customizable complex structures using biologic and biocompatible materials on a micron scale. By altering the composition of input "ink" and the direction/layering of printed material, physical characteristics of 3D printed matrices can be purposefully modified. The aims of our 2015 AOS Research Grant are to 1) Design and fabricate a tympanic membrane (TM) using a 3D biologic printer and 2) Test the acoustic properties of 3D printed TM using an *in vitro* middle ear model. To date, we have successfully designed and fabricated biomimetic 3D printed TMs. We have undertaken an initial set of acoustic tests on grafts with varied design features.

With the support of a 2015-2016 American Otological Society Research grant, we utilized previously published scanning and transmission electron microscopy studies as the basis for TM graft design. TM graft scaffolds with either 8 or 16 circumferential and radial filament arrangements were fabricated by 3D printing of polydimethylsiloxane (PDMS), flex-polyactic acid (PLA) and polycaprolactone (PCL) materials followed by uniform infilling with a fibrin-collagen composite hydrogel. Fiber orientation and layering was based on the intrinsic structure of the human tympanic membrane's lamina propria based on electron microscopic images. Grafts were produced at physiologic size -- 10mm diameter and ~100mm thickness.

Digital opto-electronic holography (DOEH) and laser Doppler vibrometry (LDV) are commonly used assays to measure TM motion patterns in response to acoustic stimulation. DOEH and LDV were used to analyze 3D printed biomimetic TMs and controls (fresh cadaveric human TMs and cadaveric temporalis fascia). Similar to the human TM, biomimetic TM grafts exhibit simple surface motion patterns at lower frequencies (400Hz), with a limited number of displacement maxima. At higher frequencies (>1000Hz), their displacement patterns are highly organized with multiple areas of maximal displacement separated by regions of minimal displacement. By contrast, temporalis fascia exhibited asymmetric and less regular holographic patterns. Velocity across frequency sweeps (0.2-10kHz) measured by LDV demonstrated consistent results for biomimetic grafts, while velocity for human fascia varied greatly between specimens. TM composite grafts of different scaffold print materials and varied filament count (8 or 16) displayed minimal, but measurable differences in DOEH and LDV at tested frequencies.

(CONT.)

Tests of mechanical properties of 3D printed TM grafts were undertaken using dynamic mechanical analysis. Repeated stress was applied to grafts over time during which mechanical property measurement was performed. Results demonstrate that 3D printed TMs maintain shape following mechanical stress, unlike temporalis fascia, which loses up to 80% of its mechanical strength over the period of stress. Additionally, mechanical properties can be altered by changing the scaffold fiber count, where increased fiber count results in higher rigidity.

Our research over the past year demonstrated the feasibility of design and fabrication of biomimetic 3D printed tympanic membranes using biologic and biocompatible materials. Preliminary *in vitro* acoustic evaluation of 3D printed TM grafts show 'tunable' characteristics that can be controlled by print material and filamentary count. These data illustrate the feasibility of creating TM grafts with biomimetic acoustic properties that reflect sound induced motion patterns of the human TM. Ongoing research focuses on understanding the influence of filament size, orientation, and overall shape on the acoustic and mechanical properties of 3D printed biomimetic TM grafts. Over the next six months, we anticipate that our research will provide a better understanding of the normal mechanics of the human TM, as well as evaluation of the a 3D printed bioimietic TM as a potential graft for use during tympanoplasty.

Progress Report - AOS Research Fellowship Grant
Title: Neutrophil Contribution to Endotoxemia-Enhanced Cochlear Aminoglycoside Uptake
PI: Zachary D. Urdang, MS

Aminoglycosides remain essential to treat life-threatening infections despite their risk of permanent ototoxicity. Two recent mouse studies demonstrated that systemic inflammatory response syndrome (SIRS) elicited by endotoxemia (systemic lipopolysaccharide (LPS) treatment) increases the risk of permanent ototoxicity after aminoglycoside treatment. Furthermore, cochleae of endotoxemic mice take up more aminoglycosides compared to healthy control mice, which may contribute to the increased risk of ototoxicity during SIRS. In corroboration, a recent human study examining a cohort of neonatal patients in the intensive care unit, it was empirically demonstrated that clinical diagnosis of SIRS concurrent with aminoglycoside therapy increases the risk-ratio of failing a DPOAE hearing screening indicating further audiological workup for potential ototoxicity. This is clinically important as diagnosis with SIRS is a major indication for broad-spectrum antibiotic therapy with aminoglycosides to treat and/or rule-out suspected sepsis. Understanding how endotoxemia induced SIRS potentiates aminoglycoside ototoxicity will provide insight towards treatments to decrease the risk of ototoxicity in critically-ill patients. Furthermore, this understanding will add insight into blood-labyrinth barrier (BLB) physiology and how inflammatory states disrupt normal cochlear physiology.

Neutrophils are the first responders to LPS-mediated innate inflammatory stimuli mediated by the TLR4 receptor, and are essential in clearing infection. Neutrophils activated by TLR4 agonists and associated down-stream signaling cascades neutralize infections and clear necrotic debris from affected tissues; however, neutrophils also cause significant collateral host-tissue damage. The exit of activated neutrophils into tissue compartments is inherently damaging, causing neutrophil-mediated vascular injury (NMVI). In addition, the cytotoxic molecules released during inflammatory states damage the host's own cells and tissues.

We have hypothesized that during endotoxemia TLR4 activated neutrophils compromise blood-labyrinth barrier integrity enhancing cochlear uptake of aminoglycosides and subsequent ototoxicity. We are conducting experiments to 1) profile cochlear inflammatory cytokines and chemokines during endotoxemia, 2) count total cochlear neutrophil populations and characterize their micro-anatomical distribution during endotoxemia, and 3) characterize the paracellular permeability of the blood-labyrinth barrier during endotoxemia.

Pilot studies have demonstrated that endotoxemia enhances cochlear transcription and expression of pro-inflammatory RNA's and proteins. This is attenuated in C3H/HeJ mice which have an inactivating mutation in TLR4 making them hypo-responsive to endotoxemia; these mice also demonstrate attenuated cochlear aminoglycoside uptake during endotoxemia when compared to wild-type mice. In endotoxemic wild-type mice we have observed more neutrophils in cochlear lateral wall tissues when compared to healthy controls using Ly6G immuno-labeling with confocal microscopy. Complimentary flow cytometry studies will be performed to determine population level changes in cochlear neutrophil numbers during endotoxemia.

Using transmission electron microscopy and $LaCl_3$ as a vascular tracer we have demonstrated that lanthanum deposits are largely confined to the lumen of cochlear lateral wall vessels in healthy wild-type mice. In endotoxemic wild-type mice lanthanum deposits are also observed outside of the vessels suggesting systemic inflammation opens pathophysiological paracellular trafficking routes in the vessels comprising the BLB.

During 2015 we have bred a colony of GCSF-KO mice with Severe Congenital Neutropenia characterized by agranulocytopenia and a pronounced neutropenia. Furthermore, what granulocytes this mouse does have are under-developed and less effective in carrying out immune functions. We have also bred a colony of TLR4-KO mice which have a full set of immune cells but do not respond normally to inflammatory cues due to the absence of TLR4 innate immune signaling. Performing corollary aminoglycoside uptake experiments in these mutant mouse strains will isolate the function of TLR4 activity and associated neutrophil activity during endotoxemia enhanced cochlear aminoglycoside uptake.

Using these mutant mice, experiments are currently underway to profile systemic and cochlear inflammatory signaling pathways using multi-plex ELISA and qRT-PCR. To count neutrophils and other immune cells in cochlear tissues we are utilizing established immuno-labeling protocols coupled with confocal microscopy in addition to flow cytometry protocols to count whole cell populations. To determine how systemic inflammation perturbs the trafficking properties of aminoglycosides across the BLB into the cochlea we are utilizing a library of vascular tracers including $LaCl_3$ and NHS-biotin.

In summary, we have developed a diverse group of experimental protocols to study neutrophil biology in the murine cochlea during endotoxemia. Hypo-functional TLR4 C3H/HeJ mice have attenuated cochlear pro-inflammatory marker expression and aminoglycoside uptake during endotoxemia. Pilot studies in wildtype mice suggest that more neutrophils are present in endotoxemic cochlear tissues, and paracellular permeability is enhanced at the blood-labyrinth barrier during endotoxemia. We are currently carrying out similar experiments in GCSF-KO and TLR4-KO mice to determine the relative role(s) of neutrophils and TLR4 signaling on endotoxemia enhanced aminoglycoside uptake in mice.

AWARD OF MERIT RECIPIENTS (1949 - 2015)

1949	George M. Coates, MD
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	Theodore H. Bast, PhD
1952	Edmund P. Fowler, Sr., MD
1953	Julius Lempert, MD
1954	Stacy Guild, PhD
1957	Georg von Bekesy, PhD
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1960	Hallowell Davis, MD
1961	John R. Lindsay, MD
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1966	Gordon D. Hoople, MD
1967	Merle Lawrence, PhD
1968	Lawrence R. Boles, MD
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1977	Frank Lathrop, MD
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1992	James L. Sheehy, MD
1993	James A. Donaldson, MD
1994	Fred H. Linthicum, Jr., MD
1995	D. Thane Cody, MD
1996	F. Blair Simmons, MD
1997	Michael E. Glasscock, III, MD
1998	Michael M. Paparella, MD
1999	Mansfield F. W. Smith, MD
2000	Robert A. Jahrsdoerfer, MD
2001	Derald E. Brackmann, MD
2002	Gregory J. Matz, MD
2003	James B. Snow, Jr., MD
2004	Robert J. Ruben, MD
2005	David J. Lim, MD
2006	Herbert Silverstein, MD
2007	Richard A. Chole, MD, PhD
2008	Malcolm D. Graham, MD
2009	William H. Lippy, MD
2010	George Gates, MD
2011	Sam E. Kinney, MD
2012	Joseph B. Nadol, Jr., MD
2013	Bruce J. Gantz, MD
2014	Richard T. Miyamoto, MD
2015	Jeffrey P. Harris, MD, PhD

GUESTS OF HONOR (1974 - 2015)

1974	Harry Rosenwasser, MD
1975	John E. Bordley, MD
1976	Ben H. Senturia, MD
1977	Henry B. Perlman, MD
1978	Howard P. House, MD
1979	Hallowell Davis, MD
1980	Victor Goodhill, MD
1981	Harold Schuknecht, MD
1982	George E. Shambaugh, Jr., MD
1983	Wesley H. Bradley, MD
1984	Brown Farrior, MD
1985	Bruce Proctor, MD
1986	Merle Lawrence, PhD
1987	Robert M. Seyfarth, PhD
1988	G. Dekle Taylor, MD
1989	Eugene L. Derlacki, MD
1990	William F. House, MD
1991	Michael E. Glasscock III, MD
1992	William E. Hitselberger, MD
1992	D. Thane R. Cody, MD
1994	Cesar Fernandez, MD
1995	Richard R. Gacek, MD
1996	James L. Sheehy, MD
1997	Mansfield F.W. Smith, MD
1998	Robert A. Jahrsdoerfer, MD
1999	Barbara A. Bohne, Ph.D.
2000	Derald E. Brackmann, MD
2001	James B. Snow, Jr., MD
2002	David J. Lim, MD
2003	James F. Battey, Jr., MD, PhD
2004	Ugo Fisch, MD
2005	George A. Gates, MD
2006	Richard A. Chole, MD, PhD
2007	Fred H. Linthicum, Jr., MD
2008	H. Ric Harnsberger, MD
2009	Robert J. Ruben, MD
2010	Edwin Rubel, PhD
2011	Richard T. Miyamoto, MD
2012	Vicente Honrubia, MD
2013	Bruce J. Gantz, MD
2014	David A. Moffat, PhD
2015	Joseph B. Nadol Jr., MD

PAST SECRETARY - TREASURERS OF THE AMERICAN OTOLOGICAL SOCIETY

1868 - 1870	C. E. Ryder, MD
1870 - 1879	J. O. Green, MD
1879 - 1898	J. J. B. Vermyne, MD
1898 - 1907	Frederick L. Jack, MD
1907 - 1912	James F. McKernon, MD
1912 - 1917	John B. Rae, MD
1917 - 1919	George E. Shambaugh, MD
1919 - 1925	Thomas J. Harris, MD
1925 - 1927	D. Harold Walker, MD
1927 - 1940	Thomas J. Harris, MD
1940 - 1945	Isidore S. Friesner, MD
1945 - 1950	Gordon D. Hoople, MD
1950 - 1955	John R. Lindsay, MD
1955 - 1960	Lawrence R. Boies, MD
1960 - 1965	James A. Moore, MD
1965 - 1972	Wesley H. Bradley, MD
1972 - 1977	G. Dekle Taylor, MD
1977 - 1982	Cary N. Moon, Jr., MD
1982 - 1987	D. Thane Cody, MD
1987 - 1992	Robert I. Kohut, MD
1992 - 1997	Gregory J. Matz, MD
1997 - 2002	Horst R. Konrad, MD
2002 - 2007	Clough Shelton, MD
2007 - 2012	Paul R. Lambert, MD
2012 -	Steven A. Telian, MD

PAST PRESIDENTS OF THE AMERICAN OTOLOGICAL SOCIETY

1868 - 69	E. Williams, MD
1870 - 73	H.D. Noyes, MD
1874 - 76	D.B. St.John Roosa, MD
1877 - 78	C.J. Blake, MD
1879 - 80	A.H. Buck, MD
1881 - 83	J.O. Green, MD
1884 - 85	C.H. Burnett, MD
1886 - 89	J.S. Prout, MD
1890	O.D. Pomeroy, MD
1891 - 94	Gorham Bacon, MD
1895 - 99	Arthur Mathewson, MD
1900 - 02	H.G. Miller, MD
1903 - 05	B. Alex Randall, MD
1906 - 0 7	Emil Gruening, MD
1908	C.J. Kipp, MD
1909 - 10	Frederick L. Jack, MD
1911 - 12	Edward B. Dench, MD
1913 - 14	J.F.McKernon, MD
1915 - 16	C.W. Richardson, MD
1917	C.R. Holes, MD
1918	Norval H. Pierce, MD
1919	Ewing W. Day, MD
1920	Robert Lewis, MD
1921	W.P. Eagleton, MD
1922	H.S. Birket, MD
1923	G. Shambaugh, Sr., MD
1924	John B. Rae, MD
1925	E.A. Crockett, MD
1926	Thomas J. Harris, MD
1927	Arthur B. Duel, MD
1928	M.A. Goldstein, MD
1929	J.G. Wilson, MD
1930	S. Mac C. Smith, MD
1931	D.H. Waler, MD
1932	L.W. Dean, MD
1933	G.I. Tobey, Jr., MD
1934	John R. Page, MD
1935	Samuel J. Crowe, MD
1936	F.R. Packard, MD
1937	E.P. Fowler, MD
1938	Harris P. Mosher, MD
1939	Isidore Friesner, MD
1940	Horace Newhart, MD
1941	George M. Coates, MD
1942	L. M. Seydell, MD
1943 - 44	W.C. Bowers, MD
1945 - 46	Gordon Berry, MD
1947	William E. Grove, MD
1948	B. J. McMahon, MD
1949	Marvin F. Jones, MD
1950	Philip E. Meltzer, MD
1951	Kenneth M. Day, MD
1952	Gordon D. Hoople, MD
1953	A.C. Furstenberg, MD
1954	Frederick T. Hill, MD
1955	D.E.S. Wishart, MD
1956	William. J McNally, MD
1957	John R. Lindsay, MD
1958	Dean M. Lierle, MD
1959	Moses H. Lurie, MD
1960	Robert C. Martin, MD
1961	Henry L. Williams, MD
1962	Lawrence R. Boies, MD
1963	Joseph A. Sullivan, MD
1964	Theodore E. Walsh, MD
1965	Harry Rosenwasser, MD
1966	Howard P. House, MD
1967	James A. Moore, MD
1968	G. Shambaugh, Jr., MD
1969	Frank D. Lathrop, MD
1970	Francis L. Lederer, MD
1971	John E. Bordley, MD
1972	Walter P. Work, MD
1973	Ben H. Senturia, MD
1974	Wesley H. Bradley, MD
1975	Lester A. Brown, MD
1976	Victor Goodhill, MD
1977	Harold Schuknecht, MD
1978	Clair M. Kos, MD
1979	G. Dekle Taylor, MD
1980	Eugene Derlacki, MD
1981	Richard J. Bellucci, MD
1982	J. Brown Farrior, MD
1983	Jack V. Hough, MD
1984	Cary N. Moon, Jr., MD
1985	Francis A. Sooy, MD
1986	Brian F. McCabe, MD
1987	Harold G. Tabb, MD
1988	Richard R. Gacek, MD
1989	D. Thane Cody, MD
1990	H.A. Ted Bailey, Jr., MD
1991	William F. House, MD
1992	Michael Glasscock, III, MD
1993	Mansfield F.W. Smith, MD
1994	Robert I. Kohut, MD
1995	Robert A. Jahrsdoerfer, MD
1996	Derald E. Brackmann, MD
1997	Joseph C. Farmer, Jr., MD
1998	Charles M. Luetje, MD
1999	Gregory J. Matz, MD
2000	C. Gary Jackson, MD
2001	A. Julianna Gulya, MD
2002	Richard A. Chole, MD PhD
2003	Horst R. Konrad, MD
2004	Jeffrey P. Harris, MD, PhD
2005	Sam E. Kinney, MD
2006	John K. Niparko, MD
2007	Antonio De La Cruz, MD
2008	Clough Shelton, MD
2009	Joseph B. Nadol, Jr., MD
2010	Bruce J. Gantz, MD
2011	C. Phillip Daspit, MD
2012	Herman A. Jenkins, MD
2013	Paul R. Lambert, MD
2014	John W. House, MD
2015	Debara L. Tucci, MD, MS, MBA

NOTES

AMERICAN OTOLOGICAL SOCIETY
2015 - 2016 Membership Roster
Includes the 2016 Candidates inducted at the AOS 2016 Spring Meeting

ACTIVE MEMBERS

Oliver F. Adunka, MD (Active 2016)
Columbus, OH

Ronald G. Amedee, MD (Active 1995)
New Orleans, LA

Simon I. Angeli, MD (Active 2009)
Miami, FL

Patrick J. Antonelli, MD (Active 2001)
Gainesville, FL

Moises A. Arriaga, MD (Active 2002)
Metairie, LA

H. Alexander Arts, MD (Active 2001)
Ann Arbor, MI

Douglas D. Backous, MD (Active 2006)
Seattle, WA

Manohar Bance, MD (Active 2013)
Halifax, Nova Scotia Canada

David M. Barrs, MD (Active 1997)
Phoenix, AZ

Loren J. Bartels, MD (Active 1992)
Tampa, FL

Carol A. Bauer, MD (Active 2006)
Springfield, IL

Charles W. Beatty, MD (Active 1995)
Rochester, MN

James E. Benecke Jr., MD (Active 2006)
St. Louis, MO

Brian Blakley, MD (Active 1996)
Winnipeg, Manitoba Canada

Nikolas H. Blevins, MD (Active 2009)
Stanford, CA

Hilary A. Brodie, MD, PhD (Active 2001)
Sacramento, CA

Craig A. Buchman, MD (Active 2005)
St. Louis, MO

John P. Carey, MD (Active 2006)
Baltimore, MD

Stephen P. Cass, MD (Active 2000)
Aurora, CO

Sujana S. Chandrasekhar, MD (Active 2004)
New York, NY

Kay W. Chang, MD (Active 2014)
Stanford, CA

Douglas A. Chen, MD (Active 2008)
Pittsburgh, PA

Steven Wan Cheung, MD (Active 2006)
San Francisco, CA

Richard A. Chole, MD, PhD (Active 1984)
St. Louis, MO

Daniel Choo, MD (Active 2008)
Cincinnati, OH

Roberto A. Cueva, MD (Active 2005)
San Diego, CA

Charles C. Della Santina, MD (Active 2009)
Towson, MD

M. Jennifer Derebery, MD (Active 2002)
Los Angeles, CA

Hamid R. Djalilian, MD (Active 2015)
Orange, CA

Joni K. Doherty, MD, PhD (Active 2015)
Los Alamitos, CA

John L. Dornhoffer, MD (Active 2004)
Little Rock, AR

Karen Jo Doyle-Enright, MD, PhD (Active 2002)
Fenton, MI

Colin L. W. Driscoll, MD (Active 2012)
Rochester, MN

Larry G. Duckert, MD (Active 1988)
Seattle, WA

Thomas L. Eby, MD (Active 1995)
Jackson, MS

Hussam K. El-Kashlan, MD (Active 2006)
Ann Arbor, MI

Adrien A. Eshraghi, MD (Active 2013)
Weston, FL

Jay B. Farrior, III, MD (Active 1990)
Tampa, FL

Jose N. Fayad, MD (Active 2007)
Dhahran, Saudi Arabia

Joseph G. Feghali, MD (Active 2002)
Bronx, NY

Howard W. Francis, MD (Active 2003)
Baltimore, MD

David R. Friedland, MD, PhD (Active 2011)
Milwaukee, WI

Rick Friedman, MD, PhD (Active 2001)
Los Angeles, CA

Michael H. Fritsch, MD (Active 2003)
Indianapolis, IN

Bruce J. Gantz, MD (Active 1987)
Iowa City, IA

Gerard J. Gianoli, MD (Active 2007)
Covington, LA

Paul W. Gidley, MD (Active 2015)
Houston, TX

Joel A. Goebel, MD (Active 1995)
St. Louis, MO

J. Douglas Green Jr., MD (Active 2008)
Jacksonville, FL

John H. Greinwald Jr., MD (Active 2013)
Cincinnati, OH

Thomas J. Haberkamp, MD (Active 1997)
Cleveland, OH

Marlan R. Hansen, MD (Active 2009)
Iowa City, IA

George T. Hashisaki, MD (Active 2015)
Charlottesville, VA

David S. Haynes, MD (Active 2009)
Nashville, TN

Keiko Hirose, MD (Active 2010)
St. Louis, MO

Barry E. Hirsch, MD (Active 1996)
Pittsburgh, PA

Michael E. Hoffer, MD (Active 2003)
Miami, FL

Karl L. Horn, MD (Active 2001)
Santa Fe, NM

John W. House, MD (Active 1984)
Los Angeles, CA

Timothy E. Hullar, MD (Active 2013)
Portland, OR

Akira Ishiyama, MD (Active 2009)
Los Angeles, CA

Robert K. Jackler, MD (Active 1992)
Stanford, CA

Carol A. Jackson, MD (Active 1994)
Newport Beach, CA

Abraham Jacob, MD (Active 2014)
Tucson, AZ

Adrian James, MD (Active 2011)
Toronto, Canada Canada

Herman A. Jenkins, MD (Active 1987)
Aurora, CO

Timothy K. Jung, MD (Active 1990)
Riverside, CA

David M. Kaylie, MD (Active 2014)
Durham, NC

Bradley W. Kesser, MD (Active 2008)
Charlottesville, VA

Ana H. Kim, MD (Active 2016)
New York, NY

Hung Jeffrey Kim, MD (Active 2014)
Washington, DC

Harold H. Kim, MD (Active 2010)
Portland, OR

Richard D. Kopke, MD (Active 2005)
Oklahoma City, OK

Robert F. Labadie, MD, PhD (Active 2009)
Nashville, TN

Anil K. Lalwani, MD (Active 1999)
New York, NY

Paul R. Lambert, MD (Active 1995)
Charleston, SC

Daniel J. Lee, MD (Active 2016)
Brookline, MA

John P. Leonetti, MD (Active 1995)
Maywood, IL

Samuel C. Levine, MD (Active 1999)
Minneapolis, MN

Phillip D. Littlefield, MD (Active 2013)
Kaneohe, HI

Larry B. Lundy, MD (Active 2011)
Ponte Vedra Beach, FL

Lawrence R. Lustig, MD (Active 2006)
New York, NY

John D. Macias, MD (Active 2015)
Phoenix, AZ

Sam J. Marzo, MD (Active 2011)
Maywood, IL

Douglas E. Mattox, MD (Active 1992)
Atlanta, GA

John T. McElveen Jr., MD (Active 1997)
Raleigh, NC

Michael McGee, MD (Active 2002)
Oklahoma City, OK

Michael J. McKenna, MD (Active 1999)
Boston, MA

Brian J. McKinnon, MD (Active 2015)
Memphis, TN

Sean O. McMenomey, MD (Active 2009)
New York, NY

Cliff A. Megerian, MD (Active 2006)
Cleveland, OH

Alan G. Micco, MD (Active 2007)
Chicago, IL

Lloyd B. Minor, MD (Active 2001)
Stanford, CA

Gary F. Moore, MD (Active 2003)
Omaha, NE

William H. Moretz Jr., MD (Active 1999)
Augusta, GA

Terrence P. Murphy, MD (Active 2002)
Atlanta, GA

Brian A. Neff, MD (Active 2014)
Rochester, MN

Erik G. Nelson, MD (Active 2011)
Lake Forest, IL

John K. Niparko, MD (Active 1995)
Los Angeles, CA

John S. Oghalai, MD (Active 2009)
Stanford, CA

Robert C. O'Reilly, MD (Active 2009)
Wilmington, DE

Dennis G. Pappas Jr., MD (Active 2004)
Birmingham, AL

Blake C. Papsin, MD (Active 2005)
Toronto, Ontario, Canada

Steven M. Parnes, MD (Active 2002)
Albany, NY

Lorne S. Parnes, MD (Active 2000)
London, Ontario, Canada

Myles L. Pensak, MD (Active 1992)
Cincinnati, OH

Brian P. Perry, MD (Active 2015)
San Antonio, TX

Harold C. Pillsbury, MD (Active 1988)
Chapel Hill, NC

Dennis S. Poe, MD (Active 1995)
Boston, MA

G. Mark Pyle, MD (Active 2003)
Madison, WI

Steven D. Rauch, MD (Active 2004)
Watertown, MA

Miriam I. Redleaf, MD (Active 2013)
Chicago, IL

J. Thomas Roland Jr., MD (Active 2005)
New York, NY

Seth Rosenberg, MD (Active 2001)
Sarasota, FL

Allan M. Rubin, MD, PhD (Active 1997)
Perrysburg, OH

Jay T. Rubinstein, MD, PhD (Active 2002)
Seattle, WA

Michael J. Ruckenstein, MD (Active 2003)
Philadelphia, PA

Leonard P. Rybak, MD, PhD (Active 1989)
Springfield, IL

Robert T. Sataloff, MD (Active 1990)
Philadelphia, PA

James E. Saunders, MD (Active 2008)
Lebanon, NH

Michael D. Seidman, MD (Active 2001)
West Bloomfield, MI

Samuel H. Selesnick, MD (Active 1999)
New York, NY

William H. Slattery III, MD (Active 2014)
Los Angeles, CA

Richard J. H. Smith, MD (Active 2012)
Iowa City, IA

Eric E. Smouha, MD (Active 2004)
New York, NY

Hinrich Staecker, MD, PhD (Active 2013)
Kansas City, KS

Konstantina M. Stankovic, MD, PhD (Active 2015)
Boston, MA

Steven A. Telian, MD (Active 1997)
Ann Arbor, MI

Fred F. Telischi, MD (Active 2002)
Miami, FL

Norman Wendell Todd Jr., MD (Active 1996)
Atlanta, GA

Debara L. Tucci, MD (Active 2000)
Durham, NC

Jeffrey T. Vrabec, MD (Active 2004)
Houston, TX

P. Ashley Wackym, MD (Active 1997)
Portland, OR

George J. Wanna, MD (Active 2015)
Nashville, TN

Jack J. Wazen, MD (Active 1993)
Sarasota, FL

Peter C. Weber, MD, MBA (Active 2002)
Boston, MA

D. Bradley Welling, MD, PhD (Active 1998)
Boston, MA

Stephen J. Wetmore, MD (Active 2001)
Morgantown, WV

Eric P. Wilkinson, MD (Active 2014)
Los Angeles, CA

David F. Wilson, MD (Active 1992)
Portland, OR

Nancy M. Young, MD (Active 2007)
Chicago, IL

SENIOR MEMBERS

Edward Applebaum, MD (Senior 1985)
Chicago, IL

Thomas J. Balkany, MD (Senior 1991)
Miami, FL

Derald E. Brackmann, MD (Senior 1979)
Los Angeles, CA

Margaretha L. Casselbrant, MD, PhD (Senior 2001)
Pittsburgh, PA

Jack D. Clemis, MD (Senior 1976)
Wilmette, IL

Joseph R. DiBartolomeo, MD (Senior)
Santa Barbara, CA

John R.E. Dickins, MD (Senior 1991)
Little Rock, AR

Robert A. Dobie, MD (Senior 1985)
San Antonio, TX

John R. Emmett, MD (Senior 1990)
Memphis, TN

George W. Facer, MD (Senior 1994)
Bonita Springs, FL

L. Gale Gardner, Jr., MD (Senior 1983)
Shreveport, LA

Michael E. Glasscock III, MD (Senior 1973)
Austin, TX

Robert A. Goldenberg, MD (Senior 1989)
Dayton, OH

Paul E. Hammerschlag, MD (Active 2001)
New York, NY

Jeffrey P. Harris, MD, PhD (Active 1988)
San Diego, CA

Ronald A. Hoffman, MD (Senior 1992)
New York, NY

Athanasios Katsarkas, MD (Senior 1991)
Montreal, Quebec, Canada

Sam E. Kinney, MD (Senior 1981)
Moreland Hills, OH

Horst R. Konrad, MD (Senior 1991)
Springfield, IL

Charles M. Luetje, MD (Senior 1991)
Olathe, KS

Charles A. Mangham Jr., MD (Senior 1987)
Hailey, ID

Gregory J. Matz, MD (Senior 1979)
Chicago, IL

Richard T. Miyamoto, MD (Senior 1987)
Indianapolis, IN

Edwin M. Monsell, MD, PhD (Active 1995)
Southfield, MI

Joseph B. Nadol Jr., MD (Senior 1988)
Boston, MA

Julian M. Nedzelski, MD (Senior 1987)
Toronto, Ontario, Canada

J. Gail Neely, MD (Senior 1985)
St. Louis, MO

Michael M. Paparella, MD (Senior 1968)
Minneapolis, MN

Simon C. Parisier, MD (Senior 1982)
New York, NY

Peter S. Roland, MD (Active 1992)
Eden, UT

Max L. Ronis, MD (Senior 1972)
Philadelphia, PA

Richard M. Rosenfeld, MD, MPH (Senior 2004)
Brooklyn, NY

Robert J. Ruben, MD (Senior 1974)
Bronx, NY

Clarence T. Sasaki, MD (Senior 1992)
New Haven, CT

Mitchell K. Schwaber, MD (Active 1993)
Nashville, TN

Clough Shelton, MD (Senior 1995)
Salt Lake City, UT

Herbert Silverstein, MD (Senior 1973)
Sarasota, FL

Aristides Sismanis, MD (Senior 1993)
Richmond, VA

Robert J. Wolfson, MD (Senior 1971)
Philadelphia, PA

EMERITUS MEMBERS

Warren Y. Adkins, MD (Emeritus 1987)
Mt. Pleasant, SC

Kedar Adour, MD (Emeritus 1988)
San Francisco, CA

Professor P. W. Alberti, MD (Emeritus 1982)
Toronto, Ontario, Canada

Bobby R. Alford, MD (Emeritus 1970)
Houston, TX

Sean R. Althaus, MD (Emeritus 1987)
Georgetown, TX

Beverly Armstrong, MD (Emeritus 1960)
Charlotte, NC

H.A. Ted Bailey, Jr., MD (Emeritus 1969)
Little Rock, AR

Charles D. Bluestone, MD (Senior 1977)
Pittsburgh, PA

B. Hill Britton, MD (Emeritus 1978)
San Antonio, TX

Seymour J. Brockman, MD (Emeritus 1964)
Beverly Hills, CA

Richard A. Buckingham, MD (Emeritus 1969)
Wilmette, IL

Rinaldo F. Canalis, MD (Emeritus 1991)
Santa Monica, CA

Robert W. Cantrell, MD (Emeritus 1979)
Charlottesville, VA

Noel L. Cohen, MD (Emeritus 1985)
New York, NY

Newton J. Coker, MD (Emeritus 1991)
Santa Fe, NM

James M. Cole, MD (Emeritus 1966)
Danville, PA

C. Phillip Daspit, MD (Emeritus 1995)
Paradise Valley, AZ

James A. Donaldson, MD (Emeritus 1974)
Richmond, WA

Arndt J. Duvall III, MD (Emeritus 1971)
Minneapolis, MN

Abraham Eviatar, MD (Emeritus 1981)
Scarsdale, NY

John M. Fredrickson, MD (Emeritus 1978)
Albuquerque, NM

Richard R. Gacek, MD (Emeritus 1969)
Worcester, MA

George A. Gates, MD (Emeritus 1987)
Boerne, TX

Richard L. Goode, MD (Emeritus 1990)
Stanford, CA

Malcolm D. Graham, MD (Emeritus 1979)
Atlanta, GA

A. Julianna Gulya, MD (Emeritus 1991)
Locust Grove, VA

Lee A. Harker, MD (Emeritus 1987)
Omaha, NE

Cecil W.J. Hart, MD (Emeritus 1992)
Palm Springs, CA

David A. Hilding, MD (Emeritus 1972)
Salt Lake City, UT

James J. Holt, MD, MS (Active 2009)
Marshfield, WI

C. Gary Jackson, MD (Emeritus 1990)
Mt Pleasant, SC

Donald B. Kamerer, MD (Emeritus 1988)
Pittsburgh, PA

Nelson Y.S. Kiang, PhD (Emeritus 1969)
Boston, MA

Arvind Kumar, MD (Emeritus 1993)
Hinsdale, IL

K. J. Lee, MD (Emeritus 1997)
Guilford, CT

S. George Lesinski, MD (Emeritus 1993)
Cincinnati, OH

Roger C. Lindeman, MD (Emeritus 1987)
Mercer Island, WA

Fred H. Linthicum Jr., MD (Emeritus 1967)
Los Angeles, CA

William H. Lippy, MD (Senior 1988)
Warren, OH

Ward B. Litton, MD (Emeritus 1969)
Bonita Springs, FL

Anthony J. Maniglia, MD (Emeritus 1989)
Cleveland, OH

William L. Meyerhoff, MD (Emeritus 1981)
Dallas, TX

Eugene N. Myers, MD (Emeritus 1974)
Pittsburgh, PA

Ralph A. Nelson, MD (Emeritus 1995)
Manchester, WA

Dennis Pappas, MD (Emeritus 1985)
Birmingham, AL

James L. Parkin, MD (Emeritus 1986)
Salt Lake City, UT

Leonard R. Proctor, MD (Emeritus 1989)
Bel Aire, MD

J. H. Thomas Rambo, MD (Emeritus 1958)
New York, NY

Wallace Rubin, MD (Emeritus 1967)
Metairie, LA

William H. Saunders, MD (Emeritus 1972)
Columbus, OH

Arnold G. Schuring, MD (Emeritus 1990)
Warren, OH

George T. Singleton, MD (Emeritus 1972)
Gainesville, FL

J. Brydon Smith, MD (Emeritus 1958)
Willowdale ON, Canada

James B. Snow Jr., MD (Emeritus 1973)
West Grove, PA

Gershon Jerry Spector, MD (Emeritus 1979)
St. Louis, MO

G. Dekle Taylor, MD (Emeritus 1965)
Jacksonville, FL

Paul H. Ward, MD (Emeritus 1972)
Los Angeles, CA

Roger E. Wehrs, MD (Emeritus 1975)
Tulsa, OK

Richard J. Wiet, MD (Senior 1987)
Sawyer, MI

Eiji Yanagisawa, MD (Emeritus 1996)
New Haven, CT

ASSOCIATE MEMBERS

Ricardo F. Bento, MD, PhD (Associate 2001)
Sao Paulo, Brasil

Judy Dubno, PhD (Associate 2014)
Charleston, SC

Andrew J. Griffith, MD, PhD (Associate 2015)
Bethesda, MD

Paul R. Kileny, PhD (Associate 1979)
Ann Arbor, MI

Brenda Lonsbury-Martin, PhD (Associate 1978)
Loma Linda, CA

Carlos A. Oliveira, MD, PhD (Associate 1992)
Brasília-DF, Brasil

John J. Rosowski, PhD (Associate 1989)
Boston, MA

Alec N. Salt, PhD (Associate 1972)
St. Louis, MO

Neil T. Shepard, PhD (Associate 1973)
Rochester, MN

Daniel Tollin, PhD (Associate 2016)
Aurora, CO

SENIOR ASSOCIATE MEMBERS

Barbara A. Bohne, PhD (Senior Associate 1979)
St. Louis, MO

Makoto Igarashi, MD (Senior Associate 1973)
Tokyo, Japan

Salvatore J. Iurato, MD (Senior Associate 1994)
Bari, Italy

Lars-Goran Johnsson, MD (Senior Associate 1979)
Finland

Steven K. Juhn, MD (Senior Associate 1980)
Minneapolis, MN

Robert S. Kimura, PhD (Senior Associate 1978)
Middleton, WI

David J. Lim, MD (Senior Associate 1973)
Los Angeles, CA

Michael Merzenich, PhD (Senior Associate 1986)
San Francisco, CA

Josef M. Miller, PhD (Senior Associate 1979)
Ann Arbor, MI

Tetsuo Morizono, MD DMS (Senior Associate 1985)
Nishi-Ku, Fukuoka City, Japan

Rodney Perkins, MD (Senior Associate 2013)
Woodside, CA

Edwin W. Rubel, PhD (Senior Associate 1986)
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Jochen Schacht, PhD (Senior Associate 1992)
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HONORARY MEMBERS

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Edgar L. Chiossone, MD (Honorary)
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Graeme M. Clark, PhD (Honorary)
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Ugo Fisch, MD (Honorary)
Erlenbach, Switzerland

Jerome C. Goldstein, MD (Honorary)
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L.B.W. Jongkees (Honorary)
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Yasuya Nomura (Honorary)
Tokyo, Japan

Michel Portmann (Honorary)
Bordeaux, France

Naoaki Yanagihara, MD (Honorary)
Matsyama, Japan

IN MEMORIUM
(in alphabetical order)

The AOS 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.

Francis I. Catlin, MD - member since 1975

Maureen T. Hannley, PhD– member since 1995

Raul Hinojosa, MD - member since 1989

Christopher J. Linstrom, MD - member since 2003

We need your help, do you know this member?

The AOS Administrative Office has lost contact with the following members:

Robert A. Butler, PhD
Anthony Maniglia, MD
J. Bydon Smith, MD

If you know of the whereabouts of any of the above members, please contact the AOS Administrative office at 217-638-0801 or by email:
administrator@americanotologicalsociety.org