PROGRAM and ABSTRACTS

of the

One Hundred Fifty Sixth Annual Meeting

AMERICAN OTOLOGICAL SOCIETY, INC.

May 5-7, 2023

Hynes Convention Center

Sheraton Boston

Boston, MA

Table of Contents

(2023 AOS Program Book)

OFFICERS
JULY 1, 2022 - JUNE 30, 2023

PRESIDENT
Lawrence R. Lustig, M.D.
Columbia University - New York, NY

SECRETARY – TREASURER and PRESIDENT – ELECT
Sujana S. Chandrasekhar, M.D.
New York Otology - New York, NY

EDUCATION DIRECTOR
Nancy M. Young, M.D.
Lurie Children's Hospital of Chicago - Chicago, IL

SECRETARY – TREASURER ELECT
David R. Friedland, M.D., Ph.D.
Medical College of Wisconsin - Milwaukee, WI

IMMEDIATE PAST PRESIDENT
Marlan R. Hansen, M.D.
University of Iowa - Iowa City, IA

PAST PRESIDENT
Patrick J. Antonelli, M.D.
University of Florida - Gainesville, FL

COUNCIL MEMBERS
William H. Slattery, M.D.
House Ear Clinic - Los Angeles, CA

Nikolas H. Blevins, M.D.
Stanford University - Stanford, CA

American Otological Society Mission Statement

Purpose
The American Otological Society, created in 1868, is dedicated to fostering a dialogue 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, physicians-in-training, audiologists and researchers in the fields of otology and neurotology. Educational activities are also open to 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 *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 focused on otologic and neurotologic evidence based science, clinical standards of care, effects on communication, and other topics to the specialty.

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.

Resolution on Diversity of Meeting Presenters and Participation for the American Otological Society and the American Neurotology Society

- Whereas, the councils of the American Neurotology Society and American Otological Society desire to promote inclusivity within the membership of both organizations.

- Whereas it is recognized that diverse leadership and diversity of presenters allows for cross pollination of knowledge, perspective and experiences enabling a stronger and more robust educational experience for our members.

- Whereas the Councils of the organizations recognize the importance of acknowledging diversity among our patients, our trainees and our colleagues.

- Whereas, the purpose of the education programs of both organizations is to disseminate information designed to improve physician knowledge, patient care and outcomes, and advance the respective specialties.

- Whereas, valuable scientific contributions to Otology and Neurotology by colleagues (regardless of gender, race, or other attributes) should be presented at the society's respective meetings.

- Be it resolved that the Scientific Program Committees of the American Neurotology Society and American Otological Society will select speakers and panel members endeavoring to balance educational goals while promoting the diversity of our respective Societies' memberships and educational offerings.

- Be it resolved the Executive Councils of the ANS and AOS will select participation at all levels of the organizations endeavoring to reflect diversity of our respective Societies' memberships.

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation

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

AMA PRA Category 1 Credits™

The American College of Surgeons designates this live activity for a maximum of 7.25 *AMA PRA Category 1 Credits™.* Physicians should claim only the credit commensurate with the extent of their participation in the activity.

ACS AMERICAN COLLEGE OF SURGEONS

ACCME ACCREDITED WITH COMMENDATION

AMERICAN COLLEGE OF SURGEONS
DIVISION OF EDUCATION

ABOHNS MOC Recognition Statement

Successful completion of this CME activity, which includes participation in the evaluation component, enables the participant to meet the expectations of the American Board of Otolaryngology's Maintenance of Certification (MOC) program. It is the American College of Surgeon's (the CME provider) responsibility to submit participant completion information to ACCME for the purpose of recognizing participation.

ABOHNS MOC Participant Data Privacy Information

If you are a Diplomate of the American Board of Otolaryngology-Head and Neck Surgery (ABOHNS) and would like to claim CME for MOC points for this educational activity (optional), you will be asked to provide personal information (Diplomate ID, first and last name, and month and day of birth) as part of the registration and/or evaluation process. The American College of Surgeons will only use this information to transmit your CME for MOC points to the ACCME on your behalf, upon successful completion of the activity.

Program Objectives Educational Activity Details

What are the practice or patient care problems being addressed by this activity?

- Application of gene therapy and precision medicine to treat deafness
- How artificial intelligence will be applied to Otology in the future
- How otologic disparities of care can occur at varying ages in the United States

How will this activity improve the learners' competence (knowledge in action), performance (skill set) and/or patient outcomes (impact of care)?

Competence:

- Increased knowledge of future gene therapy advances for genetic deafness
- Increased knowledge of where otologic disparities of care exist
- Increased understanding of how artificial intelligence will impact current and future otologic health care

Performance:

- Knowledge will increase ability of providers to educate patients about the benefit of treating sensorineural hearing loss, thereby improving compliance with recommended interventions.
- Increase provider use of appropriate genetic testing and other evaluations for sensorineural hearing loss etiology.

Patient Outcomes:

- Restoration of hearing in patient with some forms of genetic deafness
- Improved hearing results in patients with intracochlear schwannomas
- Improved patient care delivery with the use of artificial intelligence.

State the learning objectives for this activity:

1. Recognize how gene therapy approaches will be used to treat genetic deafness
2. Describe how artificial intelligence will impact the delivery of otologic health care
3. Recognize how intralabyrinthine schwannoma resection can be complemented by cochlear implantation
4. Identify areas of disparity in the delivery of otologic care

Disclosure Information

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity (planners and speakers/authors/discussants/moderators) has disclosed all financial relationships with any commercial interest (termed by the ACCME as "ineligible companies", defined below) held in the last 24 months (see below for definitions). Please note that first authors were required to collect and submit disclosure information on behalf all other authors/contributors, if applicable.

Ineligible Company: The ACCME defines an "ineligible company" as any entity producing, marketing, re-selling, or distributing health care goods or services used on or consumed by patients. Providers of clinical services directly to patients are NOT included in this definition.
Financial Relationships: Relationships in which the individual benefits by receiving a salary, royalty, intellectual property rights, consulting fee, honoraria, ownership interest (e.g., stocks, stock options or other ownership interest, excluding diversified mutual funds), or other financial benefit. Financial benefits are usually associated with roles such as employment, management position, independent contractor (including contracted research), consulting, speaking and teaching, membership on advisory committees or review panels, board membership, and other activities from which remuneration is received, or expected. ACCME considers relationships of the person involved in the CME activity to include financial relationships of a spouse or partner.
Conflict of Interest: Circumstances create a conflict of interest when an individual has an opportunity to affect CME content about products or services of a ineligible company with which he/she has a financial relationship.

The ACCME also requires that ACS manage any reported conflict and eliminate the potential for bias during the educational activity. Any conflicts noted below have been managed to our satisfaction. The disclosure information is intended to identify any commercial relationships and allow learners to form their own judgments. However, if you perceive a bias during the educational activity, please report it on the evaluation.

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity (planners and speakers/authors/discussants/moderators) has disclosed all financial relationships with any ineligible company held in the last 24 months. Please note that first authors were required to collect and submit disclosure information on behalf all other authors/contributors, if applicable.

Please see pages 115-117 for the complete disclosure list.

THE AMERICAN OTOLOGICAL SOCIETY WOULD LIKE TO THANK THE FOLLOWING MEMBERS FOR THEIR CONTRIBUTION TO THE 2023 AOS SCIENTIFIC PROGRAM

Lawrence R. Lustig, MD, AOS President, Chair
Nancy M. Young, AOS Education Director

(in alphabetical order)
Marc L. Bennett, MD
Matthew L. Bush, MD, PhD
Wade W. Chien, MD
Hamid R. Djalilian MD
Ronna Hertzano MD, PhD
Brandon Isaacson, MD
Akira Ishiyama, MD
David M. Kaylie, MD
Ana H. Kim, MD
J. Walter Kutz, MD
Philip D. Littlefield, MD
Mia E. Miller, MD
Alejandro Rivas, MD
Erica Woodson, MD
George B. Wanna, MD

POSTER JUDGES

Wade W. Chien, MD
Ronna Hertzano MD, PhD
Philip D. Littlefield, MD
George B. Wanna, MD

The Abstract deadline for the AOS 157th Annual meeting is Saturday, October 15, 2023.
Abstract Instructions and the submission form will be available on the AOS website September 1st.
Website - www.americanotologicalsociety.org

All primary and contributing authors are required to complete a disclosure/conflict of interest statement and abide by the publication/copyright statements 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 Journals of *OTOLOGY & NEUROTOLOGY* or *ONO (O&N OPEN)* do not accept paper manuscripts. Manuscripts are reviewed prior to the Annual meeting for conflict of interest 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.

Publication Statement: The material in this abstract must not have been published or presented previously at another national or international meeting and may not be under consideration for presentation at another national or international meeting including another COSM society. The study detailed in this abstract *may be submitted* for consideration for publication to *Otology & Neurotology* at any time after this call for papers begins. However, should the abstract be selected as a poster or an oral presentation, publication of the manuscript will be delayed until after the 2023 COSM meeting takes place. If this policy is violated, the AOS will prohibit presentation at the COSM meeting and the manuscript will be withdrawn from publication in print or online. The penalty for any duplicate presentation/publication is prohibition of the author from presenting at a COSM society meeting for up to three years. **Duplicate submission to ANS or another participating COSM Society will disqualify your abstract immediately.**

For Society business, please forward all inquiries to:

Kristen Bordignon, Executive Administrator
AOS Administrative Office
5830 1st St. N. Petersburg, FL 33703
Ph: 217-638-0801
Fax: 727-800-9428
Email: administrator@americanotologicalsociety.org
Website: www.americanotologicalsociety.org

Ashley Eikenberry
AOS/ANS Administrative Assistant
Ph: 217-381-4668
Email: administrator@americanotologicalsociety.org

AMERICAN OTOLOGICAL SOCIETY
156th Annual Meeting
PRELIMINARY PROGRAM
May 6-7, 2023
Boston, MA
AOS Posters will be displayed on Friday & Saturday, May 5-6, 2023

SATURDAY, MAY 6, 2023

1:00 BUSINESS MEETING *(New member introduction)*
(Open to members and nonmembers)

1:25 SCIENTIFIC PROGRAM
(*Open to registered Members and Non-members – Badge required for admittance*)

1:25 WELCOME & OPENING REMARKS BY THE PRESIDENT
Lawrence R. Lustig, MD

1:27 PRESIDENTIAL CITATIONS
Robert K. Jackler, MD
Samuel H. Selesnick, MD
Hinrich Staecker, MD, PhD
Ana H. Kim, MD
Paul A. Fuchs, PhD

1:37 INTRODUCTION OF GUEST OF HONOR
Lawrence R. Lustig, MD

1:39 GUEST OF HONOR LECTURE
"Precision Medicine & Gene Therapy for Deafness"
Prof. Karen B. Avraham
Dean, Faculty of Medicine
Tel Aviv University
Tel Aviv, Israel

2:24 INTRODUCTION OF ABSTRACTS - BASIC AND TRANSLATIONAL SCIENCE
Ronna Hertzano, MD, PhD, *Moderator*

2:25 Microneedle Mediated Delivery of siRNA-Lipofectamine is Safe for Inner Ear Gene Therapy
Sharon J. Feng, BA, BS
Aykut Aksit, PhD
Daniella Hébert, BE
Stephen Leong, BA
Elizabeth S. Olson, PhD
Jeffrey W. Kysar, PhD
Anil K. Lalwani, MD

2:32 Microbiome of the Ear: A Descriptive Comparison of the External and Middle Ear in the Healthy and Diseased States
Samantha Frank, MD
Ruwaa Samarrai, MD
Nehal Navali, BS
Dong-binh Tran PhD
George M. Weinstock, PhD

Daniel S. Roberts, MD, PhD

2:39 Topical Stimulation Induces Progenitor Cell Proliferation in the Tympanic Membrane
Sonia M. Scaria, PhD
Stacey M. Frumm, MD, PhD
Sarah A. Easow
Aaron D. Tward, MD, PhD

2:46 Cost-effectiveness of DW-MRI versus Second Look Surgery in Treating Cholesteatoma: A Modeling Study
Daniel D. Bu, MPP, MBA
Zachary G. Schwam, MD
Enrique Perez, MD
Maura K. Cosetti, MD

2:53 Conductive Hearing Loss Associates with Dementia, Neuropsychiatric, and Incident Adverse Life Events and Middle Ear Reconstruction Improves Outcomes – A Multi-National Database Study
Zachary D. Urdang, MD PhD
Amiti Jain, BS
Marwin Li, BS
Thomas L. Haupt, BS
Thomas O. Wilcox, MD
Rebecca C. Chiffer, MD
Richard K. Gurgel, MD

3:00 DISCUSSION

3:05 BREAK WITH EXHIBITORS

3:30 INTRODUCTION OF ABSTRACTS - HEARING LOSS
Nancy M. Young, MD. Moderator

3:31 Influence of Cognitive Performance, Sociodemographic Factors, and Pure-Tone Audiometry on Speech Discrimination: A Prospective Population-Based Study of 1,061 Older Adults
John P. Marinelli, MD
Nicholas S. Reed, AuD
Christine M. Lohse, MS
Wanda L. Fussell, MD
Ronald C. Petersen, MD, PhD
Maria Vassilaki, MD, PhD
Matthew L. Carlson, MD

3:38 Military and Non-Military TBI Associations with Hearing Loss and Self-Reported Hearing Difficulty among Active-Duty Service Members and Veterans
Charlotte K. Hughes, MD, MPH
Samrita Thapa, MPH
Sarah M. Theodoroff, PhD
Kathleen F. Carlson, PhD, MPH
James D. Schultz, AuD
Leslie D. Grush, AuD
Kelly M. Reavis, PhD, MPH

3:45 **Hearing Loss and Frailty Among Older Adults: The Atherosclerosis Risk in Communities Study (ARIC)**
Sahar Assi, MD
Emmanuel Garcia-Morales, PhD
B. Gwen Windham, MD
Frank Lin, MD, PhD
Karen Bandeen-Roche, PhD
Priya Palta, PhD
Jennifer A. Deal, PhD
Nicholas S. Reed, AuD
Pablo Martinez-Amezcua, MD, PhD

3:52 **RESIDENT RESEARCH TRAVEL AWARD**
Metformin Protects Male but not Female Mice Against Noise-Induced Hearing Loss
Catherine L. Kennedy, MD
Benjamin Shuster
Reza Amanipour, PhD
Beatrice Milon, PhD
Priya Patel, MD
Ran Elkon, PhD
Ronna Hertzano, MD, PhD

3:59 **DISCUSSION**

4:04 **INTRODUCTION OF PANEL**
Lawrence R. Lustig, MD

4:05 **PANEL**
"The Future is Now: Innovative AI in Otology"
David R. Friedland, MD, PhD , Moderator
Debara L. Tucci, MD, MS, MBA
Francis "Pete" X. Creighton, MD

5:05 **CLOSING REMARKS/ADJOURNMENT**
Lawrence R. Lustig, MD

5:15 **AOS MEMBER PHOTOGRAPH**

6:30 **AOS PRESIDENTS RECEPTION AND DINNER/DANCE**

SUNDAY, MAY 7, 2023

7:00 **BUSINESS MEETING** *(Treasurer & Committee Reports)*
(Open to members and nonmembers)

7:30 **SCIENTIFIC PROGRAM**
(Open to registered Members and Non-members – Badge required for admittance)

7:30 **WELCOME & OPENING REMARKS BY THE PRESIDENT**
Lawrence R. Lustig, MD

7:32 **INTRODUCTION OF ABSTRACTS - COCHLEAR IMPLANTS PART I**
Wade Chien, MD, Moderator

7:33 Do Elderly Patients Benefit from Expanded Centers for Medicare & Medicaid Services (CMS) Criteria for Cochlear Implantation in Bilateral Hearing Loss?
Sarek A. Shen, MD
Nicholas S. Andresen, MD
Stephen P. Bowditch, AuD
Daniel Q. Sun, MD

7:40 Post-Cochlear Implant Computer-based Auditory Training Yields Durable Improvements in Cochlear Implant Quality of Life
James R. Dornhoffer, MD
Christian Shannon, BS
Kara C. Schvartz-Leyzac, AuD, PhD
Judy R. Dubno, PhD
Theodore R. McRackan, MD, MSCR

7:47 Combining Intraoperative Electrocochleography with Robotics-Assisted Electrode Array Insertion
Rustin G. Kashani, MD
Armine Kocharyan, MD
Douglas M. Bennion, MD, PhD
Camille C. Dunn, PhD
Alexander D. Claussen, MD
Bruce J. Gantz, MD
Marlan R. Hansen, MD

7:54 RESIDENT RESEARCH TRAVEL AWARD
Expression of Brain-Derived Neurotrophic Factor in Human Spiral Ganglia Neurons following Cochlear Implantation
Emily C. Wong, MD
Ivan A. Lopez, PhD
Akira Ishiyama, MD
Gail Ishiyama, MD

8:01 The 3D Structure of Cochlear Incomplete Partition Type-II Malformation from Digitised Human Histopathological Specimens: Implications for Cochlear Implantation
Chloe E. Swords, MBBS, MRCS
Alexander R. Geerardyn, MD
Mengyu Zhu, MS
Peizhe Wu, MD
Julie G. Arenberg, PhD, CCC-A
Manohar L. Bance, MBChB, MSc
Alicia M. Quesnel MD

8:08 Impact of Stimulus Frequency on Azimuthal Sound Source Localization in Patients with Single-sided Deafness using Cochlear Implants
Chioma Anidi BA
Gerilyn Jones, AuD
Madison Epperson, MD
Nadine Ibrahim MD
Renee M. Banakis Hartl, MD, AuD

8:15 DISCUSSION

8:20 INTRODUCTION OF SAUMIL N. MERCHANT MEMORIAL LECTURE
Lawrence R. Lustig, MD

8:22 SAUMIL N. MERCHANT MEMORIAL LECTURE
Intralabyrinthine Schwannomas and Hearing Rehabilitation with Cochlear Implants - Lessons Learned About Cochlear Implant and Inner Ear Function"
Prof. Stefan K. Plontke
Chairman, Dept. of Otorhinolaryngology, Head and Neck Surgery
University Medicine Halle (Saale), Germany

9:07 INTRODUCTION OF ABSTRACTS – COCHLEAR IMPLANTS PART II
Ana H. Kim, MD, Moderator

9:08 Discrepancies Between Expected and Actual Cochlear Implant-Related Functional Outcomes
Joshua E. Fabie, MD
Christian Shannon, BS
Kara Leyzac, AuD, PhD
Judy R. Dubno, PhD
Theodore R. McRackan, MD, MSCR

9:15 Investigating Deferral Rates in Cochlear Implantation: How Often Do Candidates Defer and Why?
Vivian F. Kaul, MD
Bryce P.G. Dzubara, BS
Oliver F. Adunka, MD, MBA
Yin Ren, MD, PhD

9:22 Comparison of Speech Recognition and Hearing Preservation Outcomes Between the Mid-Scala and Lateral Wall Electrode Arrays
Ankita Patro, MD, MS
Nathan R. Lindquist, MD
Jourdan T. Holder, AuD, PhD
David S. Haynes, MD
Elizabeth L. Perkins, MD
Kareem O. Tawfik, MD

9:29 Understanding Determinants of Satisfaction and Decisional Regret in Adult Cochlear Implant Users
Christian M. Shannon, MS, MPAff
Judy R. Dubno, PhD,
Theodore R. McRackan, MD, MSCR

9:36 Comparison of Pre-Curved versus Straight Electrode Intracochlear Position Using Three-Dimensional Virtual Resectioning from Implanted Human Histopathologic Specimens
Emily K. Gall, MD
Alexander Geerardyn, MD
MengYu Zhu, MS
Jennifer T. O'Malley, BA
Joseph B. Nadol Jr., MD
Alicia M. Quesnel, MD

9:43 DISCUSSION

9:48 MID-MORNING BREAK

10:10 INTRODUCTION OF ABSTRACTS - HEARING LOSS PART II/GENDER IN OTOLOGY
Brandon Isaacson, MD

10:11 Sound Localization in Active Transcutaneous Bone Conduction Users with Single-Sided Deafness
Madison V. Epperson, MD
Chioma Anidi, BA
Gerilyn Jones, AuD
Nadine Ibrahim, MD
Renee Banakis Hartl, MD, AuD

10:18 Representation of Women in Otolaryngology: A Geospatial Analysis
WITHDRAWN BY AUTHOR

10:25 Cigarette Smoking's Association with Sensorineural Hearing Loss - A Population Database Study
Marwin Li, BS
Natalie M. Perlov, BS
Ayan Kumar, MD
Dev Amin, MD
Zachary D. Urdang, MD, PhD
Thomas O. Willcox, MD
Rebecca C. Chiffer, MD

10:32 DISCUSSION

10:36 INTRODUCTION OF CLINICIAN SCIENTIST AWARD
Lawrence R. Lustig, MD

10:38 CLINICIAN SCIENTIST AWARD PRESENTATION
"Audiovisual Communication Devices for Improved Speech Perception"
Gavriel Kohlberg, MD
University of Washington

10:48 INTRODUCTION OF PANEL
Lawrence R. Lustig, MD

10:49 PANEL
"An Overview of Otologic Disparities Across the Lifespan"
Matthew L. Bush, MD, PhD, MBA, Moderator
Yuri Agrawal, MD, MPH
Jacob Hunter, MD
Susan Emmett, MD, MPH
Cedric Pritchett, MD
Adam Thompson-Harvey, MD

11:50 INTRODUCTION OF INCOMING PRESIDENT
Sujana Chandrasekhar, MD

11:55 CLOSING REMARKS/ADJOURNMENT

SELECTED ABSTRACTS

ORAL PRESENTATIONS

IN ORDER OF PRESENTATION

156th Annual Meeting
AMERICAN OTOLOGICAL SOCIETY

May 6-7, 2023
Sheraton Boston / Hynes CC
Boston, MA

Microneedle Mediated Delivery of siRNA-Lipofectamine is Safe for Inner Ear Gene Therapy

Sharon J. Feng, BA, BS; Aykut Aksit, PhD; Daniella Hébert, BE; Stephen Leong, BA
Elizabeth S. Olson, PhD; Jeffrey W. Kysar, PhD; Anil K. Lalwani, MD

Hypothesis: Microneedle mediated intracochlear injection of siRNA-Lipofectamine through the round window membrane (RWM) can be used to safely and effectively transfect cells within the cochlea.

Background: Vectors used in siRNA-based gene therapy to hair cells are limited, and common transfection reagents, including Lipofectamine, have known cellular toxicity. Our lab has optimized the use of 100μm diameter hollow microneedles for intracochlear injection through the guinea pig RWM. In this study, we test the feasibility of microneedle-mediated injection of siRNA-Lipofectamine through the RWM for cochlear transfection.

Methods: Fluorescently-labeled scramble siRNA (Invitrogen BLOCK-iT™ Alexa Fluor™) was diluted into Lipofectamine RNAiMax (Invitrogen) and OptiMEM (Gibco). 1.0μl of siRNA was injected through the RWM of Hartley guinea pigs at a rate of 1 μl/min (n=8). Distortion product otoacoustic emissions (DPOAE) and compound action potential (CAP) hearing tests were performed prior to and 48 hours after injection. Afterwards, animals were euthanized and cochlea were fixed and decalcified for hair cell analysis. Control cochlea were processed in parallel from untreated guinea pigs.

Results: Fluorescence, indicating successful transfection, was observed within the basal and middle turns of the cochlea with limited distribution in the apex. Signal was most intense in the organ of Corti, spiral ligament, and spiral ganglion cells. No significant changes in DPOAE and CAP were noted post-perforation, suggesting that siRNA-Lipofectamine at low doses does not cause cochlear toxicity.

Conclusions: Small volumes of siRNA and Lipofectamine can be safely delivered to cochlear structures using microneedles, paving the way for atraumatic cochlear gene therapy.

Professional Practice Gap & Educational Need: There is no clinically available method to directly access the inner ear for both diagnostic perilymph aspiration and therapeutic drug delivery. Hollow microneedles may be used to perforate the RWM without causing physiologic or anatomic harm. Further development of microneedle technology will fill this practice gap and pave the way for inner ear gene therapy.

Learning Objective: To understand safety and distribution of siRNA-Lipofectamine in the cochlea using microneedle technology and how it improves upon current technology for inner ear drug delivery.

Desired Result: Further development of tools for facilitating inner ear diagnosis and therapy.

Level of Evidence – N/A

Indicate IRB or IACUC: Columbia University Irving Medical Center – IAACUC No. AC-AABR7603
(Approved 4/1/2022, Modification Approved 8/5/2022)

Microbiome of the Ear: A Descriptive Comparison of the External and Middle Ear in the Healthy and Diseased States

Samantha Frank, MD; Ruwaa Samarrai, MD; Nehal Navali, BS
Dong-binh Tran PhD; George M. Weinstock, PhD
Daniel S. Roberts, MD, PhD

Objective: To define predominant taxa in the healthy human outer and middle ear as well as those with bacterial/fungal otitis externa and chronic otitis media (COM) with and without cholesteatoma.

Study Design: Case-control study

Setting: Tertiary Care Center

Subjects: 31 adult subjects: 13 outer ear subjects (7 normal, 5 bacterial otitis externa, 1 fungal otitis externa); 18 middle ear subjects (3 normal, 13 COM, 2 COM with cholesteatoma).

Interventions: Swabs of the outer ear were obtained in clinic and swabs of the middle ear were obtained in the operating room and placed in SCF-1 buffer. Samples underwent 16S rRNA sequencing.

Main Outcome Measures: Abundance of bacterial phyla and genera as well as intra and inter sample diversity.

Results: Corynebacterium, Propionibacterium, and Staphylococcus were commonly isolated in the outer ear and middle ear. Turicella was also commonly isolated in the middle ear. Propionibacterium was significantly more prevalent within the normal outer ear. Corynebacterium and Propionibacterium were prevalent in subjects with dry canal wall down mastoidectomy bowls. In an actively wet ear, one organism predominated without appreciable diversity of the microbiome.

Conclusions: Corynebacterium and Propionibacterium are common skin bacteria and were found to predominate in the healthy outer ear as well as dry diseased mastoidectomy bowls with prior canal wall down. When active disease was present, one organism was exclusively identified without presence of microbiologic diversity. The microbiome of the outer and middle ears were found to cluster, which suggests communication between the healthy outer and middle ear.

Professional Practice Gap & Educational Need: There is very limited understanding of the microbiome of the human adult outer ear and middle ear despite the potential for therapeutic intervention. The microbiome of the healthy middle ear is debated with some sources reporting sterility and others reporting high diversity of organisms with decreased diversity in the setting of COM. Further, pathogenic middle ear organisms have been isolated in the healthy outer ear, suggesting a possible connection between these sites.

Learning Objective: An understanding of common microbiologic sampling methods demonstrating variations in the microbiome of the healthy and diseased middle and outer ear.

Desired Result: Physicians will develop a further understanding of the microbiome of the middle and outer ears, particularly the differences in healthy and diseased states.

Level of Evidence – Level III

Indicate IRB or IACUC: IRB 21-072J-2, University of Connecticut Health Center, Initial approval 02/09/2021

Topical Stimulation Induces Progenitor Cell Proliferation in the Tympanic Membrane

Sonia M. Scaria, PhD; Stacey M. Frumm, MD, PhD
Sarah A. Easow; Aaron D. Tward, MD, PhD

Hypothesis: Mechanical stimulation is sufficient to induce a proliferative response in the progenitor cells of the mammalian tympanic membrane (TM).

Background: Previous clinical studies of the application of topical growth factors to chronic TM perforations have reported high rates of closure. In one trial, a high rate of closure was observed when either growth factor or placebo was applied. This raises the possibility that manipulation of the TM may be sufficient to induce a regenerative response in the progenitor cells of the TM. Furthermore, the mechanisms by which the epithelial migration of TM keratinocytes responds to foreign material is unknown.

Methods: Topical agents including saline, corn oil, gelfoam, and small solids were applied to mouse TMs. TMs were then harvested and whole mount immunofluorescence imaging performed.

Results: Application either liquid or solid agents on top of the TM without perforation was sufficient to induce a robust proliferative response within the keratinocytes of the TM within 24 hours of application. Concomitant with the induction of proliferation, markers of keratinocyte progenitor activation were induced.

Conclusions: Mechanical stimulation of the tympanic membrane is sufficient to induce progenitor cell activation and proliferation in the tympanic membrane. This may provide a cleaning mechanism by which keratinocyte migration is induced in response to foreign material on the TM. This may also suggest techniques for inducing closure of chronic TM perforations by mechanical manipulation of the TM.

Professional Practice Gap & Educational Need: The mechanisms by which the tympanic membrane clears debris and how the tympanic membrane can close chronic perforations are not well understood. A better understanding of these mechanisms may predict improved methods of closing chronic perforations.

Learning Objective: - Describe the response to the tympanic membrane to mechanical stimulation
- Understand the role of tympanic membrane progenitor cells in epithelial migration.

Desired Result: - Consider utilizing mechanical stimulation of the TM to promote healing of chronic TM perforations.

Level of Evidence – N/A – animal study

Indicate IRB or IACUC : UCSF IACUC **AN165495-03**

Cost-effectiveness of DW-MRI versus Second Look Surgery in Treating Cholesteatoma: A Modeling Study

Daniel D. Bu, MPP, MBA; Zachary G. Schwam, MD
Enrique Perez, MD; Maura K. Cosetti, MD

Objective: To evaluate whether tympanomastoidectomy with DW-MRI is a cost-effective method of treating cholesteatoma compared to tympanomastoidectomy with second-look surgery.

Design and Setting: Cost-effectiveness analysis was conducted using a Markov state-transition model. The simulation model adhered to the Panel Recommendations on Cost-Effectiveness in Health and Medicine established by the US Public Health Service (USPHS). One-way and Monte Carlo probability sensitivity analysis were conducted for validation.

Interventions: Tympanomastoidectomy with DW-MRI versus tympanomastoidectomy with second-look surgery.

Main Outcome Measures: Effectiveness and health utility were measured using quality-adjusted life years (QALYs). Costs were derived from Medicare reimbursement using the perspective of the payer. Probabilities for outcomes and complications were taken from existing literature. Cost-effectiveness was assessed using the incremental cost-effectiveness ratio (ICER).

Results: With base case analysis assuming a 40-year-old patient, the total cost was $15,410 when treated with tympanomastoidectomy and second-look surgery versus $12,241 when treated with tympanomastoidectomy and DW-MRI. The second-look treatment pathway yielded 17.05 QALYs, while the DW-MRI pathway yielded 16.91 QALYs in terms of health benefit accrued across the lifetime of the patient. The cost-effectiveness ICER was $22,635/QALY. Using the conventional $50,000 willingness-to-pay threshold, second-look surgery was the more cost-effective approach 62.2% of the time by simulation.

Conclusions: Both treatment pathways were found to be cost-effective, with second-look surgery incrementally cost-effective 62.2% of the time. Assumptions were validated by one-way and Monte Carlo probability sensitivity analysis.

Professional Practice Gap & Educational Need: There is ample variation in treatment pathways regarding usage of DW-MRI and second-look surgery for cholesteatoma.

Learning Objective: To evaluate the cost-effectiveness of DW-MRI and second-look surgery approaches, accounting for health-related quality-of-life outcomes and costs for the duration of the patient lifetimes.

Desired Result: To inform the discussion on the treatment for cholesteatoma given emergent non-invasive technologies.

Level of Evidence: Level III

Indicate IRB or IACUC: Exempt

Conductive Hearing Loss Associates with Dementia, Neuropsychiatric, and Incident Adverse Life Events and Middle Ear Reconstruction Improves Outcomes – A Multi-National Database Study

Zachary D. Urdang, MD PhD; Amiti Jain, BS; Marwin Li, BS
Thomas L. Haupt, BS; Thomas O. Wilcox, MD
Rebecca C. Chiffer, MD; Richard K. Gurgel, MD

Objective: Test the hypothesis that conductive hearing loss (CHL) is associated with dementia, neuropsychiatric, and incident adverse life event (ALEs) versus normal hearing controls and that middle ear reconstruction (MER) associates with improved outcomes for these measures in a multi-national electronic health records database.

Study Design: Retrospective cohort study with propensity-score matching (PSM).

Setting:
TriNetX is a research database representing about110-million patients from the United States, Brazil, and India.

Patients: Subjects with no HL, and any CHL (ICD-10:H90.0-2) over 50-years old. With and without any MER (CPT:1010174) of any age.

Main Outcome Measures: Odds-ratios with 95% confidence intervals (OR(95%CI)) for incident dementia (F01, F03, G30), neuropsychiatric diagnoses (F20.xx-F45.xx), and ALEs (Z55.xx-Z65.xx).

Results: Of 103,609 patients over 50-years old experiencing any CHL, 2.74% developed dementia compared to 1.22% of 38,216,019 patients with no HL (OR, 95%CI: 2.29, 2.20-2.37). Of patients experiencing CHL there were 39,850 who received MER. The average age was 31.3 years old, with 51% female patients. 343,876 control patients with CHL were identified. 39,900 patients remained in each cohort after 1:1 PSM for HL- and dementia-related risk factors. Matched risk for developing dementia among MER recipients was 0.33% compared to 0.58% in controls (OR: 0.58, 0.46-0.72), 10.32% compared to 13.87% for neuropsychiatric diagnosis (OR: 0.71, 0.68-0.75), and 3.34% compared to 4.02% for ALE (OR: 0.83, 0.77-0.89).

Conclusions: CHL increases the odds for dementia and MER improves dementia, neuropsychiatric, and social (incident ALEs) outcomes. This study represents the first population study on the topic of CHL and MER for these outcome measures.

Professional Practice Gap & Educational Need: Currently, no sufficiently powered studies have examined the association between CHL and dementia and how MER associates with cognitive outcomes. This study represents a population-level study on this under-reported topic and current best evidence that MER for CHL has similar cognitive, neuropsychiatric, and social outcomes compared to cochlear implant for sensorineural hearing loss. Better delineating these associations will improve patient consultation for middle-ear otologic intervention.

Learning Objectives: 1) Recognize the analogous association of CHL with incident dementia and that MER decreases the odds for dementia. 2) Appreciate the growing number of neuropsychiatric and social determinants of health outcomes (such as ALEs) improved by MER.

Desired Result: Encourage dementia, neuropsychiatric, and social outcomes as discussion points during middle-ear reconstruction consultation.

Level of Evidence – Level III

Indicate IRB or IACUC: Exempt

Influence of Cognitive Performance, Sociodemographic Factors, and Pure-Tone Audiometry on Speech Discrimination: A Prospective Population-Based Study of 1,061 Older Adults

John P. Marinelli, MD; Nicholas S. Reed, AuD; Christine M. Lohse, MS; Wanda L. Fussell, MD
Ronald C. Petersen, MD, PhD; Maria Vassilaki, MD, PhD; Matthew L. Carlson, MD

Objective: The degree to which various patient factors influence speech discrimination is poorly characterized to date. The primary objective of the current work was to describe the influence of cognitive performance, sociodemographic factors, and pure-tone audiometry on speech discrimination in older adults.

Study Design: Prospective population-based study.

Setting: Olmsted County, Minnesota.

Patients: There were 1,061 study participants 50 years or older at enrollment in the Mayo Clinic Study of Aging between November 2004 and December 2019 who underwent formal audiometric and cognitive testing included in the current investigation.

Main Outcome Measures: The primary outcome measure was <100% word recognition scores (WRSs), with pure-tone averages (PTAs; 0.5, 1, 2, 3 kHz), age, sex, years of education, socioeconomic status assessed using state area deprivation index (ADI) quintiles, and global cognition z-scores as explanatory features.

Results: The mean (SD) age among the 1,061 participants was 76 (9) years with 528 (50%) males. Participant age [OR (95% CI) for a 10-year increase of 1.8 (1.4-2.3), p<0.001], male sex [OR 2.6 (1.9-3.7), p<0.001], and PTA [OR for a 10-dB hearing loss increase of 2.4 (2.1-2.8), p<0.001] were all significantly associated with <100% WRSs, with the greatest explanatory power attributable to the PTA. Years of education (p=0.9), state ADI quintile (p=0.6), and global cognitive performance (p=0.2) did not significantly influence WRSs.

Conclusions: Although PTA exhibits the greatest influence on speech discrimination, advancing age and male sex both independently increase the odds of having poorer speech discrimination among older adults, even after accounting for cognitive function, socioeconomic status, and years of education.

Professional Practice Gap & Educational Need: Adult-onset hearing loss is becoming increasingly recognized as a chronic disease state with important heath ramifications with projections suggesting the prevalence will increase significantly in coming years secondary to an aging demographic in the West. Delineation of modifiable and non-modifiable risk factors surrounding hearing loss is critical for the ongoing characterization of hearing loss as a chronic disease. Although ubiquitously used to assess hearing loss, little research to date has described the influence of various patient factors on speech discrimination. Especially since speech discrimination is often thought to require more central processing than pure-tone thresholds, examining the influence of cognitive performance in older adults is particularly relevant.

Learning Objective: (1) Describe patient factors associated with poorer performance on speech discrimination; (2) Describe how specific morphologic characteristics of the pure-tone thresholds (e.g., the slope across frequencies) influence speech discrimination (not included in abstract due to space limitations but will be presented).

Desired Result: Practitioners and researchers would recognize male sex and advancing age as independent non-modifiable risk factors that influence speech discrimination apart from pure-tone thresholds, cognitive function, socioeconomic status, and years of education. These data may facilitate identification of unmeasured patient factors that influence the impact of peripheral hearing loss on understanding speech.

Level of Evidence: III

Indicate IRB or IACUC: IRB approval was obtained prior to data retrieval and analysis (IRB 20-004354).

Military and Non-Military TBI Associations with Hearing Loss and Self-Reported Hearing Difficulty among Active-Duty Service Members and Veterans

Charlotte K. Hughes, MD, MPH; Samrita Thapa, MPH; Sarah M. Theodoroff, PhD
Kathleen F. Carlson, PhD, MPH; James D. Schultz, AuD
Leslie D. Grush, AuD; Kelly M. Reavis, PhD, MPH

Objective: Identify associations between history of military and non-military traumatic brain injury (TBI) on hearing loss and self-reported hearing difficulty from the Noise Outcomes in Servicemembers Epidemiology (NOISE) study.

Study Design: Cross-sectional.

Setting: Multi-institutional tertiary referral centers.

Patients: 477 Active-Duty Service members (ADSM) and 520 Veterans.

Interventions: Comprehensive TBI questionnaire.

Main Outcome Measures: Pure-tone hearing thresholds, Hearing Handicap Inventory for Adults (HHIA), and Speech, Spatial and Qualities of Hearing Scale (SSQ)-12.

Results: 26% (124/477) of ADSM and 41% (212/520) of Veterans self-reported a TBI. In ADSM with TBI, 35% were military related, 54% were non-military, and 11% had an occurrence of TBI in both. Among Veterans, 45% of TBIs were military related, 36% were non-military, and 19% in both. Military TBI was associated with increased odds of high frequency (3-8 kHz) hearing loss (≥20 dB) in both ADSM (OR=2.5, CI: 1.2-5.1) and Veterans (OR=1.7, CI: 1.0-2.8) and extended-high frequency (9-16 kHz) hearing loss in Veterans (OR=1.6, CI: 1.0-2.6). ADSM with a military TBI history were more likely to report hearing difficulty on HHIA (OR=6.7, CI: 3.4-12.9) and Veterans with any TBI history (military, civilian, or both) were more likely to report hearing difficulty on HHIA (OR=3.0, CI: 1.9-4.8; 2.0, 1.2-3.4; and 5.5, 2.6-11.4, respectively). SSQ12 results corroborated HHIA findings.

Conclusions: Military TBI was associated with hearing loss, predominately in the higher frequencies. Military TBI was associated with poorer self-perceived hearing ability in ADSM. All types of TBI were associated with poorer self-perceived hearing ability in Veterans, although the strength of this association was greater for military TBI than non-military TBI.

Professional Practice Gap & Educational Need: History of TBI likely affects measured and perceived hearing ability with stronger associations observed for military-related TBI.

Learning Objective: Understand the association between various TBI types on hearing loss and perceived hearing ability.

Desired Result: Provide knowledge on the associations of TBI with hearing and inform efforts to develop future TBI treatments.

Level of Evidence – III

IRB: #FWH20180143H Joint Base San Antonio (JBSA) Military Healthcare System; #3159/9495 Joint VA Portland Health Care System (VAPORHCS) Oregon Health and Science University (OHSU)

Hearing Loss and Frailty Among Older Adults:
The Atherosclerosis Risk in Communities Study (ARIC)

Sahar Assi, MD; Emmanuel Garcia-Morales, PhD; B. Gwen Windham, MD; Frank Lin, MD, PhD
Karen Bandeen-Roche, PhD; Priya Palta, PhD; Jennifer A. Deal, PhD
Nicholas S. Reed, AuD; Pablo Martinez-Amezcua, MD, PhD

Objective: Hearing loss (HL) affects 2/3 of older adults and is associated with declining physical and cognitive function, which could lead to frailty. We tested the hypothesis that, compared to normal hearing, those with HL have greater odds of being pre-frail and frail vs. robust.

Study Design: Cross-sectional analysis using ordinal logistic regression models adjusted for demographic and clinical factors to evaluate the association of hearing loss and frailty status.

Setting: Exam 6 (2016-17) of a community-based cohort of older adults from four U.S. communities (Washington County, MD; Forsyth County, NC; Jackson, MS; and Minneapolis, MN).

Patients: 3,179 adults (mean age = 79.2 years, 58.9% female, 22% Black) with audiometric hearing and frailty assessments.

Interventions: N/A

Main Outcome Measures: Frailty components of a validated phenotype included weakness, low energy, slow gait speed, low physical activity, and weight loss. Participants were categorized as: robust (0 components), pre-frail (1-2), or frail (≥3). Audiometric hearing measurements were categorized based on 4-frequency pure-tone average (0.5, 1, 2, and 4 kHz) as: normal hearing (<25 decibels hearing level), mild (≥25 to <40 dB HL), and moderate+ (≥40 dB HL) hearing loss.

Results: 1,793 (56.4%) were pre-frail and 251 (7.9%) were frail. Compared to those with normal hearing, participants with moderate+ HL had greater odds of being in the next frailer category (e.g., frail vs. pre-frail) (odds ratio from ordinal logistic regression=1.27, 95% CI: 1.04, 1.56).

Conclusions: HL is associated with frailty among older adults. Further studies are warranted to assess if HL treatment may prevent or delay frailty onset.

Professional Practice Gap & Educational Need: Current guidelines do not reflect the potential role of hearing loss in the transition to frailty in older adults.

Learning Objective: To understand the potential contribution of hearing loss to the frailty phenotype in older adults.

Desired Result: Increased interest in addressing hearing loss through appropriate interventions to potentially help prevent older adults from becoming frail.

Level of Evidence: III

Indicate IRB or IACUC: The IRB at each site approved the ARIC study, and all participants provided written informed consent. This study was exempt from IRB approval.

RESIDENT RESEARCH TRAVEL AWARD

Metformin Protects Male but not Female Mice Against Noise-Induced Hearing Loss

Catherine L. Kennedy, MD; Benjamin Shuster; Reza Amanipour, PhD
Beatrice Milon, PhD; Priya Patel, MD; Ran Elkon, PhD
Ronna Hertzano, MD, PhD

Hypothesis: Metformin treatment will protect mice from noise-induced hearing loss.

Background: We published an atlas of cell type-specific transcriptional changes caused by permanent threshold shift (PTS)-inducing noise in the mouse cochlea. We identified metformin as the top-ranking, FDA-approved candidate drug to counteract the transcriptional changes. This study is designed to evaluate metformin as a potential otoprotective drug.

Methods: Male and female B6CBAF1/J mice were obtained at 7-8 weeks of age. At 10 weeks of age, mice underwent a PTS-inducing noise exposure (102.5-105 dB SPL, 8-16 kHz, 2 hours). Auditory brainstem response (ABR) thresholds were obtained at baseline, 24 hours post noise exposure, and 1 week post noise exposure. Mice were administered metformin (200 mg/kg) or a saline control in their drinking water after baseline ABR and for the remaining study duration. Following the 1-week ABR, mice were euthanized and cochlear tissue was analyzed. An additional cohort of ovariectomized females was included to simulate menopause to eliminate the effect of endogenous estrogens.

Results: Metformin treatment reduced the PTS at the 16 kHz and 24 kHz frequencies (p=0.012 and p=0.011, respectively) and outer hair cell (OHC) loss at 32 kHz (p<0.0001) in male mice. In contrast, metformin treatment did not ameliorate hearing loss or OHC loss in the intact or ovariectomized female mice.

Conclusions: Metformin exhibits sex-dependent efficacy as a noise-induced hearing loss therapeutic. These data compel continued investigation into metformin's protective effects and demonstrate the importance of evaluating the therapeutic efficacy of drugs in subjects of both sexes.

Professional Practice Gap & Educational Need: This study aims to identify a potential existing therapeutic that could be used to prevent hearing loss.

Learning Objectives:
1. To understand the role of metformin as a potential otoprotective therapeutic to prevent noise induced hearing loss.
2. To understand the importance of testing otoprotective therapeutics in subjects of both sexes.

Desired Result: To recognize the potential utility of metformin to prevent noise-induced hearing loss

Level of Evidence: Not Applicable

IACUC Protocol: 0721005

Do Elderly Patients Benefit from Expanded Centers for Medicare & Medicaid Services (CMS) Criteria for Cochlear Implantation in Bilateral Hearing Loss?

Sarek A. Shen, MD; Nicholas S. Andresen, MD; Stephen P. Bowditch, AuD
Daniel Q. Sun, MD

Objective: To examine the effect of patient age on longitudinal speech understanding outcomes following cochlear implantation (CI) in bilateral hearing loss.

Study Design: Retrospective cohort study.

Setting: Tertiary academic center

Patients: 1105 adult patients receiving a single-sided CI between 1987-2022

Interventions: None

Main Outcome Measures: Post-operative speech recognition outcomes, including AzBio sentences, consonant-nucleus-consonant (CNC), and Hearing in Noise Test (HINT) in quiet were analyzed at near- (<2 years), medium- (2-8 years) and long- (>8 years) term post-operative intervals.

Results: 86 very-elderly (>80 years), 409 elderly (65-80 years), and 709 non-elderly (18-65 years), patients were included. Short-term post-operative AzBIO scores demonstrated similar magnitude of improvement relative to pre-operative scores in the very-elderly (47.6, 95%CI:[28.9-66.4]), elderly (49.0, 95%CI:[39.2-58.8]), and non-elderly (47.9, 95%CI:[35.4-60.4]). Scores for those >65 years of age remained stable after 2 years post-implant, but in those ≤65 years of age, scores continued to improve for up to 8 years (9.9, 95%CI:[2.1-17.7]) post-implantation. Similar patterns were observed for HINT and CNC scores. Across all age cohorts, patients with pre-operative AzBIO scores between 40-60% had similar WRS scores compared to those with pre-operative scores of <40%, at short term (75.4, 68.9, 95%CI:[-23.1-10.0]) and medium-term (77.2, 83.9, 95%CI:[77.2-83.9]) follow-up.

Conclusions: Patients over the age of 80 gain significant and sustained auditory benefit after CI, including those meeting expanded CMS criteria for implantation. However, patients <65 years of age demonstrated continued improvement over longer period than older patients, suggesting a role of central plasticity in mediating CI outcomes as a function of age.

Professional Practice Gap & Educational Need: There is little data on longitudinal audiometric outcomes in the very-elderly. This study aims to provide insight into the sustained benefit following cochlear implant in this population, as well as patients meeting expanded CMS criteria for implantation.

Learning Objective: To understand the longitudinal audiologic benefit of cochlear implants with respect to age and pre-operative word recognition scores.

Desired Result: Appropriate counseling practices for cochlear implants, particularly in the very-elderly population and patients meeting the expanded CMS criteria for implantation.

Level of Evidence – Level IV

Indicate IRB or IACUC: IRB00188251 Johns Hopkins School of Medicine

Post-Cochlear Implant Computer-based Auditory Training
Yields Durable Improvements in Cochlear Implant Quality of Life

James R. Dornhoffer, MD; Christian Shannon, BS; Kara C. Schvartz-Leyzac, AuD, PhD
Judy R. Dubno, PhD; Theodore R. McRackan, MD, MSCR

Objective: To examine the influence of commonly available forms of post–cochlear implant(CI) auditory training on speech recognition and CI quality-of-life(CIQOL) outcomes at 1-year post–activation.

Study Design: Prospective natural experiment

Setting: Tertiary academic center

Patients: 92 adults undergoing cochlear implantation for bilateral severe-to-profound hearing loss

Interventions: Self-reported use of post-CI auditory training as follows:(1)face-to-face training (e.g., speech-pathologist), (2)passive home-based training (e.g., listening to audiobooks), and (3)Computer-based auditory training(CBAT) (e.g., interactive software).

Main Outcome Measures: Change in Consonant-Nucleus-Consonant phoneme(CNCp), CNC word(CNCw), AzBio sentences in quiet, and CIQOL-35 Profile global and domain scores from pre-CI to 1-year post-CI.

Results: Of 92 patients, 76(82.6%) used auditory training in the first-year post-activation, with 19.3% using face-to-face training, 62.0% passive home-based training, and 28.9% CBAT. At 12 months, there was no significant association between use of any auditory training resource and change in speech recognition. However, CBAT use, and no other training, was associated with greater improvements in global and all domain-specific CIQOL scores (*d*-range=0.34–1.02), with significant associations for global scores (*d*=0.81[0.10,1.48]) and scores of communication (*d*=1.02[0.30,1.70]), emotional (*d*=0.79[0.09,1.46]), listening-effort (*d*=1.02[0.30,1.70]), and social domains (*d*=0.75[0.05,1.42]). Controlling for demographics and use of multiple resources, CBAT remained the strongest positive predictor of CIQOL improvement, with significant associations for global scores (ß=9.724[0.196,19.251]) and scores of communication (ß=15.721[4.614,26.827), environmental (ß=21.103[1.872,40.333]), listening-effort (ß=16.770[5.327,28.212]), and social(ß=16.166[0.915,31.418]) domains.

Conclusions: Auditory training with self-directed computer software resulted in improved CIQOL outcomes at 12-months post-activation. Given the availability and low cost of these interventions, this study provides evidence for the use of CBAT to improve real-world functional abilities in new adult CI recipients.

Professional Practice Gap & Educational Need: CBAT is a free and widely accessible form of auditory rehabilitation that may be associated with improved CI outcomes in adults in the first-year post-CI activation. However, the effectiveness of CBAT is remains unknown and long-term effects have never previously been examined in a large natural history observational study of adult CI users.

Learning Objective: To explore the long-term effectiveness of CBAT and other commonly available forms of auditory training in new adult CI recipients.

Desired Result: Practitioners and researchers will learn that the use of CBAT by new adult CI recipients offers durable benefits in real-world functionality as measured by the CIQOL-35 Profile. As such, clinicians should consider counselling on the use of this widely accessible and effective form of auditory rehabilitation for all newly implanted patients.

Level of Evidence – Level IV: Historical cohort or case-controlled studies.

Indicate IRB or IACUC: Pro00077593

Combining Intraoperative Electrocochleography with Robotics-Assisted Electrode Array Insertion

Rustin G. Kashani, MD; Armine Kocharyan, MD; Douglas M. Bennion, MD, PhD
Camille C. Dunn, PhD; Alexander D. Claussen, MD
Bruce J. Gantz, MD; Marlan R. Hansen, MD

Background: Preserving cochlear function and structure is an important tenet of cochlear implant (CI) surgery, especially in patients with residual acoustic hearing. Despite careful manual insertion technique, the force required to damage the cochlea lies below the threshold of human perception. Additionally, the variable speed and rate of manual insertion may confound interpretation of intraoperative physiologic measures of cochlear activity, such as electrocochleography (ECochG). Robotics-assisted technologies provide slower and steadier electrode array (EA) insertion, facilitate consistent intraoperative ECochG potentials, and allow for fine-tuned alterations during insertion in response to ECochG activity. Here we present outcomes data on patients undergoing robotics-assisted EA insertion integrated with intraoperative ECochG.

Methods: The study was performed on adults undergoing CI surgery. A robotics-assisted CI insertion system (IotaSoft, IotaMotion, Inc.) was used while simultaneously recording ECochG responses with software available from CI manufacturers. The ECochG potentials were acoustically generated with tone-burst of 125-500 Hertz (Hz). Lateral wall EAs were inserted with real-time ECochG feedback, allowing the surgeon to pause, advance, or withdraw the electrode at low speeds (0.1mm/sec). Pure tone averages (PTA; 125, 250, and 500 Hz) were documented before and after surgery.

Results: Sixteen patients underwent robotics-assisted EA insertion integrated with intraoperative ECochG. Surgeons were able to adjust insertion based on ECochG responses. The mean preoperative PTA was 49 decibels (dB). PTA at initial activation, 3-months, and 6-months was 72, 69 and 57 dB, respectively.

Conclusions: Combining robotics-assisted EA insertion with intraoperative ECochG offers real-time feedback during surgery with potential to minimize cochlear trauma and preserve residual acoustic hearing.

Professional Practice Gap & Educational Need: Preservation of residual acoustic hearing is a critical goal in cochlear implant surgery that is often not achieved with manual insertion technique. New methods of insertion that can spare function are thus of interest and necessity.

Learning Objective: Understand the dynamics of implant insertion, significance of residual acoustic hearing, and explore emerging technologies that seek to minimize insertion trauma

Desired Result: To provide attendees with knowledge of intraoperative monitoring modalities and emerging technologies for preserving cochlear function

Level of Evidence: IV

Indicate IRB or IACUC: University of Iowa Hospital and Clinics NR # 00000099

RESIDENT RESEARCH TRAVEL AWARD

Expression of Brain-Derived Neurotrophic Factor in Human Spiral Ganglia Neurons following Cochlear Implantation

Emily C. Wong, MD; Ivan A. Lopez, PhD
Akira Ishiyama, MD; Gail Ishiyama, MD

Hypothesis: It is hypothesized that electrical stimulation following CI stimulates BDNF expression in the afferent auditory pathway.

Background: Brain-derived neurotrophic factor (BDNF) is an important factor in the development and neuroprotection of afferent auditory pathways. In this study, we investigated the expression of BDNF in the afferent auditory pathway following cochlear implantation (CI).

Methods: Archival human temporal bones from seven patients (ages 67-92 years) with a history of CI and four patients with hearing loss without CI (ages 38-92 years) were studied. Temporal bone specimens were immunoreacted with mouse monoclonal antibodies against pan-neurofilaments and rabbit polyclonal BDNF. In cases of unilateral CI, the contralateral unimplanted ear served as a control.

Results: Neurofilament immunoreactivity (IR) localized to spiral ganglion neuron (SGN) nerve fibers in implanted and unimplanted ears. BDNF IR localized to the SGN somata and the surrounding satellite glial cell. The expression of BDNF in the SGN was increased in the implanted ear compared with the unimplanted ear and with otopathologies such as ototoxicity. BDNF expression in the SGN also demonstrated increased expression in CI despite complete loss of the organ of Corti hair cells and supporting cells. Even in the cases of CI with a 6 mm first generation electrode, BDNF expression was upregulated throughout the cochlea.

Conclusions: BDNF expression in the SGN appears to be upregulated by the electrical stimulation from CI. This study provides evidence that the electrical stimulation from CI stimulates BDNF upregulation, which may play a neuroprotective role in rehabilitating hearing in the deafened ear.

Professional Practice Gap & Educational Need: It is important to identify patients who benefit from cochlear implantation early using audiologic criteria as electric stimulation appears to have neuroprotective effect for the primary auditory pathway.

Learning Objective: To understand the patterns of BDNF immunoreactivity in human temporal bone specimens with CI and hearing loss due to other otopathologies.

Desired Result: Participants should be able to identify differences in BDNF IR among temporal bone specimens with CI compared with those without CI and those with hearing loss due to other otopathologies.

Level of Evidence – IV

Indicate IRB or IACUC : UCLA IRB 10-001449

The 3D Structure of Cochlear Incomplete Partition Type-II Malformation from Digitised Human Histopathological Specimens: Implications for Cochlear Implantation

Chloe E. Swords, MBBS, MRCS; Alexander R. Geerardyn, MD; Mengyu Zhu, MS
Peizhe Wu, MD; Julie G. Arenberg, PhD, CCC-A
Manohar L. Bance, MBChB, MSc; Alicia M. Quesnel MD

Hypothesis: i. The scala tympani (ST) and scala vestibuli (SV) of incomplete partition type-II (IP-II) malformations are normal for the 1st 360o; thereafter the compartments fuse. ii. The cochlear duct is normal in length and morphology. iii. The location and number of spiral ganglion neurons (SGN) are normal.

Background: Knowledge of intracochlear and neural three-dimensional (3D) morphology may assist with cochlear implant selection and post-operative programming for IP-II patients.

Methods: IP-II (n=11) human temporal bone histological specimens were identified from the NIDCD National Temporal Bone Registry and sections were digitised. The cochlear duct, scalae, and surgically-relevant anatomy of the round window and hook regions were reconstructed in 3D. The location and number of SGN were quantified by applying a machine learning algorithm.

Results: The 3D morphology of the basal turn was normal, although with a reduced ST cross-sectional area, for the first 360°. Beyond this, ST and SV fused. Cochlear duct length was reduced compared to normal controls (28mm versus 33mm), but remained a distinct endolymphatic compartment. SGN were reduced in numbers compared to age-matched normative data (39% (3-65%)), and often failed to ascend up Rosenthal's canal remaining in an abnormal modiolar location.

Conclusions: Contrary to our hypotheses, cochlear duct and SGN anatomy differed from normal cochlea. Knowledge of 3D anatomy may help facilitate pre-operative discussion of expectations with patients. Surgeons may wish to select shorter-than-normal electrode arrays to limit trauma. Unusual programming maps may occur in patients with post-lingual hearing loss, due to abnormal SGN location.

Professional Practice Gap & Educational Need: The majority of existing descriptions of inner ear malformations are based off clinical imaging. In-depth 3D anatomy of cochlear malformations has not been visualized previously, particularly the location of the neural elements. This knowledge is essential for planning the type of implant to insert to ensure atraumatic cochlear implant insertion. Atraumatic insertion is essential for limiting irreversible histological changes, inflammatory intracochlear changes, and ensuring successful auditory rehabilitation.

Learning Objective: To understand the 3D anatomy of IP-II cochlear malformations

Desired Result: This study helps physicians appreciate the differences in anatomy of the scalae and neural anatomy between normal and IP-II malformations. This may help to inform selection of arrays pre-operatively to prevent intracochlear trauma.

Level of Evidence - V

Indicate IRB: 2019P003755

Impact of Stimulus Frequency on Azimuthal Sound Source Localization in Patients with Single-sided Deafness using Cochlear Implants

Chioma Anidi BA; Gerilyn Jones, AuD; Madison Epperson, MD
Nadine Ibrahim MD; Renee M. Banakis Hartl, MD, AuD

Objective: Characterize localization accuracy across the frequency spectrum in subjects with single-sided deafness (SSD) who have undergone cochlear implantation (CI).

Study Design: Nonrandomized, prospective study.

Setting: Academic tertiary care referral center.

Patients: Patients who have undergone CI for SSD currently receiving care at University of Michigan, Department of Otolaryngology.

Main Outcome Measures:
1. Localization accuracy (quantified in RMS error) for presentation of sounds from an azimuthal array of 24 loudspeakers spaced at 15^{o} intervals in a semi-anechoic chamber both with and without CI.
2. Subjective measure of perceived localization benefit quantified with responses to the Speech, Spatial and Qualities of Hearing Scale (SSQ).

Results: Localization performance was compared across individuals, both with and without CI, using the following stimuli: broadband noise, low-frequency narrowband noise (500 Hz), mid-frequency narrowband noise (1000 Hz), and high-frequency narrowband noise (4000 Hz). Patients displayed improved localization performance with high frequency stimuli (4000 Hz) when using CI and no improvement in localization accuracy at lower frequencies (500 Hz, 1000 Hz).

Conclusions: Stimulus frequency has a significant impact on sound-source localization accuracy in patients with single-sided deafness using cochlear implants. Improved performance with higher frequency stimuli suggests the possibility of greater salience of interaural level difference cues compared with timing difference cues, though further study is needed to fully explore the hypothesis.

Professional Practice Gap & Educational Need: While sound localization performance in subjects with single-sided deafness using cochlear implant has been investigated, the effect of frequency has not been well characterized. Our study seeks to address this gap and demonstrated improved sound localization abilities at high frequency stimuli in patients with single-sided deafness using cochlear implants. This finding provides further insight on how interaural level and timing differences might contribute to sound localization in this patient population. Based on our current understanding, it is unlikely that timing cues are being accurately represented for users of cochlear implants. This knowledge can be helpful for counseling patients and providing education on the limitations of cochlear implantation, and it may also provide evidence to support development of device programming strategies to optimize binaural task performance.

Learning Objective:
1. Characterize differences in objective localization performance at differential frequencies in patients with cochlear implantation
2. Characterize differences in subjective spatial hearing benefit in patients with cochlear implantation

Desired Result: Attendees will demonstrate an improved understanding of the limitations of localization performance from unilateral rehabilitation devices in patients with cochlear implantation.

Level of Evidence - Level III - Cohort and case-control studies.

Indicate IRB or IACUC: Approved 1/28/21, University of Michigan IRBMED Protocol HUM00190678.

Discrepancies Between Expected and Actual Cochlear Implant-Related Functional Outcomes

Joshua E. Fabie, MD; Christian Shannon, BS; Kara Leyzac, AuD, PhD
Judy R. Dubno, PhD; Theodore R. McRackan, MD, MSCR

Objective: Prior research has demonstrated that realistic patient expectations are a critical factor in determining CI candidacy. The current study uses the validated Cochlear Implant quality of Life-Expectations (CIQOL-Expectations) instrument to determine expectations of potential CI users and the degree to which their pre-CI expectations are met.

Study Design: Prospective cohort study

Setting: Tertiary medical center

Patients: 60 adult CI patients

Interventions/Main Outcome Measures: Pre-CI aided and post-CI CNC word and AzBio sentence scores, pre-CI CIQOL-Expectations, and pre-CI and 3/6/12 month post-CI CIQOL-35 Profile scores.

Results: Mean pre-CI CIQOL-Expectations exceeded 12-month mean CIQOL-35 Profile scores for the global measure and the communication, environment, and listening effort domains (d=0.65 to 0.97). The communication and listening effort domain scores had the largest discrepancy between expected and actual post-CI improvement (actual scores 15.1 and 16.3 points lower than expected [d= 0.93 to 0.97], respectively). For 42% of patients, pre-CI global expectations exceeded 12-month post-CI CIQOL-35 Profile global scores, 49% met their expectations, and actual scores exceeded expectations for only 10% of patients. Similar patterns were seen for all CIQOL domains except emotional.

Conclusions: Post-CI functional abilities appear to fall short of pre-CI expectations for a substantial percentage of CI users, which was most apparent for the communication and listening effort CIQOL domains. These results may help clinicians direct personalized counseling toward common misconceptions, which can aid shared decision-making and potentially minimize the mismatch between expected and realized outcomes.

Professional Practice Gap & Educational Need: Understanding the importance of patient expectations in CI candidates and the mismatch between expected and actual performance after receiving an implant

Learning Objective: Post-CI functional abilities fall short of pre-CI expectations for a substantial percentage of CI users

Desired Result: Personalized patient counseling to narrow the gap between expected and realized post-operative hearing performance and improve shared decision making

Level of Evidence – III

Indicate IRB or IACUC: IRB Pro00073019, approved 12/20/2017, Medical University of South Carolina

Investigating Deferral Rates in Cochlear Implantation:
How Often Do Candidates Defer and Why?

Vivian F. Kaul, MD; Bryce P.G. Dzubara, BS
Oliver F. Adunka, MD, MBA; Yin Ren, MD, PhD

Objective: Evaluate the rate at which cochlear implant (CI) candidates decline surgery and identify associated factors.

Study Design: Retrospective cohort study.

Setting: Tertiary referral center.

Patients: 493 CI candidates from 07/1989-05/2020 with complete demographic and socioeconomic data.

Interventions: Diagnostic.

Main Outcome Measures: Age, gender, race, marital and employment status, median household income percentile, distance-to-clinic, and residence in a medically-underserved county.

Results: Of the 493 CI candidates included, 80 (16.2%) patients declined surgery. African American patients were 73% less likely to undergo implantation compared to White patients (OR: 0.27 [0.11-0.68];p=0.005). Asian patients were 95% less likely to undergo implantation [OR: 0.05 [0.009-0.25];p=0.0003) compared to White patients. For every one-year age increase, patients were 4% less likely to undergo implantation [OR: 0.96 [0.94-0.98];p<0.0001] and for every 10 years age increase, the patients were 33% less likely. Compared to the their single counterparts, married patients were more likely to undergo implantation (OR: 1.87 [1.12-3.15];p=0.02). No differences were observed when comparing implanted and non-implanted CI candidates in gender, employment status, distance-to-clinic, or median family income percentile. A chi-square test of independence showed no association between receiving CIs and living in medically-underserved counties (χ^2: 2; N=493; 0.3891; p=.53).

Conclusions: Not infrequently, CI candidates decline surgery. While demographic factors (race, age, and marital status) were associated with the cochlear implantation decision, socioeconomic factors (median family income and residence in a medically-underserved community) were not. Perhaps the cultural components of a patient's race have a larger impact on whether or not the patients get implanted.

Professional Practice Gap & Educational Need: As providers, we are still unsure of how best to counsel all patients, especially when it comes to the underserved communities. Physicians and audiologists need to better understand the reason for why cochlear implant candidates defer surgery, so we can better counsel them.

Learning Objective: After reading this abstract, participants will be able to distinguish which demographic and socioeconomic factors are associated with the choice of a CI candidate to defer surgery.

Desired Result: To improve physician knowledge concerning cochlear implantation deferral and factors associated with it.

Level of Evidence – IV

Indicate IRB or IACUC : The Ohio State University Wexner Medical Center - 2021H0109

Comparison of Speech Recognition and Hearing Preservation Outcomes Between the Mid-Scala and Lateral Wall Electrode Arrays

Ankita Patro, MD, MS; Nathan R. Lindquist, MD
Jourdan T. Holder, AuD, PhD; David S. Haynes, MD
Elizabeth L. Perkins, MD; Kareem O. Tawfik, MD

Objective: To assess speech recognition and hearing preservation (HP) outcomes with the Advanced Bionics™ Mid-Scala and SlimJ electrodes.

Study Design: Retrospective cohort.

Setting: Tertiary referral center.

Patients: 233 adult patients implanted between 2013 and 2021 (Mid-Scala: n=134, SlimJ: n=99).

Main Outcome Measures: CNC and AzBio scores at 6 and 12 months; postoperative HP, defined as low-frequency pure-tone average (LFPTA) $\leq$ 80 dB HL; scalar position.

Results: Mean CNC scores did not significantly differ between Mid-Scala and SlimJ recipients at 6 (46.2% vs. 45.7%, p=0.898) and 12 (49.8% vs. 47.3%, p=0.478) months. Similarly, mean AzBio in quiet scores were equivalent for both groups at 6 (55.5% vs. 58.6%, p=0.466) and 12 (59.5% vs. 61.9%, p=0.590) months. HP rates were significantly higher with the SlimJ (48.4%) than the Mid-Scala (30.8%) (p=0.033). Scalar translocations were 34.3% and 16.1% for the Mid-Scala and SlimJ groups, respectively (p=0.022). Postoperative HP was negatively correlated with scalar translocation (r_s = -0.22, p=0.058). Postoperative HP status had a very weak but positive correlation with 12-month CNC (r_s = 0.11, p=0.316) and AzBio in quiet (r_s = 0.12, p=0.259) scores. CNC, AzBio in quiet, and LFPTA shifts at 6 and 12 months were not significantly different between patients receiving the SlimJ versus those with scala tympani insertion of the Mid-Scala (p>0.05).

Conclusions: Compared to Mid-Scala, the lateral wall electrode has superior HP outcomes and fewer scalar translocations while speech recognition scores are equivalent between both electrode arrays. These findings can help providers with electrode selection and patient counseling.

Professional Practice Gap & Educational Need: To our knowledge, direct comparison of the Mid-Scala and SlimJ electrodes regarding hearing preservation and speech recognition outcomes has not been reported in the literature.

Learning Objective: To understand the differences in speech recognition and hearing preservation based on electrode array type from a single manufacturer.

Desired Result: Providers will have knowledge about the better postoperative hearing preservation outcomes with the SlimJ compared to the Mid-Scala electrode array, with the later providing no significant advantage in speech recognition. These results can be utilized for electrode selection and patient counseling.

Level of Evidence: Level IV – Historical cohort or case-controlled studies.

Indicate IRB or IACUC: IRB Exempt (221833, Vanderbilt University).

Understanding Determinants of Satisfaction and Decisional Regret in Adult Cochlear Implant Users

Christian M. Shannon, MS, MPAff, Judy R. Dubno, PhD, Theodore R. McRackan, MD, MSCR

Objective: Determine associations expected and actual cochlear implant (CI) outcomes, decisional regret, and satisfaction in experienced adult CI users.

Study Design: Cross-sectional cohort study

Setting: Tertiary medical center

Patients: 39 adult CI users meeting traditional bilateral hearing loss indications with ≥12 months CI experience

Interventions/ Main Outcome Measures: Patients completed the validated Satisfaction with Amplification in Daily Living (SADL) and Decisional Regret (DR) instruments. Pre- and post-CI outcomes (CI Quality of Life [CIQOL]-Expectations; CIQOL-35 Profile; CNC words, AzBio Sentences) were obtained from a prospectively maintained clinical database.

Results: Using established cutoff scores, 29% of patients reported a substantial degree of post-CI decisional regret. For each CIQOL domain, patients without decisional regret obtained post-CI outcome scores closer to pre-CI expectations as compared to patients with decisional regret (d= 0.25 to 0.95); similar results were observed with higher CI user satisfaction (d=0.24-0.87). Notably, the degree of pre- to post-CI improvement in CNC or AzBio scores did not differ between patients with and without decisional regret or with lower and higher satisfaction. Finally, greater pre-post improvement in CIQOL-35 Profile domain scores demonstrated far stronger associations with lower decisional regret and higher satisfaction than changes in speech recognition scores.

Conclusions: Patients with better alignment of their pre-CI expectations and post-CI outcomes and greater pre/post CIQOL improvement had lower decisional regret and higher satisfaction. This emphasizes the importance of evidence-based pre-CI counseling regarding real-world CI benefits and caution against assuming that improvements in speech recognition are related to patient satisfaction.

Professional Practice Gap & Educational Need: Prior investigations have focused on speech recognition outcomes as the primary driver for levels of satisfaction and regret an individual has with their cochlear implant device. However, audiological factors represent only a component of what determines a patient's attitudes towards their CI, and quality of life outcomes should also be considered to better understand degrees of satisfaction and decisional regret. Therein lies the opportunity to address a glaring research gap to understand how QOL is associated with CI satisfaction and regret.

Learning Objective: Determine the impact speech recognition and QOL outcomes have on a CI patient's levels of decisional regret and satisfaction with their device.

Desired Result: Practitioners and researchers will better understand what factors contribute to a CI user's levels of decisional regret and satisfaction with their device. As such, they will be able to utilize these associations to better tailor the pre-operative evaluation process and address modifiable factors to increase satisfaction and decrease decisional regret in CI patients.

Level of Evidence – Level IV

Indicate IRB or IACUC: Medical University of South Carolina; Pro00049700

Comparison of Pre-Curved versus Straight Electrode Intracochlear Position Using Three-Dimensional Virtual Resectioning from Implanted Human Histopathologic Specimens

Emily K. Gall, MD; Alexander Geerardyn, MD; MengYu Zhu, MS
Jennifer T. O'Malley, BA; Joseph B. Nadol Jr., MD; Alicia M. Quesnel, MD

Hypothesis: Perimodiolar electrodes are located closer than straight electrodes to the lateral wall of the modiolus (LWM), where spiral ganglion neurons (SGNs) are located. Electrodes that remain fully in the scala tympani (ST electrodes) are closer to the LWM than translocated electrodes.

Background: Cochlear implant (CI) electrodes have a pre-curved ("perimodiolar") or straight ("lateral wall") design. Data conflict regarding which affords better hearing outcomes, however, CI performance may be related to proximity to SGNs.

Methods: Digitized slides of all processed postmortem human temporal bones (TBs) within one database that underwent cochlear implantation during life were included. Cases with older electrode designs, irregular staining, or trauma precluding evaluation of the electrode course were excluded. Three-dimensional reconstructions of each cochlea were created. The LWM and the electrode medial margin were marked and electrode-LWM distances measured from base to apex.

Results: Thirty-six TBs, including 18 pre-curved (44.4% translocated) and 18 straight electrodes (38.9% translocated), were analyzed. Overall, pre-curved electrodes were located closer to the LWM than straight electrodes (average electrode-LWM distance of 0.69+/-0.34 mm versus 1.26+/-0.26 mm; $p < 0.01$). Pre-curved ST electrodes were located closer to the LWM than straight ST electrodes (0.54+/-0.36 mm versus 1.20+/-0.26 mm, $p < 0.01$). Pre-curved translocated electrodes were located closer to the LWM than straight translocated electrodes (0.88+/-0.20 mm versus 1.36+/-0.25 mm, $p < 0.01$).

Conclusions: For both CI electrodes that remain in the scala tympani and those that translocate, pre-curved electrodes are located closer to the LWM than straight electrodes on average. This data has implications for modeling the electrode-neuron interface.

Professional Practice Gap & Educational Need: Both perimodiolar and lateral wall electrodes are commonly used for cochlear implantation. There is a lack of reliable data regarding the incidence of translocation as well as the final resting position of cochlear implant electrodes in relation to the lateral wall of the modiolus. Here, we investigate differences in these measures in perimodiolar and lateral wall electrodes.

Learning Objective: The final cochlear position of perimodiolar electrodes is closer to the LWM than is the final position of lateral wall electrodes.

Desired Result: A determination of whether there is a significant difference in the average distance between the electrode and the lateral wall of the modiolus in perimodiolar versus lateral wall electrodes.

Level of Evidence: Level III.

Indicate IRB or IACUC: IRB 2020P001593, Mass General Brigham.

Sound Localization in Active Transcutaneous Bone Conduction Users with Single-Sided Deafness

Madison V. Epperson, MD; Chioma Anidi, BA; Gerilyn Jones, AuD
Nadine Ibrahim, MD; Renee Banakis Hartl, MD, AuD

Objective: To evaluate sound localization accuracy of subjects with single sided deafness (SSD) with active transcutaneous bone conduction implants (atBCI) compared to the unaided condition and normal hearing controls.

Study Design: Prospective Case-Control Study.

Setting: Academic Tertiary Referral Center.

Patients: Normal hearing adults and patients with moderate to profound unilateral sensorineural hearing loss implanted with an atBCI.

Interventions: Frequency-specific localization was assessed in a semi-anechoic chamber using an array of 24 speakers spaced 15^{o} apart. Stimuli were delivered at 70 dB SPL for 0.5 seconds and included broadband noise (BBN) and narrowband noise (NBN) with center frequencies of 500, 1000, and 4000 Hz. Head movements were recorded via an electromagnetic tracking system. The response angle was recorded and compared against the presented stimuli location.

Main Outcome Measures:
(1) Frequency-specific localization deviation and root-mean-square (RMS) error (measured in degrees).
(2) Subjective assessment of perceived localization ability as measured by Speech Spatial Qualities (SSQ) questionnaire.

Results: Statistical analyses were performed using ANOVA and *t*-tests. Normal hearing controls can localize stimuli with minimal RMS error, consistent with the literature. SSD individuals have difficulty localizing in their unaided condition, particularly with NBN. With the atBCI, there were replicable errors with specific locations in space, explained by superimposed air and bone conducted signals summating constructively and destructively within the normal hearing cochlea.

Conclusions: Individuals with SSD have significant difficulty with localization, with poorer performance for NBN stimuli. atBCI may improve but does not normalize localization. There are systematic and reproducible changes in localization performance when using atBCI that may be predicted from interactions of air and bone conducted signal components. Further characterization of these interaural time difference-based interactions may provide the foundation for improvement in device programming strategies to optimize performance for individuals with atBCI for SSD.

Professional Practice Gap & Educational Need: Sound-source localization is challenging in individuals with monaural hearing due to lack of interaural time and level differences. Past studies evaluating percutaneous BCI in SSD patients have demonstrated no improvement in sound localization. However, with atBCI, one small (n=5) study suggested improved localization with the device. Larger studies allowing for granular assessment of localization ability are needed in SSD patients using atBCI to help establish appropriate clinical expectations and to work towards optimizing device outcomes.

Learning Objective:

1. Understand how sound localization abilities of patients with SSD are impacted by use of atBCIs
2. Characterize subjective localization ability of individuals with SSD using atBCIs

Desired Result: To provide improved understanding of localization abilities in SSD following implantation with atBCIs to better inform patient-centered decision making and device selection in this difficult-to-treat population. To lay the foundation for adaptations to device programming to address reproducible performance errors.

Level of Evidence - III

Indicate IRB or IACUC : University of Michigan HUM00190678

Representation of Women in Otolaryngology: A Geospatial Analysis

Mark Nyaeme, BS; Michael Pozin, MS; Nicholas Peterman, BS
Rachael Mann, BS

WITHDRAWN BY AUTHOR

03/22/23

Cigarette Smoking's Association with Sensorineural Hearing Loss - A Population Database Study

Marwin Li, BS; Natalie M. Perlov, BS; Ayan Kumar, MD
Dev Amin, MD; Zachary D. Urdang, MD, PhD
Thomas O. Willcox, MD; Rebecca C. Chiffer, MD

Hypothesis: Chronic use of cigarettes or non-cigarette products with either cigarette-like smoke profile or high nicotine content increases odds for developing sensorineural hearing loss in young populations.

Background: Studies have long associated smoking with sensorineural hearing loss (SNHL). Proposed mechanisms include accelerated cochlear lateral wall degeneration via reactive oxygen species (ROS) native to carbon-based smoke, vessel atherosclerosis, and increased baseline inflammation with associated ROS burden. Currently, the largest published cohort study examining smoking-associated SNHL featured *n*=11,200. This study represents the greatest powered study to date examining the associations of tobacco, non-cigarette nicotine, and cannabis (non-nicotine smoke) use on odds for developing early-onset SNHL, with *n*=35,625,968.

Methods: The TriNetX US Collaborative Network was used to query ~100 million US patients using medical billing codes (ICD-10, CPT, etc.). Cohort inclusion criteria included EHR record after 2003, 18-54 or 55+ years old at index, and status of cigarette, non-cigarette nicotine, or cannabis use. Cohorts were controlled for SNHL-related conditions, including diabetes mellitus and noise exposure. Odds for developing SNHL were calculated against subjects 18-54 years-old who have no nicotine/cannabis use.

Results: Odds for developing SNHL are higher for people 18–54 years-old who use any nicotine product [5.91 (5.71-6.13) (odds-ratio (95% confidence interval))], cigarettes only [4.00 (3.69-4.33), chewing tobacco only [9.04 (7.09-11.63)], or cannabis only [3.99 (3.60-4.44)] compared to control. People 55+ years old who use no products had the third highest odds overall [4.73 (4.63-4.85)].

Conclusions: Both nicotine and smoke exposure appear to independently increase odds for developing SNHL, with nicotine having the strongest association.

Professional Practice Gap & Educational Need: While current evidence strongly suggests that cigarette use increases the risk for developing sensorineural hearing loss, this has not been previously demonstrated at the population level. There is also little understanding of the physiological reason behind this phenomenon, which may limit the possibility of treatment for affected patients, as well as the counseling that can be offered to those who use nicotine or smoke products other than traditional cigarettes.

Learning Objective: To understand the relative odds for developing SNHL posed by consumption of cigarettes, non-cigarette nicotine products, and cannabis in younger populations.

Desired Result: To better delineate the association between use of cigarettes, non-cigarette nicotine products, and cannabis with SNHL.

Level of Evidence – IV

Indicate IRB or IACUC: Jefferson IRB has determined this work exempt from committee review.

SELECTED ABSTRACTS

POSTER PRESENTATIONS

IN ORDER OF PRESENTATION

156th Annual Meeting
AMERICAN OTOLOGICAL SOCIETY

May 5-6, 2023
Sheraton Boston / Hynes CC
Boston, MA

Temporal Trends in Early Pediatric Cochlear Implantations in California from 2018 to 2020

Rance J.T. Fujiwara, MD, MBA; Emily C. Wong, MD
Gail Ishiyama, MD; Akira Ishiyama, MD

Objective: To characterize the demographics of children receiving cochlear implantations, identify factors associated with delayed implantations, and trend the impact of these factors over time

Study Design: Retrospective cross-sectional study

Setting: Healthcare Cost and Utilization Project California State Ambulatory Surgery Database for calendar years 2018-2020

Patients: Children ≤5 years old undergoing cochlear implantation

Interventions: cochlear implantation (*CPT* 69930)

Main Outcome Measures: The population-controlled number of cochlear implantations was calculated and stratified by race and insurance. Early implantation was defined as implantation at age ≤2 years old. A mixed effects logistic regression model was generated to identify factors associated with early implantation and how that association changed from 2018 to 2020.

Results: The final cohort included 467 children who underwent cochlear implantation. The number of implantations increased from 141 to 175 implants from 2018 to 2020 (24.1% increase); 229 (49.0%) children were implanted at ≤2 years of age. Medicaid insurance was associated with decreased odds of early implantation (OR 0.18 [95% CI 0.15-0.23], $p<0.001$), and this association with Medicaid insurance was significant when stratified across all racial groups. Black children had decreased odds of implantation at less than 2 years of age (OR 0.63 [95% CI 0.43-0.94], $p=0.02$), but Black children with private insurance had equal or higher odds of implantation than white children with private insurance (OR 4.13 [95% CI 1.26-13.46], $p=0.02$). Among children insured by Medicaid, the percentage who were implanted prior to 2 years old increased from 20.9% to 62.0% from 2018 to 2020.

Conclusions: Among children in California, socioeconomic factors, in particular public insurance, are associated with differences in access to early cochlear implantation. These disparities improved significantly from 2018 to 2020. Further investigation into changes and initiatives in California during this time frame, and barriers to access which may remain for differential socioeconomic groups, may aid in directing national efforts to improve pediatric cochlear implantation access.

Professional Practice Gap & Educational Need: variations in age of pediatric cochlear implantation relative to guidelines

Learning Objective: to understand variations in pediatric cochlear implantations and factors associated with delays, as well as how these trends have changed over time

Desired Result: to spur and encourage additional research to identify actionable, targetable measures for pediatric populations at risk for delayed implantation

Level of Evidence – Level III

Indicate IRB or IACUC : IRB#21-000110

The Role of Resident and Migrating Macrophages towards Sensory Hearing Loss in Chronic Suppurative Otitis Media

Viktoria Schiel, MD, PhD; Anping Xia, MD, PhD; Ritwija Bhattacharya, PhD
Ankur Gupta, MD; Peter Santa Maria, MD, PhD

Background: CSOM is a worldwide disease that afflicts 330 million people worldwide and is the most common cause of hearing loss in children in the developing world. We have previously found that macrophages are the main immune cells in the cochlea mirroring the timing of hair cell loss.

Hypothesis: In this report we investigated the function of resident and migrating cochlear macrophages towards hair cell loss in CSOM.

Methods: We investigated in our novel pseudomonas aeruginosa PA CSOM animal model, previously validated to mimic the human disease. We depleted cochlear resident macrophages by using the CSF-1 receptor inhibitor PLX5622 before inoculating them with PA. We determined macrophage numbers in the cochlea and hair cell loss at different timepoints (1, 3, 7, and 14 days) during the infection course using immunohistochemistry and confocal microscopy.

Results: We found that depletion of cochlear resident macrophages did not affect hearing or cause hair cell damage in wild type mice. This shows that resident cochlear macrophages are not required to maintain hearing. Total macrophages were significantly reduced in the cochlea after depletion of resident macrophages at all assessed timepoints during the infection, compared to the control group without depletion ($p < 0.05$). In CSOM, we did not find any hair cell loss after 1 and 3 days in both groups. However, we found hair cell loss at 7 and 14 days in both groups. We found significantly less hair cell loss at 14 days when resident cochlear macrophages were previously depleted ($p = 0.04$). The number of hair cells in the basal turn of the cochlea remained as 29/100 μm of the basilar membrane after depleting macrophages and 19/100 μm of the basilar membrane in the control group.

Conclusion: These data suggested that both the resident and migrating macrophages play a role in CSOM associated hair cell loss. Our further research plan will focus on the underlying molecular mechanism between macrophages and hair cell loss.

Professional Practice Gap & Educational Need: We propose to investigate how sensory hearing loss (SHL) is caused by chronic suppurative otitis media (CSOM): severe chronic middle ear infections. CSOM is a neglected disease that afflicts 330 million people worldwide and is the most common cause of permanent hearing loss among children in the developing world. It is characterized by a chronically discharging infected middle ear, and there is currently no effective cure.

Learning Objective: To investigate the role of resident and migrating macrophages towards hair cells loss in chronic suppurative otitis media.

Desired Result: To show the underlying mechanism between cochlear macrophages and hair cells in CSOM and identify macrophages as a potential target for therapy to prevent sensory hearing loss in CSOM;

Level of Evidence – Level III

Indicate IRB or IACUC : APLAC (Administrative Panel on Laboratory Animal Care, Stanford University) protocol number 32855

Fourth-generation Fluoroquinolones Fail to Show Improvement over Earlier Generations in Treating Chronic Suppurative Otitis Media

Adam C. Kaufman, MD, PhD; Brian S. Bacacao, BS; Devesh Sharma, MD
Laurent A. Bekale, PhD; Peter L. Santa Maria, MD, PhD

Hypothesis: Fourth-generation fluoroquinolones, compared to earlier generations of fluoroquinolones, will be more effective at eliminating biofilms and persister cells rapidly in *in-vivo* achievable concentrations.

Background: Fourth generation fluroquinolones were created to expand the spectrum of activity against gram-positive bacteria and delay the development of resistance. Whether this has led to improved efficacy in treating CSOM compared to earlier generations is unknown. Confusion has developed around the optimal first line topical antibiotic to be used to treat CSOM.

Methods: Bacterial and biofilm growth with quantification by spectrophotomer, *in-vivo* antibiotic treatment of murine CSOM, persister cell assay

Results: Moxifloxacin and ciprofloxacin have achievable minimum inhibitory concentrations for controlling planktonic clinical strains of *pseudomonas aeruginosa* and *staphylococcus aureas in-vitro*. Neither drug was able to eliminate biofilms of these strains in a 10-minute exposure window, however 24-hour exposure was. Ciprofloxacin had a lower minimal biofilm eradication concentration than moxifloxacin for 70% of the strains. Repeated exposure to sub-lethal concentrations of both drugs led to rapid development of intra- and extra-class resistance. Lastly, i*n vivo* CSOM infection recurred in all mice after the completion of treatment with moxifloxacin. There was no improvement in the bacterial load after treatment.

Conclusions: Moxifloxacin is effective at eliminating biofilm and persister cells *in-vitro* but fails *in-vivo*. Ciprofloxacin, although from an older generation, was as effective, if not more, than moxifloxacin. Neither generation was able to avoid the development of resistance developing. When choosing a first line topical antibiotic agent for treating CSOM, cost of agent may be the only major distinction between fluoroquinolones.

Professional Practice Gap & Educational Need: Ambiguity exists in determining the ideal first-line topical antibiotic treatment for CSOM. Newer generations of fluoroquinolones were created under the premise that they would have better bacterial coverage and develop less resistance. This has not been explicitly tested in CSOM.

Learning Objective: Ciprofloxacin, a second-generation fluoroquinolone, has equal, if not better coverage of the most common clinical bacterial strains of CSOM than moxifloxacin, a fourth-generation fluoroquinolone. Both fail to avoid the development of resistance.

Desired Result: Otolaryngologists should be choosing their topical antibiotic choice for CSOM based on availability and pricing as there does not appear to be a microbiologic difference between generations of fluoroquinolones.

Level of Evidence – N/A; Basic Science

Indicate IRB or IACUC : Stanford IACUC # 3353

The Efficacy of Amniotic Membrane as a Non-Autologous Graft in Tympanoplasty

Jeffrey Liaw MD; Juan C. Yanez-Siller, MD, MPH
Arnaldo L. Rivera MD

Objective: Amniotic membrane grafts for tympanoplasty have been described in the past for tympanic membrane repair in small studies. Published data regarding outcomes of these grafts, however, is lacking. This study reviews a series of patients who underwent tympanoplasty with amniotic membrane grafts and compares their outcomes with patients who underwent tympanoplasty with temporoparietal fascia or tragal cartilage.

Study Design: Retrospective review

Setting: Tertiary academic center

Patients: Patients undergoing tympanoplasty for tympanic membrane perforations

Interventions: Patients underwent underlay tympanoplasty for repair of tympanic membrane perforation with either amniotic membrane, temporoparietal fascia, or tragal cartilage grafts, as determined by the surgeon.

Main Outcome Measures: Rate of intact tympanic membrane on post-operative evaluation

Results: 114 patients were identified undergoing tympanoplasty from September 2021 to September 2022. Three patients were lost to follow-up. Overall, 93.7% of tympanic membranes were intact on follow up. Among the 37 cases using amniotic membrane grafts, 94.6% of tympanic membranes were intact on follow up. Of these cases, 23 were primary repairs, 14 were revision. Of the 33 cases using temporoparietal fascia grafts, 90.9% of tympanic membranes were intact on follow up. Of these cases, 24 were primary repairs, 9 were revision. Of the 41 cases using tragal cartilage grafts, 95.1% of tympanic membranes were intact on follow up. Of these cases, 26 were primary repairs, 15 were revision.

Conclusions: Amniotic membrane grafts appear to be as effective as autologous tissue for tympanoplasty. Amniotic membrane grafts may be especially useful for revision tympanoplasties with limited graft options.

Professional Practice Gap & Educational Need: Non-autologous graft materials have been described in the past for tympanic membrane repair. It obviates the need for a graft harvest which can prove beneficial in revision tympanoplasties where an autogenous graft may not be easily available. Non-autologous grafts also provide and can provide a uniform scaffold for consistent wound healing. To date, there is a lack of data regarding the outcome of amniotic membrane as a graft for tympanoplasty. This study was performed to evaluate the outcomes of patients who underwent tympanoplasty with amniotic membrane graft and compared them to the outcomes of patients in the same cohort who underwent tympanoplasty with temporoparietal fascia or tragal cartilage grafting.

Learning Objective: To understand the current gap in knowledge regarding the use of amniotic membrane grafts in tympanoplasty and appreciate its potential use as an option as a commercially available non-autologous graft.

Desired Result: Increased utilization of amniotic membrane as a non-autologous graft for tympanoplasty.

Level of Evidence: IV

Indicate IRB or IACUC : Exempt.

Multicenter Exploration of the Effect of Diabetes Mellitus on Tympanoplasty Outcomes

Jose H. Ting, MD; Jonathan Palmer, BS; Benjamin D. Lovin, MD; Alizah S. Gomez, MD
Alex D. Sweeney, MD; Hamid Djalilian, MD; Jacob B. Hunter, MD

Objective: To investigate whether diabetes mellitus (DM) or an elevated Hemoglobin A1c (HbA1c) impact tympanoplasty closure rates and hearing outcomes.

Study Design: Retrospective chart review.

Setting: Three tertiary care centers.

Patients: Adult patients who underwent tympanoplasties for tympanic membrane perforations without ossiculoplasties or mastoidectomies over a 10-year period.

Interventions: Therapeutic

Main Outcome Measures: Graft success at 3-months follow-up, defined as closure of perforation. Secondarily, audiometric measures of success, defined as a closure of the air-bone gap pure tone average to <10 dB.

Results: A total of 607 patients were included, aged 18 to 89 years (mean [SD], 48.3 [15.7]). Overall, 121 patients had DM, with 41 patients having HbA1c values within 4-months of surgery. The average HbA1c value was 7.0% (range, 5.1 – 13.5%). Patients with and without DM had 3-month tympanoplasty closure rates of 84.4% and 87.0%, respectively ($p < 0.001$). Patients with a HbA1c >6.5% (n = 18) (mean 8.6%) and those with a HbA1c <6.5% (n=23) (mean 5.8%) had 3-month closure rates of 72.2% and 82.6%, respectively (p=0.425). Comparing audiometric outcomes in 229 patients, air-bone gap (ABG) pure-tone average closure to <10 dB with DM versus no DM diagnoses was 29.8% and 35.4%, respectively, ($p = 0.473$), and ABG closure rates between HbA1c>6.5% and <6.5% were 0% and 20%, respectively.

Conclusions: Patients with a DM diagnosis have lower tympanoplasty closure rates as compared to those patients without DM. No association was found between DM diagnosis and ABG closure rates.

Professional Practice Gap & Educational Need: Currently, the effect of DM on tympanoplasty outcomes has not been evaluated. This study provides useful knowledge for preoperative counseling for patients and improving preoperative risk assessment in patients with DM.

Learning Objective: To evaluate the effect of DM on tympanoplasty outcomes

Desired Result: Changes in physician knowledge and patient outcomes

Level of Evidence – III

Indicate IRB or IACUC : University of Texas Southwestern Medical Center, #STU-2019-1753;
Baylor University, Protocol H-50149; University of California Irvine, #20173403

Improving Sound Localization While Wearing a Hearing Protection Device Through Neuroplasticity Training

Jason K. Adams, MD; Samuel A. Spear, MD; Jeffrey R. Mock, PhD; Jeremy T. Nelson, PhD
Jacek A. Walasek, BS; Enrique T. Piedra, BS; Carlos R. Esquivel, MD; Edward J. Golob, PhD

Objective: Noise induced hearing loss is a common hazard US military service members routinely encounter. Service members may choose not to use hearing protection devices (HPDs) due to impaired spatial hearing and situational awareness at the risk of future hearing loss, tinnitus and reduced operational effectiveness. Spatial hearing in central pathways exhibit neuroplasticity in early development and after unilateral hearing loss, alteration to pinna shape and cochlear implantation. Taking advantage of the principle that auditory pathways can adjust how they process spatial information to counteract disruptions from HPDs, the purpose of this study is to investigate whether focused training effort improves spatial hearing.

Study Design: Prospective study

Setting: Academic research center

Patients: Normal hearing volunteers

Interventions: Spatial hearing training, three consecutive days of 45 minute training sessions

Main Outcome Measures: Sound localization acuity, front-back confusions

Results: HPDs impair sound localization acuity (45% worse, $p<.001$) and increase front-back confusions (6x worse, $p<.001$) relative to performance without HPDs. After three days of spatial hearing training, sound localization and front-back confusion errors were reduced greater than 50%. The greatest improvements were seen after the first day of training. Training effects were specific to HPD wearers and did not influence non-wearing HPD controls. On training days, listening effort increased before vs. after training ($p<.01$) but was comparable across training days.

Conclusions: Relatively brief training can reduce HPD impairment on spatial hearing by about half, potentially leading to increased service member compliance in HPD use.

Professional Practice Gap & Educational Need: Acute noise induced hearing loss is a common hazard US military service members routinely encounter, hearing conservation through minimized exposure and hearing protective devices are the mainstays of treatment. Service members may not use hearing protective devices due to impaired spatial hearing and reduced situational awareness thus increasing wear compliance would reduce future hearing loss risk.

Learning Objective: To determine the role of spatial hearing training in improving sound localization while wearing hearing protective devices.

Desired Result: Participants will understand the effect brief auditory training has on spatial hearing while wearing hearing protective devices.

Level of Evidence – III

Indicate IRB or IACUC : FY20-21-25, Title: Hearing Protection with Neuroplasticity

Adverse Events Associated with Vibrant Soundbridge: A MAUDE Study

Christopher Yam, MS; Adam Hammer; Esther Lee, DO; Timothy Shaver, MD
Punam Thakkar, MD; Ashkan Monfared, MD

Objective: To summarize adverse events and their root causes reported to the United States Food and Drug Administration (FDA) on Vibrant Soundbridge (VSB) hearing device (Med-El, Innsbruck, Austria), an active middle ear implant for patients with moderate to severe hearing loss.

Study Design: The FDA's Manufacturer and User Facility Device Experience (MAUDE) database was queried for reports of VSB adverse events from January 1, 2012, to July 27, 2022.

Setting: Database

Patients: Patients implanted with VSB.

Interventions: VSB implantation.

Main Outcome Measures: Adverse events and their root causes related to VSB.

Results: Six hundred sixty-three total medical device reports were identified, from which 979 adverse events were extracted. Of these, 564 (57.6%) were adverse events to patients (AEPs), while 415 (42.4%) were device malfunctions (DMs). The most common AEPs were hearing performance issues 428 (75.9%). The most common DMs were compromised conductive link 125 (30.1%). Root causes identified for DMs were surgical errors 74 (55%), patient-related 31 (23%), and external causes 29 (21.6%). The most common surgically related errors involved damage to the conductive link during revision surgery 12 (14.1%). The most common patient-related causes of DMs were excessive middle ear tissue growth 16 (57%), and abrupt body movements 5 (17.9%). The most common external cause of DM was cleaning of the ear canal or mastoid cavity 20 (69%).

Conclusions: Despite its well-known limitations, the MAUDE database provides valuable information on possible complications of VSB as it relates to device malfunction or adverse events for patients. Implementation of standardized reports with relevant and well-defined categories could certainly allow for a more meaningful analysis.

Professional Practice Gap & Educational Need: Obtain an understanding of adverse events and their root causes related to VSB.

Learning Objective: Develop an understanding of the adverse events and their root causes related to VSB.

Desired Result: Heightened awareness of the adverse events and their root causes related to VSB.

Level of Evidence – N/A

Indicate IRB or IACUC: Exempt.

Targeted Immune Inhibitor Therapies to Prevent Noise-Induced Hearing Loss

Kourosh Eftekharian, MD, MPH; Anping Xia, MD, PhD; Viktoria Schiel, MD, PhD
Ritwija Bhattacharya, PhD; Ankur Gupta, MS; Peter L. Santa Maria, MBBS, PhD

Hypothesis: The immune response may play a role in hair cell injury after noise exposure and targeted immune therapies may prevent hearing loss during noise exposure.

Background: Noise-induced hearing loss (NIHL) is the second most common sensorineural hearing deficit after presbycusis, affecting almost 1 in 5 adults in the US. Many reports have shown that noise trauma can result in two types of injury to the inner ear: temporary threshold shift (TTS) or permanent threshold shift (PTS). After acoustic trauma, macrophages increase in number and migrate throughout the cochlea. The migrating macrophages and injured tissue inside the cochlea release cytokines and other toxic factors that could enhance the inflammation causing further damage.

Methods: We expose cohorts of six to eight-week-old CBA/CaJ mice to a noise band of 8-16 kHz frequency at 100 dB SPL for two hours to generate TTS. Mice receive an immune inhibitor therapy as the treatment group, and others receive placebo as the control group before and after noise exposure. The auditory brainstem response (ABR) and distortion-product otoacoustic emission (DPOAE) are measured before, immediately, three days, seven days, and fourteen days after noise exposure in the treatment and control group. Cochlear samples are collected, and immunohistochemistry is performed afterward to assess the hair cell injury. The control group receives no treatment.

Results: We report the ABR and DPOAE before and after, as well as cochlea immunohistochemistry after noise exposure, for the treatment and control groups.

Conclusions: We report on the potential for immune inhibitors for protection from noise-induced hearing loss.

Professional Practice Gap & Educational Need: Recent evidence shows the increase of macrophages in the cochlea as a response to noise exposure. Until now, there has been less attention to the role of macrophages in NIHL.

Learning Objective: Understand the potential role of immune inhibitors after noise exposure in the damage to hair cells.

Desired Result: Using immune inhibitors as a possible agent to reduce the damage after noise exposure.

Level of Evidence: N/A

Indicate IRB or IACUC: Stanford University – Stanford APLAC Number: 32855

Predisposing Factors for the Development of Superior Canal Dehiscence Syndrome

Pavan S. Krishnan, BA; Oren Wei, BS; Eric J. Formeister, MD, MS; Desi P. Schoo, MD
Nicholas S. Andresen, MD; Zahra N. Sayyid, MD, PhD; John P. Carey, MD

Objective: To correlate occupational and recreational histories and events with development of symptoms of SCDS.

Study Design: Retrospective case series.

Setting: Tertiary referral center.

Patients: Adult patients with superior canal dehiscence syndrome (SCDS) who underwent surgical repair.

Interventions: Not applicable.

Main Outcome Measures: Data on occupational and recreational histories, inciting events, and presenting symptoms were collected from the medical records.

Results: Records of 254 patients were reviewed. Fifty-eight percent were female; average age was 49 years. Thirteen percent underwent bilateral surgeries. Of those with a reported occupation (n=120), 24% had sedentary desk jobs, 16% were healthcare workers or veterinarians, 10% were educators, and 6.8% were musicians. Four patients reported occupational noise exposure that may have contributed to symptoms. Of the 25 reported hobbies, 72% were a form of physical exercise (weightlifting, running, etc.) and 24% were musical instrument players; scuba diving, flying airplanes, and singing were each reported once (4%). Records described trauma (e.g., fall, motor vehicle accident, etc.) in 15% of patients, an internal cause (e.g., Valsalva-induced such as sneezing or coughing, etc.) in 13%, and an external cause not involving trauma (e.g., loud noise exposure, ambient pressure changes such as during SCUBA diving) in 12%. In patients with at-risk occupational and recreational histories (n=63), presenting symptoms were autophony to voice (86%), bone-conduction hyperacusis (78%), pulsatile tinnitus (63%), sound-induced vertigo or oscillopsia (71%), and pressure-induced vertigo or oscillopsia (63%).

Conclusions: Certain occupational and avocational factors may predispose to development of symptoms of SCDS.

Professional Practice Gap & Educational Need: Superior Canal Dehiscence Syndrome (SCDS) was first described in 1998 by Minor et al., but the mechanism of pathogenesis is still unclear. Proposed mechanisms include congenital thinning of the otic capsule that may require a second event disrupting the bone entirely thus exposing the membranous labyrinth. This theory is originally based on a 1999 study of temporal bone histopathology specimens and has been substantiated by several case series and reports. No large-scale review of patients with SCDS has been conducted to identify predisposing histories and events that may play a role in the development of symptoms of SCDS. There is a scientific need for further understanding of how events causing a full dehiscence are associated with the development of symptoms required for diagnosis of the *syndrome*.

Learning Objective: Participants should be able to describe theories of pathophysiology of SCDS, most common occupational and recreational histories of patients diagnosed with SCDS and presenting symptoms consistent with SCDS.

Desired Result: Participants will gain an understanding of how certain occupational and recreational activities may contribute to presenting symptoms of SCDS. Our results will give participants further insight into the development of SCDS.

Level of Evidence - V

Indicate IRB or IACUC : Johns Hopkins School of Medicine's Institutional Review Board (IRB00324480)

Outcomes after Exoscopic versus Microscopic Tympanoplasty

Caleb J. Fan, MD; Jacob C. Lucas, MD; Robert M. Conway, DO
Seilesh C. Babu, MD

Objective: To analyze the outcomes of exoscopic versus microscopic tympanoplasty

Study Design: Retrospective chart review

Setting: Tertiary care otology-neurotology practice

Patients: Adult subjects with a diagnosis of tympanic membrane perforation from 2018-2022.

Interventions: Exoscopic or microscopic tympanoplasty with cartilage+perichondrium or perichondrium/fascia graft

Main Outcome Measures: Primary outcomes were graft success rate at the first postoperative visit and operative time. Secondary outcomes at 6-month follow-up included audiometric outcomes of postoperative air-bone gap (ABG), change in ABG, pure tone average (PTA), speech reception threshold (SRT), and word recognition score (WRS) and complication rates of delayed graft failure, cerebrospinal fluid leak, facial nerve injury, persistent tinnitus, and persistent vertigo.

Results: Seventy-one subjects underwent tympanoplasty by a single surgeon. Thirty-six subjects underwent exoscopic tympanoplasty and 35 subjects underwent microscopic tympanoplasty. Cartilage+perichondrium was utilized in 27 subjects (75.0%) in the exoscopic group and in 25 subjects (71.4%) in the microscopic group (p=0.7). Graft success rate was 97.2% (35/36, 95% CI [86%,100%]) in the exoscopic group and 97.1% (34/35, 95% CI [85%,100%]) in the microscopic group (p=1.0). Operative time was 57.7 minutes for the exoscopic group and 65.4 minutes for the microscopic group (p=0.08). Each group had 2 cases of delayed graft failure (p=1.0) with no other complications. Preoperative and postoperative audiometric outcomes were comparable (postoperative exoscope vs microscope, p-value): ABG (10.9dB vs 9.2dB, p=0.06), change in ABG (8.9dB vs 7.5dB, p=0.6), PTA (29.1dB vs 25.6dB, p=0.5), SRT (26.2dB vs 24.0dB, p=0.7), and WRS (95.5% at 65.0dB vs 93.6% at 62.8dB, p=0.5).

Conclusions: The outcomes after exoscopic tympanoplasty are comparable to those after microscopic tympanoplasty.

Professional Practice Gap & Educational Need: The current standard of care is that otologic surgery is performed with a microscope. Newer technologies such as the endoscope and exoscope have become more popular in recent years, which requires a comparison of patient outcomes to uphold standards in otologic surgery.

Learning Objective: The outcomes after exoscopic tympanoplasty are comparable to those after microscopic tympanoplasty.

Desired Result: For otologic surgeons and patients to understand that newer technologies such as the exoscope do not sacrifice outcomes in tympanoplasty surgery.

Level of Evidence – IV

Indicate IRB or IACUC : Exempt

Developing Hearing Screening Outreach: Successes and Challenges

Emily G. Evangelista, MS; Jesse Casanova, MS; Kimberly Coca, MD
Tamsyn Barlow, MBChB; Ayanda Gina, MECI, BSC
Julia Toman, MD; Sibiya, A. MBChB, MMed

Objective: The burden of auditory disease that lies on elderly populations in old-age homes is exacerbated by widespread patterns of hearing loss under-detection. The purpose of this study was a pilot attempt at building a routine hearing screening program that is contextually realistic and sustainable for the population.

Study Design: A multi-center remote hearing screening pilot.

Setting: Old-age homes in Durban, South Africa.

Patients: Patients >65 years old residing in old-age homes.

Interventions: Otoscopy, tympanometry, pure-tone testing, DIN testing, on-site cerumen removal, hearing aid fitting, and audiologist referral.

Main Outcome Measures: Subjective improvement with cerumen removal, auditory testing results, interventions performed, follow-up required.

Results: 85 patients were tested and of these patients 50 (58.8%) required referral to either an ENT or audiologist. This study demonstrated the need for routine testing and hearing health monitoring among population groups living in old-age homes.

Conclusions: Optimization of clinical documentation for clarity and conciseness, standardization of clinical notetaking, and collaboration with local clinics and providers for fluid patient follow-up are all adjustments that could be made to improve the efficiency and effectiveness of the outreach. Local stakeholders should have well-described pipelines for referrals, clinical documents pre-defined and readily available, and a short training session for clinical volunteers one day prior to screening.

Professional Practice Gap & Educational Need: Partnership between local medical centers, university collaboration, and administrators and residents in old-age homes.

Learning Objective: Successes and areas for improvement for a remote hearing screening program in old-age homes.

Desired Result: Guidance for best practice in a collaborative approach to standardize hearing screening development in old-age homes in Durban, South Africa.

Level of Evidence – III

Indicate IRB or IACUC: Exempt.

Risk Analysis Index Frailty Score Predicts Non-Home Discharge following Cochlear Implantation

Traeden Wilson, BS; Kavellin Rumalla, MD; Alis Dicpinigaitis, MD
Christian Bowers, MD; Richard Gurgel, MD, MSCI

Background: The Risk Analysis Index (RAI) uses clinical and patient-reported factors to generate a score to classify a patient's frailty and predict their risk for adverse outcomes following surgery. We aimed to study the prognostic significance of preoperative frailty measured by RAI for prediction of non-home discharge (NHD) after cochlear implantation.

Study Design: The National Inpatient Sample (NIS) 2006-2018 was queried using ICD codes to identify discharges associated with cochlear implantation. Baseline frailty scores and discharge outcomes were analyzed using crosstabulation chi-square tests. Discriminatory accuracy was assessed by computation of C-statistics.

Setting: The NIS is the largest public all-payer inpatient database in the United States, containing data on over seven million hospital stays per year.

Patients: 4913 patients discharged following cochlear implantation were included in the study.

Interventions: RAI.

Main Outcome Measures: NHD disposition.

Results: Baseline frailty, mean (SE) RAI score was 7.4 (0.5) with scores categorized for analysis: 0-9 (61%), 10-20 (31.7%), and 21+ (7.3%). For discharge destination, 93.9% were routine home, 3.3% to facility, and 2.7% home with home health. The NHD rate increased significantly with increasing RAI score: 1.7% for 0-9, 3.2% for 10-20, and 18.0% for 21+ ($p<0.001$). The RAI score predicted primary endpoint of NHD with acceptable discriminatory accuracy ($c=0.750$), whereas the mFI-5 score demonstrated poor discrimination ($c = 0.688$).

Conclusions: This is the first application of the RAI for measurement of frailty and prediction of outcomes after cochlear implantation. Increasing frailty, as determined by RAI, may help predict NHD in patients undergoing cochlear implantation.

Professional Practice Gap & Educational Need: Patients and clinicians may believe that older patients should not be considered for CI due to risks of surgery. Many studies have been devoted to the safety of CI in older adults, though few report on an accurate metric to account for medical comorbidities, i.e., frailty, and how frailty may impact the postoperative course of CI patients. This study utilizes a novel way to stratify risk – the RAI- to determine whether increasing frailty may require more intensive post-operative monitoring for discharge to home.

Learning Objective: Understanding RAI's predictive ability on postoperative complications, namely non-home discharge, following CI.

Desired Result: To provide a metric that can risk stratify adult CI patients for post-operative complications or non-home discharge.

Level of Evidence - Level III

Indicate IRB or IACUC: University of Utah IRB_00147585

Ageism in Hearing Loss Diagnosis and Treatment

Emily M. Ishak; Michael W. Denham, MPhil; Maeher R. Grewal
Justin S. Golub, MD, MS

Objective: To explore the relationship between age and hearing loss (HL) diagnosis/treatment for those with borderline/mild hearing loss (≥20 to <40 dB pure-tone average).

Study Design: Cross-sectional epidemiologic study (National Health and Nutrition Examination Survey; NHANES)

Setting: US community

Subjects: ≥12 years old with borderline/mild HL

Methods: Multivariable logistic regressions controlling for hearing level. Age (the predictor of interest) was grouped into quartiles (Q1: <25 years; Q2: 25-49 years, Q3: 50-74 years; Q4: ≥75 years). Q1 was used as a reference in all odds ratios.

Main Outcome Measures: Hearing test within the past 1 or 4 year(s), hearing aid usage

Results: Of 2,115 subjects with borderline/mild HL, 3% (n=53) were in age quartile Q1; 7% (n=147) were in Q2, 56% (n=1,190) were in Q3, and 34% (n=725) were in Q4. Compared to Q1, those in Q2, Q3, and Q4 had 4.06 times (95% CI=2.11-8.02, $p<0.001$), 4.51 times (2.56-8.19, $p<0.001$), and 4.56 times (2.55-8.39, $p<0.001$) lower odds of a hearing test within the past 4 years. Similar, although slightly larger, odds ratios were obtained when the outcome was hearing test within 1 year. Compared to Q1, those in Q2, Q3, and Q4 respectively had 4.38 times (1.47-13.5, $p<0.05$), 5.41 times (2.27-11.8, $p<0.001$), and 3.95 times (1.65-8.72, $p<0.05$) lower odds of using a hearing aid.

Conclusions: A large, unaddressed disparity exists in the diagnosis and treatment of borderline/mild HL as individuals age out of the first quartile of life.

Professional Practice Gap & Educational Need: To raise awareness of disparities in screening and treatment of HL in individuals older than the first quartile of life.

Learning Objective: To identify the relation between age and likelihood of a recent hearing test and hearing aid usage among those with borderline/mild HL.

Desired Result: Increased HL testing and treatment for the aging population.

Level of Evidence – III

Indicate IRB or IACUC: Exempt

Real-Time Virtual Surgical Scene Representation and Tool Tracking for Temporal Bone Procedures

Jesse D. Haworth, BSE; Andy S. Ding, MD, MSE; Manish Sahu, PhD
Katherine J. Zhu, BS; Russell H. Taylor, PhD
Francis X. Creighton, MD; Robin Yang, MD

Background and Objectives: Given the complex anatomy of the temporal bone, image navigation systems have been developed to help identify nearby critical structures but have been hampered by subpar registration accuracy. In this study, we show feasibility of an optical tracking system that can accurately create virtual representations of the surgical scene including tools and pre-operative cone-beam computed tomography scans (CBCTs).

Methods: Three temporal bone phantoms were 3D-printed with a photopolymer resin. Optical markers were attached to each phantom and to an Anspach EG1 drill. An Atracsys tracking system was used to intraoperatively locate optical markers on the surgical drill and phantoms. Six 2-mm divots were placed on the surface of each phantom for verification of the visualization system. Pre-operative CBCTs obtained for each phantom were then segmented using 3D Slicer, denoting the coordinate of each divot. A pivot calibration was performed to determine the drill tip's location with respect to the Atracsys. Using the virtual visualization software RViz, the drill was overlaid onto the phantom segmentation. Accuracy of the system was evaluated by comparing drill tip positions in RViz to divot positions segmented from CBCTs.

Results: Euclidean distance was calculated between each divot coordinate from RViz and the corresponding point on CBCT. The result was an average error of 0.79mm with a standard deviation of 0.28mm.

Conclusions: We developed a real-time virtual representation for temporal bone procedures with submillimeter registration accuracy. This technology could integrate with other computer-aided surgical systems to accurately determine the position of surgical instruments relative to critical anatomy.

Professional Practice Gap & Educational Need: Although image navigation systems exist for temporal bone surgery, our study is the first to show a system that is also able to virtually represent surgical scenes and accurately depict surgical tool locations in this space. This functionality has a variety of applications, including the ability to 1) replay surgeries in a 3D virtual space, 2) examine and determine optimal drilling paths for freehand procedures, 3) generate training data for neural network applications, and 4) determine the location of instruments relative to underlying anatomy in real-time to improve surgical safety.

Learning Objective: This experiment was designed to determine if the current visualization system could accurately represent the surgical scene in virtual space.

Desired Result: We hope our study inspires further research to utilize and develop computer-aided surgical technologies like this in other applications of otolaryngology.

Level of Evidence – N/A – Feasibility study only.

Indicate IRB or IACUC: IRB00322104

Endoscopic versus Microscopic Resection of Glomus Tympanicum

Ansley J. Kunnath, BA; Michael H. Freeman, MD; Nathan R. Lindquist, MD
Kareem O. Tawfik, MD

Objective: Comparison of short and long-term outcomes of microscopic and endoscopic resection of glomus tympanicum (GT) tumors.

Study Design: Retrospective case review

Setting: Single tertiary referral center

Patients: All adult patients undergoing GT resection without mastoidectomy from 2007-2021

Interventions: Surgical resection – endoscopic versus microscopic approach. Preoperative and postoperative audiometry was also performed.

Main Outcome Measures: Primary outcomes were tumor recurrence at 1 year and presence of residual tumor at conclusion of surgery. Secondary outcome measures included operative time, postoperative air-bone gap, postoperative symptom resolution, and surgical complications.

Results: 38 patients underwent resection of GT (76% female, mean age 59 years). 29 cases were performed microscopically, 8 cases were endoscopic, and 1 case was endoscopic-assisted microscopic. Both endoscopic and microscopic approaches yielded high rates of complete tumor resection (7/8 endoscopic cases, 27/29 microscopic cases). There was no significant difference in operative time (136 minutes for microscopic; 138 minutes for endoscopic). There was no difference in mean postoperative air-bone-gap between microscopic and endoscopic approaches (p=0.20). One patient in the endoscopic group who had residual tumor at the time of surgery was found to have clinically significant tumor recurrence after 5.2 months. The remaining patients in our cohort were not found to have tumor recurrence after a mean follow-up of 21.2 months.

Conclusions: These results suggest comparable outcomes with both endoscopic and microscopic approaches. Endoscopic transcanal resection of glomus tympanicum does not appear to compromise surgical outcomes.

Professional Practice Gap & Educational Need: Establishment of non-inferiority of endoscopic glomus tympanicum resection

Learning Objective: Endoscopic and microscopic approaches to glomus tympanicum are not different in terms of operative time, recurrence rate, or audiometric outcome.

Desired Result: Non-inferiority

Level of Evidence – IV

Indicate IRB or IACUC: Vanderbilt University Medical Center IRB, #220712

Impact of CCR2 Deletion on Outer Hair Cells in Chronic Suppurative Otitis Media

Ankur Gupta, BA; Anping Xia, MD, PhD; Viktoria Schiel, MD, PhD
Ritwija Bhattacharya, MS; Kourosh Eftekharian, MD, MPH
Peter L. Santa Maria, MD, PhD

Hypothesis: Deletion of CCR2 enhances outer hair cell loss through reduction of migrating macrophages in the cochlea of mice with CSOM

Background: Chronic Suppurative Otitis Media (CSOM) is one of the most common causes of permanent hearing loss among children in the developing world. It is characterized by chronically draining middle ear, with no effective cure. We have shown that CSOM induces an inflammatory macrophage response in the inner ear, associated with hair cell damage. We have also revealed that CCL-2, part of the monocyte chemoattractant protein (MCP) family, is elevated over time following middle ear infections. MCP receptor CCR2 has been implicated in many neurodegenerative disorders. In our current study, we investigate the role of CCR2 on hair cell damage in CSOM.

Methods: PCR genotyping was done to isolate CCR2-/-, CCR2+/-, and CCR2 +/+ mice. We inoculated Pseudomonas bacteria to the mouse middle ear cavity for generating CSOM and monitored them at 7 and 14 days after middle ear infection, time points before and after hair cell damage occurs in our model. We dissected the cochlea to assess hair cell damage with whole mount specimens and evaluated macrophages within cross sections.

Results: Our results measure the OHC survival number, with Myosin VIIa immunostaining, in the cochlear basal, middle, and apical turns at 7 and 14 days. We also measured the number of F4/80 macrophages with F4/80 immunostaining in the cochlear turns.

Conclusions: In the future, we will continue to learn more about the mechanism in which CCR2 influences the immune response in the inner ear and whether it plays a protective or harmful role on hair cells in CSOM.

Define Professional Practice Gap & Educational Need: Limited understanding in the inflammatory mechanism of action in the inner ear that causes sensorineural hearing loss in CSOM.

Learning Objectives: 1. Develop an understanding of the mechanism of inner ear inflammation in CSOM.
2. Study possible pathways that may explain the role of CCR2 on outer hair cells.

Desired Result: Deletion of CCR2 demonstrates increased outer hair cell loss relative to CCR2 control in mice with CSOM, showing a possible mechanism in sensorineural hearing loss due to cochlear inflammatory response.

Level of Evidence does not Apply – Basic Science Study

IRB/IACUC: Stanford APLAC 32855

The Hampshire Sheep as a Large-Animal Model for Cochlear Implantation

Nicholas A. Waring, BS; Brandon J. Vilarello, BA; Yew Song Cheng, MD
Elizabeth S. Olson, PhD; Hideko Heidi Nakajima, MD, PhD; Alexander Chern, MD

Hypothesis: The round window membrane (RWM) in Hampshire sheep is surgically accessible via an extended facial recess approach without sacrificing the facial nerve.

Background: Sheep have been proposed as a large-animal model for studying cochlear implantation. However, in the limited literature, cochlear implantation in studied sheep breeds has required either sacrifice of the facial nerve or a retrofacial approach to access the RWM. Here we use Hampshire sheep to assess RWM accessibility via a facial recess approach.

Methods: Five temporal bones from adult female Hampshire sheep were surgically prepared with a mastoidectomy and extended facial recess approach for access to the RWM. Sheep were pre-screened for *Coxiella burnetii*. RWM visibility was graded using St. Thomas' Hospital (STH) classification. Micro-CT scans with a slice thickness of 80 microns were obtained for all temporal bones. Cochlear implant (CI) electrode insertion was performed (Nucleus® 24 Contour Advance™ Practice Electrode), with micro-CT confirmation of appropriate electrode placement and insertion depth.

Results: RWM was exposed in all specimens without sacrificing the facial nerve. Under the STH classification, RWM visibility was determined to be Type I (100% visibility) for 2 specimens and Type IIA (>50% visibility) for 3 specimens. Facial nerve was exposed in 2 specimens. Chorda tympani was sacrificed in all specimens. Successful CI electrode insertion was confirmed by micro-CT.

Conclusions: Contrary to other breeds reported in the literature, Hampshire sheep appear to be a suitable large-animal model for CI electrode insertion through an extended facial recess approach without sacrificing the facial nerve.

Professional Practice Gap & Educational Need: Sheep are a suitable large-animal model for cochlear implants and other implantable hearing devices; however, the sheep breeds currently reported in the literature have unfavorable anatomy for RWM access via a facial recess approach and require either sacrifice of the facial nerve or a retrofacial approach. Here, we report a breed of sheep that allows for RWM access via a facial recess approach with preservation of the facial nerve. This breed is thus potentially better suited for large-animal studies of cochlear implants and other implantable hearing devices.

Learning Objective: To evaluate RWM accessibility via the facial recess in Hampshire sheep.

Desired Result: Describe the anatomic suitability of the Hampshire sheep as a useful animal model for research on cochlear implants and other implantable hearing devices.

Level of Evidence - N/A

Indicate IRB or IACUC: Exempt.

A Systematic Review of Otologic Manifestations of Hematologic Malignancies

Allie M. Ottinger, BS; Mallory J. Raymond, MD; M. Andrew Rowley, BS
Michael Bobian, MD; James Dornhoffer, MD
Emily Brennan, MLIS; Habib G. Rizk, MD

Objective: To examine the array of otologic and neurotologic symptoms, physical exam findings, and imaging features of patients with hematologic malignancies.

Data sources: PubMed, Scopus, and CINAHL were searched through February 26, 2021.

Study selection: English language articles that included patients with hematologic malignancies with 1) inner, middle, or outer ear manifestations, and/or 2) temporal bone, cerebellopontine angle, vestibulocochlear or facial nerve involvement.

Data extraction: Patient and study demographics, timing and classification of otologic symptoms and physical exam findings, associated imaging features, and methods of diagnoses.

Data synthesis: Pooled descriptive analysis was performed within the three broadly defined malignancies of leukemia, lymphoma and multiple myeloma. Two-hundred seventy-two articles reporting on 553 patients, of whom 307 had leukemia, 204 had lymphoma and 42 had multiple myeloma, were included. Hearing loss and unilateral facial palsy were the most common presenting symptoms for 111 reported subjects with leukemia (n=46, 41.4%; n=43, 38.7%) and 90 with lymphoma (n=38, 42.2%; n=39, 43.3%). Similarly, hearing loss and otalgia were the most common presenting symptoms for 21 reported subjects with multiple myeloma (n=10, 47.6%; n=6, 28.6%). Hearing loss and unilateral facial palsy were the most common otologic symptoms indicative of relapse in subjects with leukemia (n=14, 43.8%) and lymphoma (n=5, 50%), respectively.

Conclusions: The otologic symptoms of hearing loss, facial palsy, and otalgia might be the first indication of a new diagnosis or relapse of leukemia, lymphoma, or multiple myeloma. Providers should have a heightened level of suspicion of hematologic malignant etiologies of otologic symptoms in patients with current or past medical histories of these malignancies.

Professional Practice Gap & Educational Need: Otologic manifestations of hematologic malignancies are diverse and overlap with many common otologic conditions. To date, the literature on otologic manifestations of hematologic malignancies has been comprised primarily of rare or unique presentations, limiting clinicians' abilities to evaluate the medical necessity of investigating a hematologic malignancy as a cause of a relatively common otologic symptom.

Learning Objective: To recognize the array of otologic symptoms, physical exam findings, and imaging features associated with and caused by hematologic malignancies; to recognize the similarities of otologic manifestations of hematologic malignancies with benign conditions.

Desired Result: Attendees should recognize the array of otologic symptoms, physical exam findings, and imaging features associated with and caused by hematologic malignancies and the similarities of otologic manifestations of hematologic malignancies with those of benign conditions.

Level of Evidence - Level III

Indicate IRB or IACUC: Exempt

Idiopathic Sudden Sensorineural Hearing Loss: Efficacy of Oral and Intratympanic Steroid Therapy

Grace Callan, BS; Erin A. Harvey, MD; Neil Osafo, BS; Jazzmyne A. Adams, MPH
David R. Friedland, MD, PhD; Jake Luo, PhD

Objective: Determine oral steroid (OS) treatment response for idiopathic sudden sensorineural hearing loss (ISSNHL) and compare clinical outcomes to intratympanic (IT) steroids.

Study Design: Retrospective cohort study.

Setting: Tertiary Academic Center.

Patients: Patients diagnosed with ISSNHL receiving at least 1 course of OS between January 2009 and February 2022. OS patients were compared to a previously reported cohort of 74 patients who underwent IT treatment.

Interventions: OS or IT steroid therapy for ISSNHL.

Main Outcome Measures: 1) Efficacy of OS for ISSNHL; 2) Relative efficacy of OS to IT steroids.

Results: There were 96 patients treated with OS; 56.2% male, mean age 55.8±13.9 years; 84.4% ≥40 years. Average presenting 4-frequency pure tone average (4PTA) was 60.8±29.8dB. Low frequencies exhibited full recovery in 53.5% of patients while high frequencies recovered in 44.6%. 43.8% of OS patients had full 4PTA recovery compared to 25.7%) who underwent IT (p=.017). For patients under 40 years old, full recovery rates were similar between OS (60.0%) and IT (61.5%). In patients over 40 years old, however, full recovery was seen in 40.7% of patients on OS and 18% for IT. A greater proportion of patients with mild to moderate hearing loss had full recovery on OS than IT therapy.

Conclusions: Oral steroid therapy shows prognostic benefit for full recovery in all patient age groups as well as in patients with milder degrees of hearing loss when compared to IT.

Professional Practice Gap & Educational Need: Both oral steroid and intratympanic steroid therapy is utilized currently in ISSNHL. A gap exists in understanding the relative efficacy of each therapy as stratified by patient characteristic.

Learning Objective: Understand recovery rates for oral steroid therapy in different age demographics, degrees of hearing loss, and use of oral or IT steroid.

Desired Result: For physicians to use evidence-based information in counselling patients during decision making for treatment in ISSNHL.

Level of Evidence - IV

Indicate IRB or IACUC : IRB# 1538127

The Association of Hearing Loss and Music Engagement in the Canadian Longitudinal Study of Aging

Alexander Chern, MD; Srishti Nayak, PhD; Peyton L. Coleman, BS
Reyna Gordon, PhD

Objective: Music engagement has been associated with increased quality of life, health, and well-being. However, studies investigating its relationship with hearing loss (HL) have been limited to small samples. Our objective was to examine the association of HL with music engagement on a population level.

Study Design: Cross-sectional analysis of prospective, epidemiologic cohort study

Setting: Canadian Longitudinal Study of Aging

Patients: 26,236 adults ≥45 years old

Interventions: none

Main Outcome Measures: The exposure was HL, measured by better hearing ear pure tone average (PTA). The outcome was music engagement, measured by frequency of singing or playing a musical instrument (1=every day, 2=several times/week, 3=several times/month, 4=several times/year, 5=once/year or less) or having played a musical instrument, listened to radio/music, or participated in a musical program in the past 7 days. Multivariable linear/logistic regressions were performed to assess associations between music engagement and HL, adjusting for age, sex, socioeconomic status, and hearing aid usage.

Results: Mean (SD) age was 62.7 (10.1) years; 51% were women. Mean (SD) better ear PTA was 17.6 (10.9) dB; 5.2% were hearing aid users. Multivariable regression demonstrated a significant association between increased severity of HL and decreased active music engagement. For every 10-dB worsening in better ear PTA, there was a 0.051-point decrease in frequency of singing or playing a musical instrument (95% CI 0.035-0.068, $p<0.0001$).

Conclusions: Using population-level analyses, increased severity of HL was independently associated with reduced active music engagement. Our findings align with behavioral studies demonstrating decreased music appreciation in individuals with HL.

Professional Practice Gap & Educational Need: Music engagement has been associated with increased quality of life, health, and well-being. Recent literature has suggested that hearing loss is associated with decreased music engagement; however, these studies are limited by their small sample sizes, heterogeneous outcome variables, and inconsistent results. Examining this association on a population level with significantly higher-powered analyses will help further elucidate the relationship and potential mechanism between hearing loss and music engagement.

Learning Objective: After this presentation, the learner should be able to describe the relationship between hearing loss and music engagement from an epidemiologic perspective.

Desired Result: Clinicians will better understand the relationship between hearing loss and music engagement.

Level of Evidence: III

Indicate IRB or IACUC: Exempt

Failure in HiRes Ultra Series Recall Devices Does Not Necessarily Lead to Decrement in Performance

Erin A. Harvey, MD; Muhammad Khokhar, BS; Michael S. Harris, MD
Jazzmyne A. Adams, MPH; David R. Friedland, MD, PhD

Objective: To assess performance for patients identified with Advanced Bionics Ultra/3D (V1) cochlear implant electrode failure.

Study Design: Retrospective cohort study.

Setting: Tertiary academic center.

Patients: Adult patients implanted with a V1 device.

Interventions: Cochlear implantation and audiometric testing.

Main Outcome Measures: Failure rate, auditory performance.

Results: There were 104 ears representing 102 patients implanted with a V1 device. Of the 55 patients marked as non-failure, 44 (80%) consistently tested normal in follow up. Forty-eight (46.2%) devices showed failure as indicated by a drop in impedance, which is higher than previously reported in the literature (21.1%). Eleven patients with failure opted for observation (22.9%). These patients reported both subjectively stable hearing, and had no significant change in CNC word or AzBio in quiet testing between their best performance and performance at failure($p>.05$). Sentence testing for patients who elected observation was significantly higher (74.5±22%) at failure compared to those undergoing revision (60±37%, $p=.02$). Age at implant and time from implant to failure was similar between observation and revision groups ($p>.05$). Twenty-nine patients were revised and showed significant improvement in post-activation score compared to time of failure, with a mean improvement of 12.9% ($p<.0001$) for CNC word scores and 17.2% ($p<.001$) for AzBio in quiet.

Conclusions: Our identified failure rate for the HiRes Ultra Series (V1) recall is higher than that previously reported. A significant number of patients with signs of failure do not demonstrate decrement in subjective or objective performance which may inform a decision to not undergo revision surgery.

***Professional Practice Gap & Educational Need:** Understanding of current V1 failure rates, and knowledge of speech perception outcomes in patients who either observe or revise after failure is detected.

***Learning Objective:** Understand auditory perception outcomes for observed and revised V1 failures.

***Desired Result:** To inform decision making for management of patients experiencing V1 device failure.

***Level of Evidence -** IV

***Indicate IRB or IACUC :** IRB# 1538127

Pioneering Surgical Cures: Vestibular Neurectomy for Meniere's Disease

Dianela Perdomo; Jeremy Greene, MD, PhD; Nathaniel C. Comfort, PhD
Andy Harrison; Bryan K. Ward, MD

Objective: Elucidate the development of vestibular neurectomy as a treatment for Meniere's disease (MD) from its proposition in the late 1800s to present day.

Study Design: Historical review and analysis

Methods: The Walter Dandy, Samuel Crowe, and surgical log collections at the Chesney Medical Archives were reviewed (1905-1955). Google Scholar was used to identify relevant articles in English and French (1861-2000).

Results: The dawn of antiseptics, advancements in anesthesia, and proliferation of medical specialties rendered the 20th century ripe with surgical experimentation. In 1908, Frazier was the first to section the auditory nerve for MD, but uncertainty over surgical candidacy constrained interest in the procedure. At Johns Hopkins, the birth of the Otologic Laboratory in 1924 introduced new technologies like the audiometer, adding rigor to clinical assessment and evaluation. While Crowe, the chair of otolaryngology, focused on developing the novel specialty, Meniere's cases were referred to neurosurgeon Walter Dandy, whose fascination with paroxysmal epilepsies seeded his interest in MD. From 1924-1946, Dandy performed 692 neurectomies, marketed as the first cure for what was believed to be a progressive disease. After his passing, trainees' attention shifted to traumatic injuries, likely influenced by WWII. This left the procedure scarcely utilized until third parties rekindled interest decades later.

Conclusions: Neurectomy as the preferential treatment for MD was not driven by pure scientific reasoning but was rather contingent on historical context and sponsorship by a prominent figure like Walter Dandy. Appreciation of MD's natural history has since curtailed the favorability of destructive procedures in preference for conservative management.

Professional Practice Gap & Educational Need: Appreciate the evolving epistemology of MD from the 1900s to present day, and why a procedure once esteemed a cure is now scarcely utilized.

Learning Objectives: Understand the origin and development of vestibular neurectomy as a treatment for MD

Desired results: Understand the historical drivers of surgical experimentation and factors contributing to widespread adoption of procedures like neurectomy apart from evidence-based research.

Level of Evidence – N/A

Indicate IRB or IACUC: Johns Hopkins Privacy Board application #2022-05. Exempt from IRB.

Vestibular Dysfunction after Cochlear Implantation: A Retrospective Cohort Study

Aparna Govindan, MD; Mia Saade, BS; Jennifer Kelly, PT, DPT, NCS
Zachary Schwam, MD; Enrique Perez, MD; George B. Wanna, MD
Maura K. Cosetti, MD

Objectives: To characterize vestibulopathy in patients with cochlear implants and assess the temporal relationship between implantation and vestibular dysfunction.

Study Design: Retrospective review

Setting: Tertiary otology care center

Interventions: None

Patients: Patients undergoing vestibular rehabilitation from 2017-2022 with prior cochlear implantation preceding vestibular symptoms.

Main Outcome Measures: Demographics, time from implantation to vestibular symptom onset, dizziness handicap index (DHI), activities-specific balance confidence (ABC), and number of falls in past year were collected. Univariate analysis was performed to assess the relationship between these measures and diagnosis. A subset analysis of patients with benign paroxysmal positional vertigo (BPPV) versus those without was performed.

Results: 32 patients met inclusion criteria. 19 (59%) were men. Mean age at implantation was 54 years (range 4-88). Average time from implantation to symptom onset was 50.8 months (range 0-206). Commonly reported symptoms included dizziness (91%), imbalance (84%), and vertigo (72%). Top diagnoses at time of evaluation were BPPV (38%) and peripheral vestibular dysfunction (50%). Of those with BPPV, 58% experienced canalithiasis in a previously implanted ear. Mean age implantation was found to be significantly different between those with and without BPPV (64 vs. 48, $p = 0.04$). There were no differences in time to vestibular symptoms onset, DHI, or ABC.

Conclusions: Vestibular dysfunction developed years after cochlear implantation in this cohort, suggesting that chronic or persistent vestibulopathy is seldom a direct result of implantation despite being highly cited on the differential. Close monitoring and prompt follow-up of vestibular symptoms after implantation are warranted given the prevalence of diagnoses with effective treatment options.

Professional Practice Gap & Educational Need: Few studies have studied the impact of cochlear implantation on the vestibular system, yet vestibulopathy in implanted patients are often anecdotally correlated to the presence of the implant. The purpose of this study is to understand if there is temporal correlation between vestibular dysfunction and cochlear implantation.

Learning Objective: To characterize the presentation of vestibular dysfunction after cochlear implantation and to assess the temporal relationship between cochlear implantation and post-implantation vestibular dysfunction

Desired Result: Persistent vestibular dysfunction rarely develops immediately after cochlear implantation.

Level of Evidence – IV

Indicate IRB or IACUC: 21-01768, Icahn School of Medicine at Mount Sinai Hospital, approved 12/30/2021

Facial Nerve Aberrations Encountered during Cochlear Implant Surgery

Chisei Satoh, MD, PhD; Yukihiko Kanda, MD
Haruo Yoshida, MD, PhD; Yoshihiko Kumai, MD, PhD

Objective: To define the frequencies and types of facial nerve aberrations encountered during cochlear implant surgery.

Study Design: A retrospective review.

Setting: A university-based tertiary medical center.

Patients: A total of 485 patients who received cochlear implants from 1997 to 2022.

Interventions: Patients with intraoperatively discovered nerve aberrations were included.

Main Outcome Measures: The types of facial nerve aberration, coexisting inner- or middle-ear malformations, and electrode insertion method.

Results: Facial nerve abnormalities were found in 11 ears (of 6 cases) (1.7%). All evidenced inner ear malformations and stapes deformities or loss. Cochlear malformations were apparent in six ears and cochlear nerve hypoplasia was observed in eight. Preoperative, three-dimensional (3D) computed tomography (CT) images of all such cases were studied. When the images indicated that electrode insertion might be difficult using the posterior tympanotomy approach, the posterior wall of the external auditory canal was removed in three ears and a combined approach was employed to treat one ear. All such cases evidenced (abnormal) inferior dislocation of the horizontal facial nerve segment and anterior dislocation of the vertical segment. No case exhibited postoperative facial nerve paralysis or vestibular dysfunction.

Conclusion: Most cases exhibiting facial nerve aberrations during cochlear implant surgery evidenced middle- or inner-ear problems, or cochlear nerve malformations. A canal wall-down approach has been used to treat some such cases; the point is that safe electrode placement is always possible.

Professional Practice Gap & Educational Need: Surgeons placing cochlear implants must be aware of possible facial nerve aberrations; these may compromise safe electrode placement. We define the facial nerve aberrations that may be encountered, perhaps coexisting with inner- and middle-ear malformations.

Learning Objective: Facial nerve aberrations encountered during cochlear implant surgery are associated with high rates of inner- and middle-ear malformations. Thus, careful surgical planning is required. We emphasize that the abnormal facial nerve patterns are similar in most cases.

Desired Result: Electrode insertion is safe in patients with facial nerve aberrations but careful preoperative planning is necessary.

Level of Evidence - Level V

Indicate IRB or IACUC: IRB 20032302-3, Nagasaki University Hospital

Effect of Cochlear Implantation on Social Life

Priyanka Reddy, MD; Kara J. Schneider, AuD; Terrin N. Tamati, PhD
Aaron C. Moberly, MD

Objective: Explore the effects of hearing loss on social life and identify residual social life deficits that remain after cochlear implantation.

Study Design: Retrospective Review of Prospectively Obtained Data

Setting: Tertiary Care Adult Neurotology Center

Patients: Adults between the ages of 35 and 83 years were included. Participants either had normal hearing (NH) or used a cochlear implant (CI).

Interventions: CI and non-CI specific quality of life (QOL) surveys focused on social and overall QOL.

Main Outcome Measures: (1) The difference in non-CI specific social QOL survey responses between NH and CI participants. (2) The relationship between CI specific social and global QOL responses and non-CI specific social QOL responses in CI users.

Results: A total of 51 participants were included: 31 CI users and 20 NH participants. Of the non-CI specific social QOL questionnaires, CI users reported significantly poorer scores on Self-Efficacy in Social Interactions than NH peers ($p=0.049$). Both the Self-Efficacy in Social Interactions scores and the Social Isolation Questionnaire scores were significantly correlated with the CI specific social domain of QOL ($r=0.64$, -0.58 respectively). Only the Self-Efficacy in Social Interactions scores had a moderate association with global CI QOL ($r=0.47$).

Conclusions: CI users self-report similar social life outcomes as their NH peers with the exception of poorer self-efficacy in social situations. Moreover, self-efficacy in social interactions and social isolation were associated with social QOL in CI users, and self-efficacy in social interactions was associated with broader CI-related QOL. Findings support the relevance of individuals' perception of their social life to their overall QOL with a CI.

Professional Practice Gap & Educational Need: This study evaluates the social life of patients with hearing loss and CIs in comparison to NH peers. This study also analyzes in greater detail the relationship of CI specific QOL to various granular assessments of social life and identity.

Learning Objective: Understand the effects of hearing loss on various aspects of social life and identity as well as the effect of cochlear implantation on these granular assessments of social life and identity.

Desired Result: To better counsel patients on the aspects of social life and identity that are affected by hearing loss and cochlear implantation as well as which aspects of social life are most related to CI QOL.

Level of Evidence - Level IV

Indicate IRB or IACUC : Local IRB #2015H0173

Robotics-Assisted Cochlear Implantation with the iotaSOFT: Initial User Experience Results

Rick Nelson, MD, PhD; Matthew Carlson, MD; Oliver Adunka, MD; Felipe Santos, MD
Robert Hong, MD, PhD; Bruce Gantz, MD; Marlan R. Hansen, MD

Objective: Robotics-assisted electrode array insertion provides slow, steady insertion profiles that help mitigate damage to cochlear structure and function. We collected and evaluated data from initial users of the iotaSOFT™ Insertion System, a recently FDA-cleared device that robotically controls the insertion

Study Design: Retrospective Case Review.

Setting: Survey from 10 surgeons from 6 hospitals.

Patients: Cochlear implant recipients with radiographically normal cochleae.

Interventions: Cochlear implantation with robotic-assistance during the electrode array insertion portion of the surgery. Speed of insertion was limited to 0.1 or 0.2mm/sec.

Main Outcome Measures: Survey feedback from users regarding case times, problems and solutions encountered, and advice to other users were solicited to develop best practices for the device.

Results: Users found the device valuable for providing consistent insertion speed, stability of electrode insertion, and the ability for hands-free insertion. 8/10 users felt proficient with less than 10 cases, and found the device adds 5-15 minutes to total case time once proficient. Some users encountered problems during loading, but experience varied. The most important best practices were to provide adequate incision size and location and an ample facial recess. Lastly, nearly half of respondents used ECochG as a complimentary technology during cases.

Conclusions: Through user experience, proficiency of a robotics-assisted device during CI surgery can be achieved with minor adjustments of the surgical approach. As experience with the device expands, techniques for best practices will continue to improve and the inherent advantages in robotic assistance will improve patient care.

Professional Practice Gap & Educational Need: The use of robotics-assisted devices during CI electrode array insertion is still novel, but the recognition of differences in technique between surgeons and the development of best practices will advance the field and improve patient care.

Learning Objective: Understand the surgical challenges and potential advantages of robotics-assisted cochlear implantation with the iotaSOFT.

Desired Result: Clinicians will understand how robotic-assisted technologies can be implemented within their current surgical workflows.

Level of Evidence – Level V

Indicate IRB or IACUC : Exempt

Capacity of Ionic Liquids in Transtympanic Dexamethasone Delivery

Oghomwen E. Ogbeide-Latario, BSc; Yutaka Koizumi, MD
Eden Tanner, DPhil; Elliot Kozin, MD; Samir Mitragotri, PhD
Aaron K. Remenschneider, MD, MPH

Hypothesis: We hypothesize that ionic liquids can enhance trans-tympanic delivery of therapeutics for the treatment of middle and external ear disease.

Background: Local delivery of drugs to the middle ear are limited by the tympanic membrane's squamous epithelial layer. Ionic liquids are a class of compounds comprised of cations and anions that have been shown to enhance transdermal delivery of therapeutic molecules. Taken together, ionic liquids may represent a new delivery method for drugs to reach the middle ear through an intact tympanic membrane.

Methods: A custom ex-vivo Franz diffusion cell system was generated to model trans-tympanic drug delivery. Thin porcine skin was used as a proxy for the tympanic membrane at a liquid/liquid interface. 100μL each of 5mg/mL of dexamethasone-loaded ionic liquid, 5mg/mL dexamethasone-loaded PBS and ionic liquid alone were placed in the donor chamber and samples from the receptor chamber collected over 4 hours. Absorbance at 241nm was assessed to quantify transmembrane dexamethasone delivery.

Results: Dexamethasone was delivered transcutaneously at higher concentrations in IL-Dex as compared to PBS-Dex. Nearly all of the dexamethasone was delivered across the stratum corneum into the dermis with IL-Dex, compared to significantly less in PBS-Dex ($p=0.002$). Dermal penetration of dexamethasone was significantly greater than transcutaneous flux of drug in IL-Dex preparations.

Conclusion: We identify an ionic liquid/dexamethasone construct with superior skin penetration, but without significant release from the underlying dermis. Preparations of drug with ionic liquids may have implications for dermal conditions of the external ear, such as otitis externa and require further assessment.

Professional Practice Gap & Educational Need: Innovation in the field of external and middle ear disease is needed to reduce the morbidity associated with external and middle ear conditions and improve efficacy.

Learning Objective: At the end of this presentation, the audience will recognize the potential for non-invasive drug delivery in the ear using ionic liquids, a new class of compounds.

Desired Result: The audience will understand the benefits and limitations and need for further research into new therapeutics for common external and middle ear disease.

Level of Evidence – N/A

Indicate IRB or IACUC: Exempt

Evaluating the Impact of a Temporal Bone Dissection Course on Resident Confidence and Efficiency with Otologic Procedures

Ido Badash, MD; Alison Yu, MD; Liyang Tang, MD; James Kim, MD
Raymond Kung, MD; Seiji B. Shibata, MD, PhD

Objective: Determine if participation in a temporal bone dissection course is associated with increased resident confidence and efficiency with otologic procedures.

Study Design: Prospective, single-center survey study.

Setting: Academic teaching hospital.

Subjects: 15 residents of different training levels (PGY2-PGY5) from a single residency program in the United States.

Interventions: Residents participated in a 3-day temporal bone dissection course including a validated temporal bone dissection examination. Just before starting the course and immediately after completing the course, residents completed surveys assessing their confidence and efficiency with different otologic procedures. Surveys also contained questions regarding training level, previous experience with otologic procedures, fidelity of temporal bone specimens, and usefulness of the course for surgical training.

Main Outcome Measures: Confidence and efficiency with otologic procedures, anatomic fidelity of temporal bones, and usefulness of the temporal bone dissection course for surgical training. Responses were measured on a five-level Likert Scale with options of strongly agree (1), agree (2), neither agree or disagree (3), disagree (4), and strongly disagree (5).

Results: Compared with responses prior to the course, residents reported increased confidence with performing facial recess dissection (3.1 vs. 3.8, $p<0.05$), facial nerve decompression (3.5 vs. 4.3 vs. $p<0.001$), canal wall down mastoidectomy (3.0 vs. 3.7 vs. $p<0.05$), and labyrinthectomy (3.5 vs. 4.4, $p<0.01$) after course participation. Residents also reported increased efficiency with opening ears (1.7 vs. 2.3, $p<0.01$) and performing cortical mastoidectomy (2.3 vs. 3.1, $p<0.01$), facial recess dissection (3.5 vs. 4.3, $p<0.01$), facial nerve decompression (3.8 vs. 4.3, $p<0.05$), and labyrinthectomy (3.9 vs. 4.5, $p<0.05$) after the course. Postgraduate year, prior experience with otologic procedures, and dissection examination scores did not correlate with changes in confidence or efficiency. Residents reported that temporal bones had a high degree of anatomic fidelity (1.5) and were useful for improving operative technique (1.4).

Conclusions: Residents reported increased confidence and efficiency with otologic procedures after participation in a temporal bone dissection course regardless of training level or prior experience. Overall confidence and efficiency with techniques more advanced than cortical mastoidectomy remained low even after course completion.

Professional Practice Gap & Educational Need: Due to recent work-hours limitations, there has been increasing demand for surgical training outside of the operating room. While frequently utilized, there is limited information about the association of temporal bone dissection courses with resident confidence and efficiency with otologic procedures.

Learning Objective: 1) Understand the impact of a temporal bone dissection course on resident confidence and efficiency when performing otologic procedures.

Desired Result: 1) Increased incorporation of temporal bone dissection courses into residency training; 2) Recognition of the impact of temporal bone dissection courses on improving resident confidence and efficiency with otologic procedures.

Level of Evidence: III – Cohort.

Indicate IRB or IACUC : Exempt.

Calibration and Validation of a Force Sensing Surgical Drill

Yuxin Chen, BS; Anna Goodridge, MS; Manish Sahu, PhD
Russell H. Taylor, PhD; Deepa J. Galaiya, MD

Objective: Demonstrate the capacity of a novel force-sensing surgical drill to tell measure real-time forces applied on the surgical drill tip during robotic surgery.

Background: Measurement of tool-to-tissue forces during robotically assisted surgery is necessary, both to provide haptic feedback and to define force limits. We have therefore developed a force-sensing otologic drill to measure tool-to-tissue forces. In this study, we show the calibration and validation of this drill.

Methods: A specialized drill holder was designed using an ATI Nano43 force sensor for the Anspach EG1 surgical drill and attached to the robot arm. We calibrated the drill (1) for its weight against gravity and (2) for the surgeon's hand force on the drill, allowing us to calculate the resultant force on the drill tip. To validate the predicted resultant force, a raw egg was mounted on a second ATI force sensor as ground truth. 15 egg-drilling trials of 8 points and 16 egg-drilling trials along a circular path were done, comparing the drill tip forces to the ground truth forces.

Results: (1) The self-weight calibration was validated at >100 points with an average error of 0.0145 N. (2) The hand force calibration was validated with an average error 0.0169 N. (3) The average root mean square error (RMSE) on points was 0.0569 N with a standard deviation 0.0091 N and the average RMSE along the path was 0.0649 N with a standard deviation 0.0068 N. (4) The average max peak force in each trial is 2.0074 N with a standard deviation 0.5514 N.

Conclusions: We have demonstrated the design, calibration and validation of a robotic force-sensing drill, showing minimal error compared to the measured drill forces.

Professional Practice Gap & Educational Need: Demonstrates innovations in robotically assisted otologic surgery by showing the design, calibration and validation of a force-sensing drill. Accurate tool-to-tissue force measurements are needed to prevent tissue damage during robotically assisted drilling.

Learning Objective: To validate a force-sensing robotic surgical drill.

Desired Result: Attendees will recognize this as a first step in a series of innovations required for force sensing in robotic surgery.

Level of Evidence: III

Indicate IRB or IACUC: Exempt.

Predicting Cochlear Implant Postoperative Audiologic Outcomes Using Preoperative Lip-Reading Scores

Alexander J. Jones, MD; Jasmine Moawad, BS; Douglas J. Totten, MD, MBA
Evan Cumpston, MD; Rick F. Nelson, MD, PhD

Objective: To assess predictive ability of visual-assisted City University of New York (CUNY) sentence test scores on postoperative AzBio sentence scores in cochlear implant (CI) patients

Study Design: Retrospective cohort study

Setting: Tertiary referral center

Patients: Patients undergoing CI with preoperative CUNY testing

Main Outcome Measures: Impact of high pre-operative combined audio + visual CUNY (defined as ≥70%) scores, low-frequency pure tone average scores, and duration of deafness on one-year postoperative AzBio scores.

Results: Twenty-three mostly white (83%) female (61%) patients with mean age 49 years were included. Comparing patients with good preoperative CUNY audio + visual scores (≥70%) to those with poorer performance (<70%), there were no statistical differences in age (p=0.877), sex (p=0.102), duration of deafness (p=0.827), preoperative low tone (250 + 500 Hz) average (p=0.328), or preoperative pure tone average (p=0.896). Similarly, there was no statistical difference between postoperative AzBio scores between CUNY scoring groups (p=0.123, Cohen's d = 0.650).

Conclusions: Preoperative visual-assisted CUNY scores were not associated with postoperative CI AzBio scores. Further, larger investigations are required to determine role of multisensory processing in CI speech perception.

Professional Practice Gaps: As many potential candidates pursue cochlear implantation, identifying good candidates for CI is imperative.

Learning Objectives: Responses to visual may not predict postoperative CI performance

Desired Results: Patients with hearing loss often utilize visual cues for communication. The effect of patient multisensory processing capacity on postoperative CI results is yet to be determined.

Level of Evidence: V

IRB: Indiana University IRB #13133 (approved 10/8/2021)

Long-term Outcomes and Prognostic Factors of Cochlear Implantation in Pre-terms Children

Idit Tessler, MD, MPH; Jonathan Adler, MD
Ziva Yakir; Amit Wolfovitz, MD

Objective: To evaluate long-term hearing outcome in preterm infants following cochlear implantation (CI) in compare to term-borne infants, and to assess prognostic effect of birth-week and birth-weight.

Study design: Retrospective comparative study.

Setting: Single tertiary center.

Patients: Children who underwent CI between 2008-2017 with documented 5-year follow-up. Study cohort was divided into preterm infants, and two control groups: (I) mixed etiologies hearing-loss, and (II) GJB2-related deafness.

Main outcome measures: Speech-reception-threshold (SRT) and mono-syllabic word identification (HAB) scores were assessed at 2- and 5- years post implantation.

Results: Study included 21 preterm-borne (35 ears), 31 children (59) in control I, and 39 (67) in the control II. The cases mean birth-week was 31.5, and birth weight 1531±668 grams. Cases chronologic and corrected age at implantation was 26.4 and 21.9 months, respectively, and control I and II 26.3 and 24.5 respectively. Best SRT performance were for control II, while cases and controls I had comparable results (23±6.6 vs. 26.5 ±6.3 and 26.1±6.8, respectively, p=0.01). No significant difference was found in 2- and 5-years HAB scores between all groups (2-years: 68.1±21.4%, 67.4±18.3%, and 66.9±17.4%, p=0.97; 5-years: 72.8±16.1%, 77.5±18.8% and 72.7±15.8%, for cases, controls I, II, respectively). Extremely low birth-wight (ELBW, <1000g) infants had significantly worse HAB scores, compare with other preterm infants (55±17.3% vs. 82.1±18.2%, p=0.01). No significant difference was found according to birth-week.

Conclusions: Our findings suggest prematurity itself does not affect CI outcome, and preterm-borne can achieve comparable hearing outcomes to term-children. However, ELBW in preterm-borne is associated with worse outcomes.

Professional Practice Gap & Educational Need: Preterm implantees are a unique group, with scant literature regarding CI outcomes and hearing prognosis. This data can be essential for expectation mitigation for the patient's family and treating physicians.

Learning Objective:
1. Understanding hearing outcomes of CI in preterm borne infants
2. To identify prognostic factors for CI successes in preterm borne infants

Desired Result: Data from this study could assist physicians in the management of hearing disorders in preterm borne infants and to facilitate the patient's family expectation.

Level of Evidence: III

Indicate IRB or IACUC: 5076-18-SMC

Patient-Related Predictors of Hearing and Speech Recognition Outcomes after Adult Cochlear Implantation in a Southern Louisiana Population

Sara E. Bressler, MD; Ari Saravia, BS; Stephanie Warrington, MD
Kelsey Lacourrege, MD, MPH; Moises A. Arriaga, MD, MBA
Anne K. Maxwell, MD; Rahul Mehta, MD

Objective: To determine patient-related predictors of hearing and speech recognition outcomes after cochlear implantation (CI) among adults in a region with prevalent health disparities.

Study Design: Retrospective review of a CI database (2017-2020).

Setting: Academic tertiary-care hospital.

Patients: Adults (>18 years) with bilateral severe-to-profound hearing loss.

Interventions: Cochlear implantation.

Main Outcome Measures: Pre- and post-operative auditory testing (pure tone average, speech reception threshold, and open-set sentence testing in quiet [AzBio]) compared across demographics, medical history, and intraoperative pathology.

Results: 125 CI surgeries were performed. Mean age was 60.9±18.6 years (18-88). Ninety-eight (78%) patients were white and 14 (11%) black, while the surrounding community is 44.8% white and 46.3% black. Black patients had worse pre-operative PTA (p=0.0079) and AzBio (p=0.04), yet a longer time from evaluation to activation (12.8 vs. 8.2 months, p=.0183), and unfortunately worse post-operative AzBio in quiet (34 ± 19 vs. 75 ± 23, p=0.001). Most had a long duration of deafness (>10 years), which was not dependent on race (79% black vs. 64% white, p=0.36). Medicaid would not pay for CI in adults, despite 31.5% of adult state residents having this insurer. Cochleostomy, performed in 12 (10%) ears for round window fibrosis (n=6), anatomic abnormalities (n=6), and middle ear inflammation (n=1), resulted in worse post-operative PTA (p=0.039). Age at implantation, insurer (private vs. Medicare), and communication method were not significant predictors.

Conclusions: While CI remains an effective intervention for auditory rehabilitation, hearing and speech recognition outcomes and access to care may differ based on racial disparities.

Professional Practice Gap & Educational Need: Although cochlear implantation remains a standard of care for patients with severe-to-profound hearing loss, the impact of certain patient-related factors and social determinants of health on hearing and speech recognition outcomes remains largely unaddressed.

Learning Objective: Learners will better appreciate the importance of patient-related predictors and access to care on hearing and speech recognition outcomes following cochlear implantation.

Desired Result: Healthcare teams involved with cochlear implant patients will strive to maximize access to improved hearing health outcomes.

Level of Evidence – III

Indicate IRB: IRB #1412 at Louisiana State University Health Sciences Center-New Orleans

Balloon Dilation for Chronic Eustachian Tube Dysfunction under Local and General Anesthesia: A Systematic Review and Meta-Analysis

Usman Khan, MD, MSc; Jon Nam, BSc; Nael Shoman, MD

Objective: There has been a recent increase in the publication of articles evaluating outcomes of balloon dilation of the eustachian tube (BDET) as a treatment for chronic eustachian tube dysfunction (ETD) in both clinical and operating room settings. Our objective was to evaluate the overall efficacy of BDET for treating ETD, with a subgroup analysis of BDET performed under local (LA) versus general anesthesia (GA).

Data sources: PUBMED, EMBASE and Cochrane databases were searched for English articles from January 2010 to October 2022.

Study selection: The PRISMA guidelines were followed. Only RCTs and prospective trials evaluating BDET for ETD were included. All articles evaluating BDET performed under LA versus GA were assessed. Our search identified a total of 19 articles after screening (365 articles).

Data extraction: Only studies using homogeneous and validated outcomes measures (Eustachian Tube Dysfunction Questionnaire (ETDQ-7), tympanometry) were included for meta-analysis (6 studies). Other reported parameters include surgical time, LA protocols, and surgical complications.

Data synthesis: A meta-analysis using the random effects model demonstrated a decrease in mean ETDQ-7 scores by 2.60 up to a year following BDET (328 patients, CI -1.61 to -3.59, $p<0.001$). Descriptive weighted statistics were used to analyze in-office BDET studies (179 patients), demonstrating no significant differences in outcomes (tympanometry/ETDQ-7 scores), minimal complications, faster surgical time, and high patient-reported willingness to choose LA vs GA.

Conclusions: BDET is effective for treating chronic ETD. BDET performed in office with careful patient selection and an established LA protocol is safe and comparable to BDET in the operating room.

Professional Practice Gap & Educational Need: There has been a considerable increase in publication of high-quality articles evaluating long-term outcomes of BDET for chronic ETD. A recent publication trend towards performing BDET in a clinical setting under local anesthesia is also new in the literature. The aim of our study is to address this educational gap to guide clinical decisions regarding the use of BDET for chronic ETD in both the clinical and operating room settings.

Learning Objective: To provide an up-to-date analysis on outcomes of BDET for chronic ETD and compare surgical parameters and outcomes when BDET is performed in a clinical setting versus the operating room.

Desired Result: BDET is an effective treatment for symptomatic chronic ETD that is refractory to medical treatment and can be considered in both clinical and operative room settings depending on patient selection and local anesthesia protocols.

Level of Evidence – Level I (systematic review and meta-analysis)

Indicate IRB or IACUC: Exempt (systematic review and meta-analysis)

Is There a Need for ICU Admission following Routine Acoustic Neuroma Surgery?

Nayeon Kim, BS; Anusha Sherwani, BS
Christopher A. Bogaev, MD; Brian P. Perry, MD

Objective: To determine if there is a need for ICU admission following acoustic neuroma removal by analyzing differences in complication rates in patients who are admitted to the regular neurosurgical floor vs the neuro ICU.

Study Design: Retrospective review.

Setting: Tertiary referral center.

Patients: Fifty patients undergoing acoustic neuroma removal using either translabyrinthine, retrosigmoid, or middle cranial fossa approaches from January 2020 to August 2022.

Intervention: acoustic neuroma resection and post-operative care setting.

Main Outcome Measures: All patients who underwent acoustic neuroma removal by the neurotology and neurosurgical authors between January 2020 and August 2022 at a single facility were reviewed for inclusion for the chart review. The majority of patients were admitted to the regular neurosurgical floor based on tumor characteristics and comorbidities. Post-operative complications are identified and stratified into major and minor complications. Statistical analysis with Mann-Whitney U test is used against an internal control cohort with surgeries performed between 2017 and 2020.

Results: Data collection and analysis is ongoing; however, preliminary results show that there are no statistically significant differences in either major or minor complications between study group and the control group.

Conclusions: To our knowledge, this is the first study to analyze complication rates of patients who are admitted to the neurosurgical floor following acoustic neuroma surgery. Our findings suggest that for routine acoustic neuroma surgery, admitting patients to the regular neurosurgical floor is not inferior to the ICU. Further prospective, randomized studies are necessary to validate these findings in order to make systematic changes to the post-operative standard of care.

Professional Practice Gap & Educational Need: Reconsideration of standard recovery protocol for selected patients undergoing acoustic neuroma resection surgery to reduce healthcare costs, and increase patient satisfaction via less restricted family visitation.

Learning Objective: There are no significant differences in post-operative complications in selected patients who are cared for in a non-ICU setting.

Desired Result: Changes to patient recovery protocol following acoustic neuroma surgery.

Level of Evidence: III

Indicate IRB or IACUC: Exempt

The Impact of Inpatient Audiometry on Clinical Decision Making

Nadine Ibrahim, MD; Madison Epperson, MD; Chioma Anidi, BA
Gerilyn Jones, AuD; Renee Banakis Hartl, MD, AuD

Objective: Evaluate the degree to which inpatient audiometry impacts in-hospital outcomes and clinical decision making.

Study Design: Retrospective case review.

Setting: Academic tertiary referral center.

Patients: A retrospective chart review was completed of patients at the University of Michigan who were admitted to the hospital between January 2000 and September 2022 and underwent consultation for inpatient audiometric evaluation.

Main Outcome Measures:

1. Qualitative description of indication, diagnosis, and changes to management plan resulting from inpatient audiometric evaluation.
2. Impact of inpatient audiometric evaluation on clinical decision making quantified by descriptive statistical analysis, including percentage of consultations resulting in active change to inpatient management plan.
3. Test-retest reliability of inpatient vs outpatient audiograms, quantified by dB change in puretone and speech thresholds and percent change for word recognition testing.

Results: A total of 3,797 patient records were reviewed for analysis. Common indications for inpatient audiograms included temporal bone trauma, new onset sudden sensorineural hearing loss, and chronic hearing impairment. In some cases, audiometric testing resulted in changes to inpatient treatment plans, though most did not impact hospital-related management. Bedside testing resulted in less reliable threshold measurements compared with audiometry completed in a sound-treated booth.

Conclusions: Inpatient audiometry is a time- and resource-intensive intervention without well-established guidelines outlining its indications or a clear understanding of its utility in the inpatient setting. Results presented here suggest that inpatient audiometry has a minor impact on clinical outcomes and that outpatient audiograms may be sufficient for the majority of otologic consults in combination with a complete history and a thorough physical exam including tuning forks. Additional study across institutions with variable practice would be beneficial to help establish practice guidelines that could be applied more widely.

Professional Practice Gap & Educational Need: Audiometry is a critical component of a detailed assessment of many otologic and neuro-otologic concerns. Some clinical practice includes obtaining an inpatient audiogram for quick assessment of hearing sensitivities in the acute setting, however the value of an inpatient evaluation relative to a delayed, outpatient audiogram has not yet been demonstrated in the literature. Data presented here will help guide practitioners in determining when inpatient assessment is indicated.

Learning Objective:

1. To assess the clinical significance, as well as expected versus realized improvement in outcomes, related to inpatient audiometry.
2. To quantify the test-retest reliability of inpatient audiometric evaluation compared with outpatient testing.

Desired Result: We aim to provide context around the clinical value of an inpatient versus outpatient audiogram for providers. Ultimately, determining the clinical value of the inpatient audiogram will guide and improve clinical management when evaluating an Otologic or Neuro-Otologic concern.

Level of Evidence – IV - Historical cohort or case-control studies.

Indicate IRB or IACUC: University of Michigan HUM00225111 – Exempt status.

Delayed Diagnoses in Patients with Dizziness in the U.S. Commonwealth of Virginia and the Tidewater Region

Kendra N. Walker, BS; Kevin M. Guy, MS; Peter G. Volsky, MD

Objective: Vestibular disease and dizziness are common causes of impairment in the US and accurate diagnosis is necessary to provide appropriate management using available healthcare resources. The objective of this study is to address a regional public health need for timely diagnosis of dizziness and vestibular disease.

Study Design: Cross-sectional study.

Setting: TriNetX Research Network.

Patients: Adults diagnosed with dizziness or vestibular disease between 2010-2020 at a Sentara Healthcare facility in the Tidewater region of southeastern Virginia.

Interventions: N/A

Main Outcome Measures: Prevalence of dizziness symptom diagnoses followed by delayed vestibular disease diagnoses.

Results: During the study period, 31,670 diagnoses of dizziness were rendered; 18,390 were followed with a dizziness related non-vestibular diagnosis, 930 were followed with a vestibular disease diagnosis, and 12,350 were never followed by a diagnosis to explain the dizziness symptom. The proportion of patients diagnosed with vestibular disease (3%) after receiving a dizziness diagnosis in the region is far below expected norms (25-34%) in the general population. There were greater proportions of delayed diagnoses of labyrinth dysfunction (OR 4.8, $p<0.0001$), superior semicircular canal dehiscence (OR 3.1, $p=0.0023$), otolith disease (OR 3.1, $p=0.0023$), among others, and a decreased proportion of delayed diagnosis of benign paroxysmal positional vertigo (OR 0.56, $p<0.0001$).

Conclusions: Approximately 40% of patients with dizziness do not obtain a specific diagnosis. The discrepancy between expected and observed prevalence in our region indicates that vestibular disease is likely underdiagnosed, resulting in lost opportunities to access rehabilitation and medical management, and suggests the need for more thorough evaluation.

Professional Practice Gap & Educational Need: Recognize weaknesses in rendering diagnoses to patients with dizziness and understand the importance of timely and accurate vestibular disorder diagnosis.

Learning Objective: Define diagnostic rates of vestibular disease in our region and better understand the confounding diagnoses that are more difficult to identify in cases of dizziness.

Desired Result: Tailor clinical programs for improved patient access to care.

Level of Evidence – N/A

Indicate IRB or IACUC : IRB # 21-12-NH-0256 at Eastern Virginia Medical School, Approved 12/01/2021

The Placebo Effect in Tinnitus: A Systematic Review and Meta Analysis of Randomized Controlled Trials

Rameen K. Walters, BS; Frederick G. Durrant, BS; Shaun A. Nguyen, MD
Ted A. Meyer, MD, PhD; Paul R. Lambert, MD

Objective: To quantify the placebo effect in randomized clinical trials (RCTs) treating tinnitus with oral or intratympanic placebo treatment.

Data Sources: CINAHL, PubMed, and Scopus were searched for articles from conception to October 2022. MESH and key terms such as "Tinnitus," "Placebo," and "Medication" were used to find randomized, placebo-controlled trials. The search was limited to articles in English.

Study selection: RCTs with adult subjects evaluating tinnitus pre- and post-treatment with an oral or intratympanic medication versus a placebo arm were included. Cross-over studies, studies involving middle/inner ear surgeries or devices, and studies that exclusively included non-idiopathic etiologies of tinnitus were excluded.

Data extraction: Mean tinnitus symptom survey scores for the Tinnitus Handicap Index (THI) and Visual Analog Scales (VAS) (Intensity, Annoyance, Awareness) of the placebo arm were extracted for analysis by two independent reviewers (RKW, FGD). Risk of bias was completed using the Cochrane risk-of-bias tool.

Data synthesis: 953 studies were screened with 16 studies being included in the final analysis. Meta-analysis of mean difference (MD) was calculated using RevMan 5.4. MD between pre- and post-treatment THI scores of the placebo arms was 5.14 ([95% CI 2.75 to 7.54], $p < 0.0001$). MD between pre- and post-treatment VAS scores for Intensity, Annoyance, and Awareness were 0.32 ([-0.01 to 0.65], p = 0.06), -0.03 ([-0.27 to 0.20], p = 0.78), and 0.29 ([0.04 to 0.55], p = 0.02), respectively.

Conclusions: Placebo significantly reduced THI scores and VAS Awareness scores in patients receiving oral or intratympanic placebo treatment for tinnitus.

Professional Practice Gap & Educational Need: There are no meta-analyses evaluating the placebo effect in the medical treatment of tinnitus.

Learning Objective: To understand the placebo effect in patient's being treated for tinnitus with medication.

Desired Result: Statistically significant difference between pre- and post- treatment tinnitus symptom scores in patients in the placebo arm of RCTs.

Level of Evidence: Level IA.

Indicate IRB or IACUC: Exempt.

Impact of Pre-Operative Imaging on Surgical Planning for Cochlear Implantation

Torri E. Lee, BA; Diana Y. Lee, MD; Sean Weiss, MD
Seth R. Schwartz, MD; James E. Saunders, MD, MS

Objective: To identify the most common pre-operative imaging practices for cochlear implantation and how these findings influence surgical decisions.

Study Design: Cross-sectional study.

Setting: Electronic survey.

Population: Neurotologists who perform cochlear implantation surgery (n=59).

Main Outcome Measures: Imaging techniques (computed tomography (CT), magnetic resonance imaging (MRI)) surgical decision changes.

Results: Pre-operative CT scans were used 1.48 times more than MRIs for adults with acquired hearing loss (38 CTs, 21 MRIs) while MRIs were used 1.84 times more than CT scans for children (42 MRIs, 28 CTs). Imaging that revealed partial ossification of the cochlea changed 77.5% of surgeon's electrode array choice. There was no consensus about changing electrode choice for partial round window ossification (36, 44.4%) and type 2 cochlear hypoplasia (34, 46%). Moderate dilation of the vestibular aqueduct changed 8.5% of surgeons' electrode choice (n=6). For all scenarios, imaging did not significantly change surgical approach outside of electrode choice (p=0.682).

Conclusions: Pre-operative imaging is predominately used to select appropriate electrode array rather than to inform additional surgical approach. Partial ossification of the cochlea highly influences electrode array choice while vestibular aqueduct dilation is less likely to change surgical decisions.

Professional Practice Gap & Educational Need: Pre-operative imaging is commonly used for patients undergoing cochlear implantation, but the influence of imaging results on surgical approaches and decision making needs to be better understood.

Learning Objective: To gain knowledge about the ways in which pre-operative imaging guide surgical decisions in cochlear implantation surgery.

Desired Result: To inform attendee that pre-operative imaging predominantly affects electrode array surgical decisions for cochlear implantation.

Level of Evidence – Level V

Indicate IRB or IACUC: Dartmouth Health Institutional Review Board STUDY02000363- approved 7/24/2020

Utility of Single-Item Subjective Hearing Questions in Older Adult Hearing Screening

Janet S. Choi, MD, MPH; Tyler J. Gathman, MS
Tina C. Huang, MD; Meredith E. Ada,ms, MD MS

Objective: In the recent US Preventive Service Task Force review on hearing screening for older adults, single-item questions on subjective hearing were described as reliable screening tools. Using a population-based sample, we examined the accuracy of single-item questions on detecting objective hearing loss.

Study Design: Cross-sectional study

Setting: 2005-2016 National Health and Nutrition Examination Survey

Patients: 14,230 participants (12-85+ years)

Interventions: Participants were asked to assess their hearing: Q1-"Which statement best describes your hearing?"(Excellent-1, good-2, a little-3, moderate-4, a lot of trouble-5, or deaf-6) and Q2/Q3-"Hear a whisper/normal voice from across a quiet room"(yes/no). Mild(≥25dB) and moderate(≥40dB) hearing loss were defined as better hearing ear speech-frequency pure-tone average(0.5, 1, 2, and 4kHz).

Main Outcome Measures: Area Under the Receiver Operating Characteristic Curve (AUC)

Results: Among adults ≥50 years, the AUC for diagnosing mild hearing loss using Q1 was fair at 0.75 [95%CI:0.74-0.76] and was poor for Q2 (0.64 [95%CI:0.62-0.66]) and Q3 (0.60 [95%CI:0.57-0.63]). Using Q1 as the screening tool, cut points that obtain highest correct classification varied by age (3 for ≥50 years vs. 2 for ≥70 years) and sex (3 for male vs. 4 for female). The AUC for diagnosing mild hearing loss for adults ≥50 years was lower than for diagnosing moderate hearing loss for adults ≥50 years (0.84 [95%CI:0.83-0.86]) or mild loss for younger adults (20-49 years) (0.81 [95%CI:0.77-0.86]).

Conclusions: Single-item questions on subjective hearing exhibit limited utility as screening tools for mild hearing loss among older adults. Accuracy varies by the question, hearing loss severity, and demographics. Effective hearing screening for older adults should include objective assessments and additional questionnaire.

Professional Practice Gap & Educational Need: This study will improve the current gap in our knowledge on the accuracy of single questions on subjective hearing in detecting variable degrees of hearing loss and factors associated with its accuracy.

Learning Objective: At the conclusion of this presentation, the participants should be able to recognize the limited utility of single questions on subjective hearing as screening tools for hearing loss in older adults despite the statements within the recent US Preventive Service Task Force review describing single questions as reliable and consistent screening tools.

Desired Result: Results from the study support that future studies investigating the role of hearing screening in older adults would benefit from incorporating objective assessments and/or augmentation of the single-item questions with additional clinical information.

Level of Evidence: Level III

Indicate IRB or IACUC: exempt

A Confidence Booster: No Association Found Between COVID-19 Vaccination and Audio-Vestibular Dysfunction

Víctor de Cos, BS; Olivia A. La Monte, BS; Timothy J. Sears, BS
Omid Moshtaghi, MD; Peter Dixon, MD; Rick Friedman, MD, PhD

Objective: The purpose of this study is to compare the potential prevalence of neurotologic side effects of COVID-19 vaccine against expected vaccination side effects.

Study Design: Surveys were distributed to otolaryngology clinic patients to assess the presence of neurotologic symptoms occurring within 4 weeks of receiving a COVID-19 vaccination.

Setting: Single institution academic hospital otolaryngology clinic

Patients: Surveys were administered to adult (>18-year-old) patients who presented to an outpatient otolaryngology clinic for any reason from January to September of 2022.

Interventions: Diagnostic

Main Outcome Measures: Surveys distributed assessed patient demographics, COVID-19 vaccination status and associated side effects, as well as presence of neurotologic symptoms including dizziness, headaches, aural fullness, tinnitus, otalgia, and hearing loss. A Wilcoxon signed-rank test and nonparametric comparison of medians was conducted to compare the two groups of symptoms.

Results: The preliminary data for this pilot study included 27 patients with a mean age of 56.85, 48% male, and 93% White. Patients who received the COVID-19 vaccination were significantly less likely to experience any neurotologic side effects post-vaccination as compared to symptoms formerly established as vaccination side effects (0% vs. 22%; $p = 0.04$).

Conclusions: Hesitancy and mistrust surrounding COVID-19 vaccines have affected global rates of vaccination, which has severely impacted the ability of public health officials to stop the spread of this lethal infection. These initial findings demonstrate that audio-vestibular side effects are unlikely to occur in patients vaccinated against COVID-19 and can aid in improving vaccine trust.

Professional Practice Gap & Educational Need: Although the COVID-19 pandemic has affected the healthcare landscape on a global scale, physicians continue to have limited published literature on whether neurotologic side effects of vaccination exist.

Learning Objective: At the conclusion of this presentation, the participants should be able to identify whether COVID-19 vaccination demonstrates a possible association with audio-vestibular dysfunction.

Desired Result: These findings may improve the ability of physicians to promote vaccine trust and improve awareness about which side effects are and are not associated with COVID-19 vaccination.

Level of Evidence – IV

Indicate IRB or IACUC: UCSD IRB #801971

Effects of Newborn Hearing Screening Timing: pre-COVID versus COVID-era

Mary Morcos, BS; Lauren McGrath, AuD; Christina Khalil; Sophie Wiltshire
Carleton Eduardo Corrales, MD; Jennifer Shin, MD

Objective: To investigate whether auditory brainstem response newborn hearing screens (NBHS) resulted in higher refer rates during the COVID-19 pandemic. We assessed whether these rates and diagnostic outcomes were affected by observed difference screening result timing.

Study Design: NBHS was performed in 10,870 patients. Newborns who did not pass their first screen were referred for a second screen and subsequently referred for diagnosis. Assessments of refer rates, hour-of-life at screening, time between first and second screen, and diagnostic outcomes were performed.

Setting: Tertiary academic medical center.

Patients: Newborns with hearing screens performed at well-baby units.

Intervention: Diagnostic screening.

Main outcome measure: Postnatal age, time difference between screenings, and pandemic timeframe all may have contributed to whether neonates received downstream testing. Primary outcomes were screening "refer" and permanent hearing loss diagnosis rates.

Results: Vaginally-delivered COVID-era newborns had significantly higher "refer" rates, as compared to pre-COVID-era (23.67% versus 18.25%, p=0.026). Pandemic newborns underwent NBHS at statistically significantly earlier ages. When two screens were performed, the time difference between screens was significantly shorter in the COVID-era group. Post-screening diagnosis of bilateral hearing loss occurred at significantly lower rates (20.4% versus 41.0%). Although COVID-pandemic C-section newborns were screened significantly earlier, this was not a significant predictor of confirmed hearing loss on post-screening diagnostic testing.

Conclusions: COVID-era newborns were screened significantly earlier in life than pre-COVID newborns. Earlier screening was associated with a statistically significant impact on "refer" rates and lower permanent hearing loss diagnoses. Earlier screening may have contributed to unnecessary diagnostic follow-up testing.

Professional Practice Gap & Educational Need: NBHS resulted in higher refer rates in vaginally delivered newborns during the COVID-19 pandemic, and we investigate potential causes.

Learning Objective: To quantify the impact of the pandemic on refer rates, rate of post-screening hearing loss diagnoses, and timing of screening.

Desired Result: To understand whether newborn hearing screenings during the COVID-19 pandemic occurred earlier, and whether earlier screening affected downstream referral rates and diagnoses of bilateral hearing loss.

Level of Evidence - Level IV

Indicate IRB or IACUC : Exempt

Bedside Vestibular Tests as a Clinical Screening Tool for Cerebellopontine Angle Masses

Kevin P. Stavrides, MD; W. James Azeredo, MD; Tice Harkins, BS
Arun Gadre, MD; J. Scott Greene, MD; Jeffrey Walter, DPT

Objective: Cerebellopontine angle (CPA) masses are a concerning cause of unilateral hearing loss, imbalance, and tinnitus. The gold standard evaluation for these masses is magnetic resonance imaging (MRI). However, MRIs are costly, low yield, and anxiety-inducing for claustrophobic patients. Identification of vestibular abnormalities may enhance CPA mass detection in patients with asymmetrical hearing loss and tinnitus. The objective of this study is to determine if bedside vestibular tests can identify patients with unilateral cochlear symptoms at increased risk for CPA masses.

Study Design: Prospective observational study.

Setting: Tertiary care center.

Patients: 83 non-institutionalized U.S. citizens age >18 years with a chief complaint of asymmetrical sensorineural hearing loss and/or tinnitus. Patients with a history of dizziness or imbalance were excluded.

Interventions: Diagnostic.

Main Outcome Measures: Each patient was evaluated for positive or negative exam findings with bedside vestibular tests consisting of head impulse, spontaneous nystagmus, gaze-evoked nystagmus, mastoid vibration, and hyperventilation-induced nystagmus. Findings from vestibular tests were correlated with the presence or absence of CPA mass on MRI.

Results: A total of seven out of 83 patients had confirmed CPA masses on MRI (8.4%). Patients with all negative findings from vestibular tests were only 1.43% less likely to have a CPA mass on MRI compared to patients with one or more positive findings. The presence of at least one positive bedside vestibular test is not significantly correlated with the presence of a CPA mass on MRI, X^2 (1, N = 83) = 0.0392, p = 0.84. Patients with the presence of both hyperventilation-induced and gaze-evoked nystagmus were 33.6% more likely to have a CPA mass on MRI compared to patients without the presence of both and 31.6% more likely than the study population. The presence of both hyperventilation-induced and gaze-evoked nystagmus was correlated with a positive MRI finding of CPA mass, X^2 (1, N = 83) = 6.9, p = 0.0088.

Conclusions: Normal bedside vestibular testing does not reliably rule out the presence of a CPA mass. However, positive bedside exam findings of both gaze-evoked and hyperventilation-induced nystagmus together are significantly associated with the presence of CPA masses on MRI. Therefore, the presence of these exam findings in a patient with borderline asymmetric hearing loss and/or tinnitus may increase the likelihood of CPA mass.

Professional Practice Gap & Educational Need: Since 95% of MRIs are negative for CPA masses, more effective clinical screening tools should be employed prior to further imaging studies.

Learning Objective: To understand the relation between bedside vestibular test findings and the presence of CPA masses.

Desired Result: To demonstrate that simple bedside vestibular tests can be used to identify which patients referred to otolaryngologists with potential CPA masses should undergo further evaluation with imaging.

Level of Evidence: Level V

Indicate IRB or IACUC: Exempt

Neck Angles, Drilling Forces, Drilling Accuracy, and Frustration Levels Differ According to Ergonomic Position in a Simulated Otologic Drilling Task

Eric J. Formeister, MD, MS; Hyonoo Joo, BS; Zihao Lin, MS, Aditi Kishore, BS
Michael Pozin, BS, John P. Carey, MD; Deepa Galaiya, MD

Objective: To characterize neck flexion angles, drilling force, drilling accuracy, and perceived exertion/frustration during performance of a simulated otologic drilling procedure in different ergonomic positions.

Study Design: Randomized cross-over trial.

Setting: Tertiary center.

Subjects: Attending (n=5), fellow (n=2) and resident (n=6) otolaryngologists.

Interventions: Participants performed microscopic drilling of eggs consecutively in three different seated positions: (1) ergonomically ideal ("good"); (2) ergonomically unfavorable "slouch" position; (3) ergonomically unfavorable (neck "craning") position.

Main Outcome Measures: Neck angle measurement via inertial measurement units; force applied during otologic task; drilling accuracy, and perceived effort and frustration as measured by the NASA Task Load Index (NASA-TLX).

Results: The average neck angle in the good position was 18.2 degrees, compared to 28.8 degrees in the craning position and 36.2 degrees in the slouch position. Average peak forces in the good position (0.65 N) were lower than that in the slouch position (0.97 N) or craning position (0.75 N). Accuracy of egg drilling was significantly better in the good compared to craning position ($p=0.04$) but not in the good compared to slouch position ($p=0.13$). All domains of the NASA-TLX were significantly worse in the slouch and craning position compared to the ergonomically favorable position $p<0.01$).

Conclusions: In this simulated task of microscopic otologic surgery, measured neck angles over time were worse in ergonomically unfavorable positions compared to the favorable position, which was accompanied by higher mean forces applied during drilling, decreased accuracy of drilling, and higher perceived effort, exertion, and frustration levels. Future studies are needed to characterize the effects of ergonomic interventions on ergonomic risk in otology.

Professional Practice Gap & Educational Need: Ergonomic risk in otology is a well-known entity and can place surgeons at increased risk of burnout and reduced career longevity. However, this risk is based primarily on small survey studies using convenience samples from professional societies and single institution investigations. A more comprehensive assessment of ergonomic risk in otology using quantitative, objective measures is needed in order to guide interventions and curricular changes in training programs.

Learning Objective: To investigate whether ergonomically unfavorable positioning is accompanied by increasing neck flexion during performance of a microscopic otologic simulation and to assess whether positioning affects force applied during this task, accuracy of the task, and perceived exertion and frustration levels during the task.

Desired Result: At the end of the presentation, the participant will learn what constitutes ideal ergonomic positioning in the otology operating room, several measures of ergonomic risk, and how unfavorable ergonomic positioning can influence accuracy of drilling and perceived frustration levels.

Level of Evidence - Level IV.

Indicate IRB or IACUC:
This study was approved by the Johns Hopkins Institutional Review Board (IRB number 00289314).

The Role of Socioeconomic Status in the Outcomes of Patients with Malignant Otitis Externa

Woo Yul Byun, BSE; Lisa Zhang, MD; Joseph F. Bonanno, BS
Stephanie S. Wentzel, BS; Yin Ren, MD, PhD

Study Design: Retrospective Cohort

Setting: University-based tertiary medical center

Patients: Adult patients (n= 23) presenting with confirmed Malignant Otitis Externa from 2010-2022

Interventions: None

Main Outcome Measures: Data including race, marital status, zip code, days hospitalized, insurance type, five-year mortality, admissions, and follow-up visits was collected from patients diagnosed with malignant otitis externa.

Results: A total of 39 charts were reviewed among patients with suspected malignant otitis externa between 2010-2022. 23 patients were included total. 26.1% (6/23) of patients lived in a zip code where the median family income lied below the first quartile of our data set. There were significant associations between those lost at > 1-year follow-up & insurance type (**p = 0.016**) and between those with an income below the first quartile and days hospitalized (**p= 0.037**). There was a significant association between race & overall 5-year survival (**p = 0.016**); however, survival specific to malignant otitis externa was not significantly associated with race (p = 0.676).

Conclusions: The income quartile of patients with malignant otitis externa had a role in the duration of their inpatient course, possibly suggesting a more severe disease course among those from areas with a lower median family income.

Professional Practice Gap & Educational Need: Educate otologists on the role of socioeconomic factors in the management of patients with malignant otitis externa.

Learning Objective: To gain insight into the factors contributing to disease severity in those with malignant otitis externa.

Desired Result: Given the significant associations with income level and length of hospitalization, clinicians should be mindful of potential financial barriers when determining a treatment plan for patients at high risk for developing malignant otitis externa.

Level of Evidence – IV

Indicate IRB or IACUC: IRB 2022H0178

Revision Balloon Eustachian Tuboplasty: Conclusions of Initial Experience

Ophir Handzel, MD; Brynn Lopez; Dennis S. Poe, MD, PhD

Objective: Evaluate the response to revision balloon Eustachian tuboplasty (BET). Analyze factors influencing the success or failure of the procedures.

Study Design: A retrospective chart review

Setting: Tertiary referral center.

Patients: Patients with dilatory Eustachian tube (ET) dysfunction (ETD) who have undergone both primary and revision BET.

Interventions: Primary and revision BET.

Main Outcome Measures: Results of interventions are evaluated based on the change in otoscopy (normal, retracted, middle ear fluids), tympanic membrane response to Valsalva's maneuver, symptoms of barochallenge ETD, evaluation of the degree of inflammation and opening of the ET orifice by nasopharyngoscopy, degree of air-bone gap and tympanometry (A/B/C).

Results: Of 360 patients undergoing primary BET, fifteen were revised. All the latter failed to achieve a complete resolution with the primary procedure. Two patients had barochallenge ETD, and delayed symptomatic relapse that responded to revision BET. Three patients with barochallenged ETD required adjunctive procedures to revision BET. Ten patients had variable forms of otitis media and ETD. All required adjunct procedures to revision BET. Nonresponders to primary BET tended to have anatomical obstruction not initially recognized (i.e., cartilage spur bulging to the ET lumen) addressed during revision surgery. Some delayed failures resulted from inadequate medical treatment and inflammation of the ET.

Conclusions: Patients not responding to primary BET should be examined thoroughly for anatomical contributing factors to obstruction. Delayed failure can be helped by maximizing medical treatment and adjunct procedures to revision BET, especially when tympanic membrane pathologies are present.

Professional Practice Gap & Educational Need: BET is becoming an increasingly popular treatment choice for ETD, applied by many surgeons. Despite its popularity, the role of revision BET has not been established. Few data exist regarding the indications for the repeated procedure and the characteristics of patients most likely to benefit from it.

Learning Objective: The audience/reader will be aware of the results of revision BET, the suggested selection criteria for revision BET, and which patients will most likely benefit from a revised procedure. The specifics of the targeted physical examination to define the best candidates for and components of revision BET will be discussed.

Desired Result: Clinicians will incorporate the presented data in their management of patients who failed to completely respond to primary BET for dilatory ETD. This will include differentiating between immediate and delayed failures and the details of the targeted physical examination. This will hopefully result in a higher proportion of patients benefitting from revision BET and fewer revisions performed in patients less likely to benefit from the procedure.

Level of Evidence - IV

Indicate IRB or IACUC: Children hospital of Boston IRB-00010256

Novel Diagnostic Implications from Absence of the H3.3 K36M Mutation in Chondroblastoma of the Temporal Bone

Michael J. Ye, MD; Krishna V. Hegde, MD; Pei-Ciao Tang, PhD
Mitesh V. Shah, MD; Shaoxiong Chen, MD, PhD
Rick F. Nelson, MD, PhD

Hypothesis: Screening for histone gene H3.3 driver mutations in chondroblastoma of the temporal bone (CTB) will elucidate pathogenesis, aid in diagnosis, and guide management for these challenging tumors.

Background: Distinct driver mutations in histone gene H3.3 (H3F3B-K36M and H3F3A-G34W) define chondroblastomas of the long bones (CLB) and giant cell tumors (GCT), respectively. 95% of CLB harbor the H3F3B K36M mutation, which results in decreased tri-methylation of lysine 36. The genetic drivers of CTB are unknown. We aim to report our findings on the unique genetics of CTB and aid in pathological differentiation versus other histologically similar bone tumors.

Methods: Sanger DNA sequencing of H3.3 and all core histones was performed in human pathological specimens of CTB, CLB, and GCT (n = 3 each). Relative H3.3 methylation levels were compared between specimens using immunohistochemical staining and Western blot utilizing an anti-K36me3 antibody.

Results: H3F3B-K36M mutation was detected in all CLB but was not detected in CTB or GCT tumors. H3F3A-G34W mutation was observed in all GCT but not in CLB and CTB. No novel mutations within other histones were detected in CTB. H3.3 K36 tri-methylation was robust in GCT but was decreased across both CLB and CTB.

Conclusions: Accurate diagnosis of CTB can be challenging even for experienced pathologists. Despite the lack of H3F3B mutations, CTB exhibit similar K36M methylation status implicating a common mechanism of chondroblastomas. Our findings suggest anti-K36me3 immunohistochemistry may be effective at differentiating between CTB and other histologically similar lesions such as GCT.

Professional Practice Gap & Educational Need: The histopathologic characteristics of chondroblastoma overlap with other bone tumors including chondromyxoid fibroma and giant cell tumor of bone. Treatment options and modalities differ between each of these entities. This study brings to light nuances unique to the diagnosis of chondroblastoma of the temporal bone in order to aid with accurate diagnosis.

Learning Objective: To understand the unique genetics, pathogenesis, and immunohistochemistry of chondroblastoma of the temporal bone.

Desired Result: To screen for genetic differences between chondroblastoma of temporal bone and those arising from long bones in order to aid in pathological workup and accurate diagnosis, elucidate pathogenesis, and guide future investigation for these tumors.

Level of Evidence – III

Indicate IRB or IACUC: Exempt

Cochlear Implantation After Head and Neck Radiation: Case Series, Systematic Review, and Meta-Analysis

Jumah G. Ahmad, MD; Benjamin D. Lovin, MD
Marc-Elle Nader, MD; Paul W. Gidley, MD

Objective: To report results of cochlear implantation (CI) after head and neck (HN) external beam radiation (XRT).

Study Design: Retrospective review with systematic review and meta-analysis.

Setting: Tertiary referral center.

Patients: History of HNXRT.

Interventions: CI.

Main Outcome Measures: Audiologic outcomes and complications.

Results: Six (60%) patients had HN cancer (HNC) and 3 (30%) had central nervous system pathologies (CNS). One HNC patient had bilateral implants. There were no complications. The mean time from XRT to CI was 9.6 years in HNC and 31.2 years in CNS. The mean time from CI to last follow up was 1.8 years. Twenty articles with an additional 98 cases were suitable for systematic review. Sixty-seven cases (61.5%) had HNC and 17 had CNS (15.6%). A bimodal distribution of age was noted with a mean of 59.1 years for HNC and 35.8 for CNS. Abnormal intraoperative findings were common with soft mastoid bone most frequent. Complications occurred in 10% of cases, including dehiscence, infection, and extrusion. Seventeen cases had staged procedures. Two devices were implanted without magnets. Free flaps were used before, during, and after CI. Sixty-three cases fit inclusion criteria for the meta-analysis of audiologic outcomes. All cases demonstrated improvement in speech discrimination with mean increase of 57% at a mean of 25.7 months post-operatively.

Conclusions: CI is effective in hearing rehabilitation in patients with a history of HNXRT. Special considerations related to planning, patient expectations, technique, and post-operative care are required in this unique population.

Professional Practice Gap & Educational Need: Although there have been many studies on this topic, none have comprehensively reviewed all the data in the literature.

Learning Objective: To understand appropriate considerations when performing CI on patients with history of HNXRT.

Desired Result: Improved outcomes of patients with CI after HNXRT through appropriate planning, technique, post-operative care, and appropriate patient counseling.

Level of Evidence: Level IV.

IRB: PA19-0106.

Incidence of Pattern and Location of Superior Semicircular Canal Dehiscence: A Computer Topographic Scan Review with Correlation of Presentation and Implications for Surgical Management

Juan C. Yanez-Siller, MD, MPH; Jeffrey Liaw, MD
Edmund Howe, BS; Arnaldo L. Rivera, MD

Objective: Superior semicircular canal dehiscence (SSCD) location varies greatly. Preoperative knowledge of SSCD location may influence selection of surgical approach. We seek to evaluate the location pattern of SSCD and add to the available literature in terms of their clinical and surgical significance.

Study design: Retrospective review

Patients: as of the time of this submission, computer tomography temporal bone scans (CTTB) of 21 patients with SSCD have been reviewed. CTTB of additional 30 patients (total 51), plus audiogram and symptoms at presentation (all patients) will be reviewed and presented in the final publication.

Intervention: CTTB of 21 patients with symptomatic SSCD (36 affected sides) have been evaluated. CTTB of additional 30 patients and symptoms and audiogram patterns at presentation will also be reviewed.

Main outcome measures: age, sex, location of SSCD, symptoms and audiogram at presentation.

Results: So far CTTB of 21 patients (10 male, 11 female; mean age 54.8-years) with symptomatic SSCD have been evaluated; (36 affected sides; 20 right, 16 left). Centrally located (i.e., highest point of superior semicircular canal) have been detected in 7/36 affected sides (19.4%). 12/36 (33.3%) involved the ascending+central portions, 5/36 (13.9%) central+descending portions, 5/36 (13.9%) isolated to the descending portion ("downsloping") and 2/36 (5.6%) ascending+central+descending ("half-arch") portions of the superior semicircular canal. Separate ascending and descending defects (same side) were noted in 5/36 (13.9%).

Conclusions SSCD defect location patterns vary considerably. Defect location may impact symptom presentation and may help determine appropriate surgical approach for repair.

Professional Practice Gap & Educational Need: SSCD defect location varies significantly. The defect location has been briefly described. Further detail on its clinical and surgical implications is necessary to advance the literature and knowledge of this disease.

Learning Objective: Evaluate the location pattern of SSCD and add to the available literature in terms of their clinical and surgical significance.

Desired Result: Knowledge gain regarding incidence of different SSCD patterns and its clinical and surgical implications.

Level of Evidence: Level V

Indicate IRB or IACUC: Exempt

Comparison of Hearing Results with the Use of Different Heat-Activated Crimping Prostheses in Stapedotomy

Benjamin D. Liba, MD; Sara Kortebein, MD; John Symms, MD
Todd A. Hillman, MD; Douglas A. Chen, MD

Objective: To determine differences in hearing outcomes of a completely encircling heat-activated crimping prosthesis (SMart 360°) compared to partially encircling prosthesis (SMart)

Study Design: Retrospective chart review

Setting: Private neurotology tertiary referral center

Patients: Patients who underwent stapedotomies performed by the senior authors from 2008-2019 using the SMart prosthesis and SMart 360° prothesis**.**

Interventions: Stapedotomy operations with placement of a SMart or SMart 360° prosthesis.

Main Outcome Measures: Differences in pre-operative air bone gap (ABG) compared to post-operative ABG at 3-months, 1 year and 2 years after surgery.

Results: 228 stapedotomies were performed (SMart n=48 and SMart 360° n= 220). Mean pre-operative ABG for SMart and SMart 360° were 27 dB and 29 dB respectively. The mean difference in ABG for SMart and SMart 360° at 3 month, 1 year, and 2 years were 17 dB, 18 dB, and 11 dB respectively and 20 dB, 20 dB, and 19 dB. ABG differences were not statistically significant ($p = 0.97$ at 3 months, 0.55 at 1 year, and 0.26 at 2 years). There were 6 failures of the SMart prosthesis (12.5%) and 5 for the SMart 360° (2.3%)

Conclusions: No statistically significant differences in ABG changes for SMart compared to SMart 360°. Higher rate of prosthesis failure was found with the SMart prosthesis.

Professional Practice Gap & Educational Need: Determination of most efficacious stapes prosthesis.

Learning Objective: Which stapes prosthesis produces better hearing results with fewer failures.

Desired Result: To disseminate information necessary to choose the best stapes prosthesis for patients.

Level of Evidence – Level III

Indicate IRB or IACUC: 2022-029-agh

Characteristics of Eustachian Tube Dysfunction in Migraine Patients

Eunice Park BS; Austin Miller, MD; Yuan Liu, MD, PhD

Objective: To investigate the prevalence of and characterize Eustachian tube dysfunction (ETD) in patients with migraine.

Study Design: Retrospective case series

Setting: academic, tertiary care center neurology clinic

Patients: Adult patients diagnosed with migraine from 2010-2022 who underwent tympanometric testing.

Interventions: N/A

Main Outcome Measures: Prevalence and severity of ETD based on tympanometry; association between patient-reported symptoms and ETD; comparison of characteristics between migraine patients with and without ETD.

Results: Of 216 patients, 48 (22%) had at least 1 ear with an abnormal tympanogram (type As, B, or C), indicating ETD, compared to a prevalence of 5% in US adults from previous literature. The ETD group had a mean Tympanometric Peak Pressure of -32.4 daPa (vs -3 daPa in the non-ETD group, $p<0.001$) and mean Static Admittance of 0.44 mmho/ml.(vs 0.80 mmho/mL in the non ETD group, $p<0.001$). Migraine patients with ETD were more likely to be female (88% vs. 73%, $p=0.033$), older (mean age 54 vs. 46, $p=0.002$), and have hypertension (48% vs. 25%, $p=0.002$), but less likely to have tinnitus (56% vs. 73%, $p=0.031$) than those without ETD. Migraine patients with ETD were not more likely to report ear pain, aural fullness, hearing loss, or dizziness than patients without ETD. On univariate logistic regression, sex ($p=0.039$), age ($p=0.003$), hypertension ($p=0.003$), and tinnitus ($p=0.03$) were independent predictors for ETD. In a multivariate logistic regression model, sex, age, and tinnitus remained statistically significant.

Conclusions: ETD appears to be more common in patients with migraine than the general population. Ear pain, fullness, and subjective hearing loss were not reliable predictors of ETD.

Professional Practice Gap & Educational Need: Better understanding of how aural symptoms relate to underlying eustachian tube problems in migraine patients.

Learning Objective: To recognize higher rates of ETD in migraine patients and realize that symptoms commonly used to diagnose ETD may not correlate with ETD based on tympanometry in this population.

Desired Result: Demonstrate and characterize ETD in patients with migraine.

Level of Evidence - Level V

Indicate IRB or IACUC : IRB #5210258—Loma Linda University

Cost Effectiveness Model of Non-echo Planar Diffusion Weighted MRI in Place of Planned Second-Look Surgeries for Cholesteatoma

Terral A. Patel, MD; Abhinav Ettyreddy, MD; Tracy Cheng, MD
Kenneth J. Smith, MD, MS; Shaum S. Sridharan, MD
Andrew McCall, MD

Objective: Identify the cost effectiveness of using non-echo planar diffusion weighted MRI (non-EP DWMRI) in the management of residual cholesteatoma after primary surgical management.

Data sources: Pubmed database was queried for relevant probability parameters to use in the statistical model.

Study selection: Studies with patients who have had primary canal wall up surgeries for cholesteatoma and planned to undergo second-look surgery. Inclusion criteria included the use of non-EP DWMRI with surgical confirmation.

Data extraction: Analysis parameters were manually abstracted from published historical data and a health care perspective. Cost data were based on current Centers for Medicare and Medicaid Services fee rates in US dollars.

Data synthesis: A cost-effectiveness analysis model comparing planned second-look surgery to serial non-EP DWMRI was performed using a decision-analytic model that assumes primary surgical management. Effectiveness was defined as proper identification and treatment of residual disease. Base case analysis found MRI to be less costly but less effective than planned second-look surgery with incremental cost effectiveness ratio value over $100,000 per patient with missed cholesteatoma. When effectiveness included avoidance of surgery in cholesteatoma-free patients, non-EP DWMRI was more effective and less costly.

Conclusions: Non-EP DWMRI may be a less costly and more effective alternative to planned second look surgery in the management of residual cholesteatoma. However, this strategy has some potential downsides, such as greater extent of disease at time of identification due to delay in diagnosis and missed disease in infrequent cases. Future studies are warranted to determine the impact of a wait-and-scan approach following primary surgical management of cholesteatoma.

Professional Practice Gap & Educational Need: Currently, second-look surgery is commonly undertaken in the management of cholesteatoma after initial surgery. The introduction of non-echo planar diffusion weighted MRI has allowed for the improved detection of cholesteatoma and although it is currently used in the management of cholesteatoma in some situations, more data are needed to evaluate its cost effectiveness in lieu of planned second-look surgery.

Learning Objective:
1. Understand the cost-effectiveness of non-echo planar diffusion-weighted MRI in managing cholesteatoma following primary surgery for cholesteatoma.
2. Consider alternative strategies for management of cholesteatoma following primary surgery for cholesteatoma.

Desired Result: Changes in physician knowledge and promoting future study.

Level of Evidence – III

Indicate IRB or IACUC: Exempt

The Impact of Regional Nerve Blocks in Otologic Surgery

Olivia A. La Monte, BS; Fernanda Pacheco; Morgan Davis, MD
Brenton Alexander, MD; Rodney Gabriel, MD
Omid Moshtaghi, MD; Elina Kari, MD

Objective: To investigate the impact of regional nerve blocks on postoperative opioid use.

Study Design: Retrospective chart review of patients undergoing cochlear implantation at our institution. Data collected includes patient demographics, chronic pain, procedure type, anesthetic used, perioperative opioid administration in morphine milligram equivalents (MME), intraoperative and postoperative pain scores, and postoperative opioid use.

Setting: Academic hospital

Patients: 89 patients who underwent cochlear implantation

Interventions: Regional nerve block of the superficial cervical plexus or the greater auricular nerve

Main Outcome Measures: Perioperative opioid use reported as morphine milligram equivalents (MME)

Results: Out of 89 patients, 44 (49% female, 51% male) received a regional nerve block and 45 (46% female, 54% male) did not. Mean age for intervention group and control group was 68 and 64, respectively ($p=0.21$). Secondary outcome measures, including chronic pain and substance abuse, did not differ significantly between groups. On average, nerve block patients required slightly lower MME compared to patients who did not receive nerve blocks (43 MME vs 40 MME, $p=0.49$).

Conclusions: In this cohort of patients undergoing cochlear implantation, we found that the implementation of preoperative nerve blocks was associated with a trend towards lower MME requirements intra- and perioperatively. Although not statistically significant, phase 2 of this study is a prospective trial, in progress, to determine if preoperative nerve blocks can decrease outpatient narcotic usage. Using nerve blocks has the potential to significantly decrease opioid utilization following outpatient otologic surgery, reducing complications and the risk of opioid dependence.

Professional Practice Gap & Educational Need: According to the CDC, in the last two decades more than 564,000 people have died from opioid overdoses including both prescribed and illicit opioids. To mitigate the opioid crisis, multimodal pain regimens have become increasingly popular as a means of reducing the use of opioids for acute, postoperative surgical pain. Multiple surgical disciplines such as orthopedics and OBGYN have implemented the use of regional nerve blocks for managing postoperative pain with the benefit of reducing narcotic usage and a more favorable side effect profile (i.e. less drowsiness, constipation, nausea and vomiting, respiratory depression). The use of regional nerve blocks for otologic surgery, however, is not routinely practiced, and little research has been conducted regarding the utility and effectiveness of these blocks to reduce narcotic requirements which has the potential to directly impact prescribing practices among otolaryngologists.

Learning Objective: The purpose of this study is to provide data and an overview of the benefits associated with regional nerve blocks in neurotologic surgery. The retrospective component of our study presents perioperative opioid use related to nerve blocks. The prospective trial will provide data on preoperative anesthetic nerve blocks and their impact on outpatient opioid use.

Desired Result: Regional nerve blocks can effectively reduce acute surgical pain and postoperative opioid use in patients undergoing outpatient otologic surgery.

Level of Evidence – III

Indicate IRB or IACUC : UCSD IRB #800282, Approved 11/10/2021

A Historical Recount: Carl-Olof Nylén's Denied Passion

Ahmed S. Alzubaidi, BA; Khizur Kamran, BS
Omid Moshtaghi, MD; Sunny J. Taft, MD

WITHDRAWN BY AUTHOR

Modified Preauricular Approach for an Implantable Stimulator of the Distal Branches of the Auriculotemporal Nerve

Vivek Kanumuri, MD; Julian Purrinos, BS; Devin Kennedy, BS
Erin Williams, MS; Patrick Ganzer, PhD; Michael Hoffer, MD

Hypothesis: A preauricular approach can be used to reliably implant a nerve cuff on distal auriculotemporal branches.

Background: There is increased interest in the distal branches of the auriculotemporal nerve for a number of clinical applications including treatment of migraine, neuralgia, cardiac disease, and modulation of tinnitus. However, there has been limited anatomic description of branching patterns of these distal nerves specifically when considering potential non-invasive and invasive stimulation. In this cadaveric study, we demonstrated feasibility of placement of an implantable nerve cuff on the superficial temporal branches of the auriculotemporal nerve.

Methods: We performed cadaveric dissections using a modified pre-auricular approach to expose the course of the auriculotemporal nerve as it branches into tragal and superficial temporal branches. The number of major distal branches was counted, and diameter of the nerve at various points along its course was assessed. An implantable nerve cuff was then placed along a major superficial temporal branch and coupled to a mock stimulator/pulse generator placed in a tight subperiosteal pocket.

Results: At least one major superficial temporal branch and one major tragal branch of the auriculotemporal nerve was able to be identified in all cadaveric specimens. The average diameter of the largest superficial temporal branch just distal to its takeoff was 1.1mm. A nerve cuff was able to be reliably coupled to the largest superficial temporal branch.

Conclusion: A preauricular approach can be used to reliably identify a major superficial temporal branch of the auriculotemporal nerve and place an implantable nerve stimulator.

Professional Practice Gap & Educational Need: Anatomy and clinical applications of the distal branches of the auriculotemporal nerve

Learning Objective: The learner will gain an improved understanding of the anatomy of the distal branches of the auriculotemporal nerve along with potential clinical applications

Desired Result: This approach may represent an important clinical tool as we explore the effectiveness of stimulation of the superficial temporal nerve in treating otological and neurologic pathology

Level of Evidence – N/A

Indicate IRB or IACUC: Exempt

Immunolocalization of ACE-2 Receptor for SARS-CoV-2 in the Human Eustachian Tube

Miryam S. Saad; Ivan A Lopez, PhD
Gail Ishiyama, MD; Akira Ishiyama, MD

Hypothesis: Investigate expression of Angiotensin-Converting Enzyme-2 (ACE-2), a SARS-CoV-2 entry receptor, in the human Eustachian tube

Background: The Eustachian tube is an osseocartilaginous canal connecting the nasopharynx to the middle ear responsible for pressure equalization, secretion clearance, and protection from nasopharyngeal pathogens. SARS-CoV-2 RNA was isolated from the human mastoid and middle ear. The Eustachian tube may serve as conduit for SARS-CoV-2 entry into the middle ear.

Methods: Archival celloidin embedded specimens from 9 individuals with no auditory or balance disorders were studied. Sections containing the middle ear and Eustachian tube were immunoreacted with ACE-2 mouse monoclonal antibodies and secondary antibodies against mouse or HRP. Digital images were obtained using a Leica (SP8) laser confocal microscope.

Results: There is differential degree of ACE-2-immunoreativity detected in the mucosal epithelium of the Eustachian tube and middle ear. There is strong expression of ACE-2 on the apical ciliated cuboidal cells of the middle ear mucosa over the cochlear promontory, and moderate expression of ACE-2 on the apical ciliated columnar cells near the opening of the Eustachian tube into the middle ear. Goblets cells could be visualized and were ACE-2 non-immunoreactive. There was lower expression of ACE-2 within the ciliated cuboidal near the aditus ad antrum.

Conclusions: ACE-2 expression in the Eustachian tube supports the possibility of a transmucosal route for SARS-CoV-2 entry into the middle ear from the nasopharynx. Continuity of ACE-2 expression suggests that SARS-CoV-2 which infects the nasopharynx may then track to infect the ciliated epithelium of the Eustachian tube and then subsequently the middle ear.

Professional Practice Gap & Educational Need: The route for SARS-CoV-2 entry into the middle and inner ear is unknown. Identifying SARS-CoV-2 entry proteins in the Eustachian tube and middle ear is clinically significant to understand a potential route of viral entry to the middle ear.

Learning Objective: To describe ACE-2 receptor expression distribution in the human eustachian tube and middle ear.

Desired Result: Identifying ACE-2 expression in the eustachian tube and middle ear can help elucidate the route for SARS-CoV entry into the middle ear with significant implications for diagnostics, therapeutics, and otologic procedures.

Level of Evidence – Level IV

Indicate IRB or IACUC: #10-001449, UCLA

AMERICAN OTOLOGICAL SOCIETY RESEARCH FOUNDATION
RESEARCH GRANT AWARDS

The American Otological Society is committed to the non-promotional advancement of knowledge and science and to a free exchange of medical education in otology and neurotology. The American Otological Society, through its Research Foundation, is offering Research Grant Awards, an Award for a Clinical Trial, full-time Research Training Fellowships, exclusive medical student grants, and a Clinician-Scientist Award. 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. **Research supported by all of the grant mechanisms can relate to any aspects of the ear, hearing and balance disorders. We welcome applications that address quality and safety of care as well as to improve education and training in otology.** These grant awards and fellowships are for work conducted in *United States or Canadian institutions only*. Additional details may be found on the AOS website. https://www.americanotologicalsociety.org/aos-grant-submission-instructions

SAVE THE DATE 2023

NOVEMBER 1, 2023. If you would like to submit a grant for consideration of funding in the next cycle, July 1, 2024-June 30, 2025, in ONE PDF, include a LETTER OF INTENT and BIOSKETCH (NIH template), including details regarding other existing support, and any potential overlap with your mentor(s) must be submitted by November 1st of the year prior to funding. The next funding cycle begins July 1, 2024. The letter of intent must state the desired grant mechanism for the proposal (CSA, Fellowship grant, Clinical Investigation, Research grant or Medical Student grant), the Principal Investigator, and Institution(s), a working title, with an abstract and Specific Aims (2-page limit on abstract and aims).The biosketch is not included in the page limit.
Complete applications will be invited from selected applicants based on the Research Advisory Board's review of the letters of intent. Applicants will be notified whether they are invited to submit a full application the first week of December. Completed applications must be received by January 31st.

NEW! "MEDICAL STUDENT GRANT 2.0" opportunity!

THESE DEADLINES ARE SPECIFIC FOR MEDICAL STUDENT APPLICATIONS ONLY:
October 1: Letter of Intent due
November 1: Notification for request for a full application
December 15: Full application due
March 1: Notification of awards
Details are in the submission instructions.

Information may be obtained from:
Andrea Vambutas, MD, Executive Secretary, Research Fund of the American Otological Society
Email: avambuta@northwell.edu

AND **Kristen Bordignon**, AOS Research Fund Administrative Assistant
Email: administrator@americanotologicalsociety.org

2022-23 AOS Research Advisory Board

Andrea Vambutas, MD, Executive Secretary
Timothy E. Hullar, MD, Trustee
Steven D. Rauch, MD, Trustee
Daniel J. Tollin, PhD, Trustee
Samuel Gubbels, MD, Trustee
Ronna Hertzano, MD, PhD Trustee
Wade W. Chien, MD, Trustee
Gwenaelle Geleoc, PhD, Consultant
Amanda Lauer, PhD, Consultant
Lina A. J. Reiss, PhD, Consultant

The Research Advisory Board (RAB) is comprised of seven AOS members, each serving a 7-year term and three consultants, each serving a 5-year term. These individuals are among the most highly respected researchers in our field. The expertise and dedication of the RAB are critical to the success of the mission of the AOS Research Foundation.

American Otological Society Clinician Scientist Award
Progress report: 2/1/2022 – 1/31/2023
PI: Gavriel D. Kohlberg, MD
Mentor: Richard Wright, PhD
Title: Use of multisensory input and deep learning techniques to develop a next generation listening device to improve speech perception in noise for individuals with hearing loss

Progress Report
For the last year I have been focused on the following aim**:**

To evaluate how listeners combine real time visual speech text generated from an Automated Speech Recognition Program (ASR) with auditory speech information where both the output of the ASR and the auditory information have been corrupted by background noise

For this aim, 10 normal hearing subjects and 15 subjects with hearing loss were tested on a series of listening tasks. Speech stimuli from the AzBio sentence corpus were presented in three listening conditions: auditory, text and combined auditory and text. For the auditory condition, multitalker babble was added to each target speech stimulus. For the text condition, text was generated offline by passing the target speech stimulus through a commercially available automated speech recognition (ASR) program after adding multitalker babble to the speech. In the auditory condition subjects were instructed to repeat what they heard. In the text condition they tasked with repeating what they thought the original spoken sentence was. In the combined condition, they were instructed to both listen to the auditory stimulus and read the text stimulus and report what they thought the spoken sentence was. Stimuli were presented in each condition (auditory, text, combined auditory and text) at +6 dB SNR, +4 dB SNR and +2 dB SNR.

First, we found that increased background noise decreases speech perception performance for both normal hearing listeners and those with hearing loss in auditory, text and combined auditory and text conditions. ANOVA was applied across background noise levels (+6, +4, +2 dB SNR) for each condition (auditory, text and combined auditory and text) for both NH and HL listeners. In all listening conditions for both NH and HL listeners there was a significant decrease in speech perception (as measured by percent of words correctly identified).

	Mean	SD	Mean	SD	Mean	SD
Normal hearing	Auditory		Text		Combined auditory and text	
6 dB SNR	90.8	2.5	69.5	4.5	93.1	1.6
4 dB SNR	86.7	5.2	52.9	7.6	88.7	4.5
2 dB SNR	81.1	8.9	43.6	9	82.8	6.1
Hearing loss						
6 dB SNR	61.3	23.2	72	4.1	80	5.9
4 dB SNR	53.4	24.6	55.2	8.1	72.5	8.7
2 dB SNR	40.8	18.9	38.6	9	54.3	16.8

Table 1

Next, we looked to see how listeners performed across conditions (auditory, text and combined auditory and text) within the same noise level. Normal hearing listeners had higher speech perception accuracy on the combined auditory and text condition compared to the auditory condition at an SNR of +6 only (93.1% vs 90.8% $p < 0.02$). At SNR of +4 (88.7% vs 86.7%) and +2 (82.2% vs 81.1%) a difference in accuracy was not found. At all three SNR levels the normal hearing listeners performed better on the combined auditory and text condition compared to the text condition alone ($p < 0.001$ for all). Likewise, at all three SNR levels, the normal hearing listeners performed better on the auditory condition than the text condition ($p < 0.001$ for all).

Subjects with hearing loss had higher speech perception accuracy on the combined auditory and text condition compared to either the auditory condition alone or the text condition alone across all noise conditions ($p < 0.002$ for all). Similarly, those with hearing loss achieved higher accuracy scores in all levels of background noise when comparing combined auditory and text to text alone condition ($p < 0.01$ for all). A difference was not found

between speech perception performance on the auditory condition or text condition in any of the noise conditions for those with hearing loss. Results for NH and HL subjects are displayed in Figure 1a-c

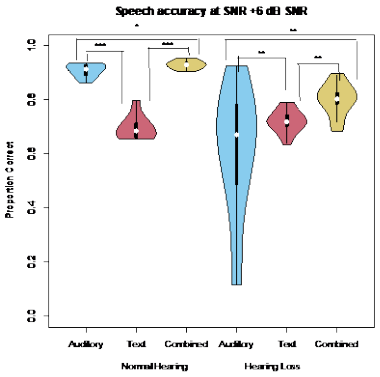


Figure 1a

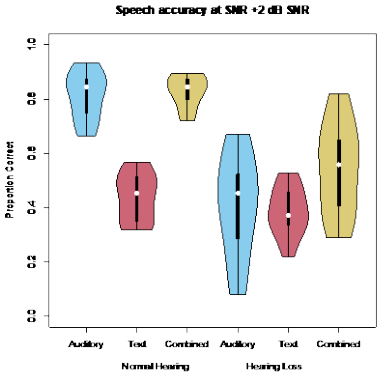


Figure 1b

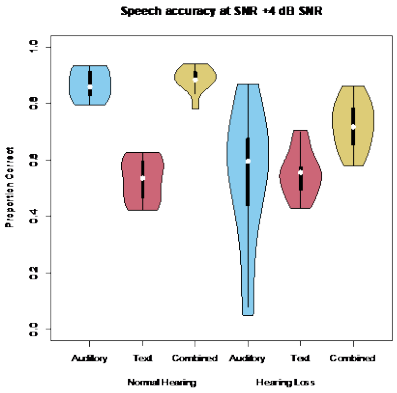


Figure 1c

Having found that listeners with hearing loss perform better on the combined auditory and text condition compared to either auditory or text conditions in all three noise conditions, we wanted to explore how listeners combine these two modalities at the sentence level. To accomplish this, we compared each subjects' accuracy on the individual sentence level (correctly identified words / total words in the sentence) to the accuracy of the text generated by the automated speech recognition (ASR) program. Figure 2a shows how HL listeners performed at +4dB SNR on the auditory condition only. While we compare the ASR performance to the auditory performance, the listeners did not see the ASR text in this condition. Figure 2b, shows the text only condition; note that HL listeners performed very similarly to the ASR text. In figure 2c we see how the combination of auditory and text stimuli leads to a significant shift of performance of HL listeners to the bottom right of the graph, corresponding to improved subject performance compared to either auditory (2a) or text (2b) stimulus alone. This experiment supports our hypothesis that listeners can integrate information from both auditory and text stimuli at the sentence level to reach a greater level of accuracy than would be expected from either of these inputs alone.

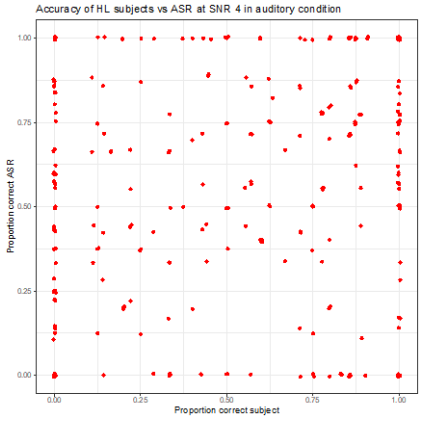


Figure 1a

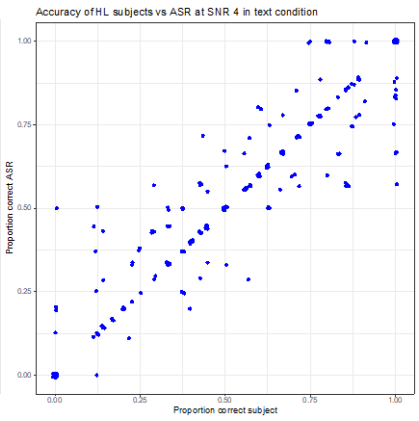


Figure 1b

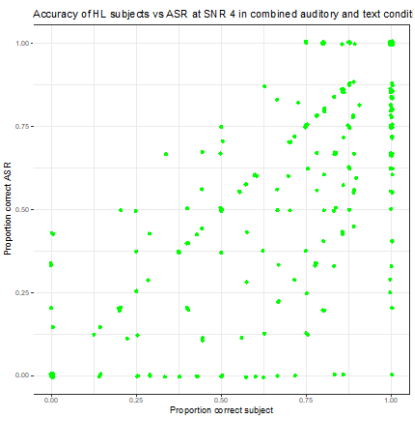


Figure 1c

I currently have a K23 grant proposal to the NIDCD related to this line of inquiry under review. I hope to continue the research and training aims that I have developed through the generous support of the AOS clinician Scientist Award.

American Otological Society Clinical Investigations Grant – 6 month Progress Report

Project Title: Hearing Loss and Balance Issues in Sickle Cell Disease
Project Dates: 7/1/22 – 6/20/23
AOS-CIG co-PIs: Eboni I. Lance and M. Dawn Nelson

Lay Summary:

Sickle cell disease (SCD) is an inherited blood disorder with several neurovascular complications. Recent literature shows increased risk for sensori-neural hearing loss in adults with SCD, but its impact on dizziness and balance disorders is unknown. We will administer surveys, collect clinical data, and perform hearing testing, balance and dizziness evaluation, and brain MRI in 20 adults with SCD with and without hearing loss, balance, and/or dizziness disorders, and 10 healthy adult control participants without SCD. Using this data, we will determine the frequency and symptoms associated with hearing loss, dizziness, and balance disorders in SCD and establish relationships between hearing loss, dizziness and balance disorders and SCD-related MRI findings and clinical characteristics. The results from this proposal could lead to formal targeted screening for these disorders in this chronic disease population.

Background: Sickle cell disease (SCD) is an inherited disorder of red blood cells that can lead to systemic complications. Neuro-vascular complications of SCD are quite common, particularly in more clinically severe SCD types, including SS and $S\beta^0$ thalassemia genotypes. These complications include stroke from large vessel occlusion, or silent cerebral infarcts from small vessel involvement that are associated with motor, sensory, and cognitive deficits (over 50% of SCD adults) or recurrent headaches (over 1/3 of SCD patients). Growing evidence suggests that ischemia within an area with limited vascular supply, such as the inner ear labyrinth, is also an important risk factor for loss of hearing and vestibular function in the general population. Recent meta-analyses identified sensorineural hearing loss cumulative risk ratios of 6.03 in adults with SCD, a significant increase in comparison to people without SCD.

Unfortunately, the relationship between hearing loss and vestibular function in SCD has not been investigated previously, and the overall impact of SCD on inner ear function remains largely unknown. Given the chronic course of the disease and significant morbidity associated with imbalance and hearing loss, understanding the extent of vestibular and auditory involvement in SCD is particularly important for this vulnerable disease population. Accordingly, here our <u>overarching hypothesis</u> is that SCD patients have higher rates of (i) subjective symptoms compared to the general population and (ii) objective signs of vestibular and auditory dysfunction compared to healthy controls. We posit that these labyrinthine dysfunctions are related to the vascular pathophysiology associated with SCD. We will explore this hypothesis using patient surveys, validated measurements of auditory and vestibular functions, and neuroimaging per the following specific aims.

<u>Aim 1</u>: Determine the frequency of hearing and vestibular symptoms in SCD patients.
We will administer a comprehensive survey to assess the rates of hearing loss and vestibular symptoms and their associations with SCD-related complications. Participants will be recruited with a goal of at least 100 individual surveys. *Our hypothesis is that hearing loss and vestibular symptoms are more common in SCD patients in comparison to regional and national epidemiological data. We also posit that vestibular and auditory symptoms are more frequent in the SCD genotypes associated with neurovascular complications (SS or $S\beta^0$ thalassemia).*

Progress: As of January 2023, we have completed our goal of 100 surveys (currently at 101 surveys) with the following demographics:

- 85 participants with sickle cell disease
  - SS type - 48 participants
  - SC type - 23 participants

    - Sβ^{+} - 12 participants
    - Unknown - 1 participant
- Control – 16 participants
- 20 child participants
- 67 female and 34 male participants
- 20 participants reported (19.8%) having hearing problems now
- 48 participants reported (47.5%) experiencing headaches
- 42 participants reported (41.6%) experiencing dizziness and imbalance

Though we have met our goal, we will continue to administer the survey in order to attempt prevalence estimates. Our study team has started data cleaning and initial data analyses. We will work on an abstract/poster for scientific conference presentations and a draft of a manuscript for publication over the next 6 months.

Aim 2: Establish associations between SCD-related risk factors and loss of hearing and vestibular function.

We will obtain objective measures of hearing and vestibular functions in 20 adult participants with SCD and compare the results with a group of 10 aged-matched healthy control participants. We will use a non-invasive novel MRI method to produce high resolution imaging of inner ear structures and measure cerebral blood flow (CBF) and oxygen extraction fraction (OEF), which are the known risk factors for stroke and silent cerebral infarcts in this population. *Our hypothesis is that SCD participants have significant loss of hearing and vestibular functions in comparison with healthy control participants and these findings are associated with labyrinthine hemorrhage and higher CBF/OEF. We also posit that increasing age, severe anemia, and a history of stroke/silent cerebral infarcts will be associated with worsening hearing and vestibular measures.*

Progress: As of January 2023, we have completed evaluations in 12 participants with SCD and 7 control participants. The table below contains more detailed information regarding their evaluation results.

- 18 participants have completed vestibular testing
- 16 participants completed have completed the MRI with 9 people having normal (56.2%) results and 7 (43.8%) with abnormal results.
- 17 participants have completed hearing testing

Table 1: Participant Hearing and Vestibular Evaluation Results

	SICKLE CELL (N=12)	CONTROL (N=7)
AGE, YEARS (RANGE)	45 (26-73)	46 (25-70)
Sex, female (%)	9 (75)	4 (57)
Pure tone average, n (%)		
<25 dB SPL	7 (75)	N/A
≥25 dB SPL	3 (25)	
Tympanogram, n (%)		
Type A	9 (90)	
Type C	1 (10)	
Caloric testing, n (%)		
Absent (abnormal) response	8 (80)	0 (0)
vHIT, gain (SEM)		
Horizontal SCC	1.04 (0.2)	0.99 (0.2)
VEMP testing, amplitude uV (SEM)		
oVEMP	4.3 (1.7)	7.2 (2.9)
cVEMP	44.9 (8.7)	58.8 (16.6)

*decreased gain or catch-up saccades in at least one canal

American Otological Society Research Grant - Medical Student Award
Progress report: 7/1/2022 – 2/11/2023
PI: Erika Lipford, MS
Title: The role of ATF signaling in prevention of noise-induced hidden hearing loss

Introduction: According to the World Health Organization, the number of individuals affected by some form of disabling hearing loss is estimated to be 466 million, with a projected increase to 700 million by 2050 [1]. The predicted rise in incidence, combined with the 1.1 billion young people currently believed to be at risk for hearing loss due to excessive recreational noise exposure [2], underscores the importance of understanding the underlying mechanisms of noise-induced hearing loss (NIHL). The neurons that innervate inner hair cells within the cochlea are known to be both genetically and physiologically heterogeneous and can be divided into three subtypes: type 1A, 1B, and 1C. Prior research from our laboratory found that the type 1A neurons, which are considered relatively protected from noise trauma, upregulate the pro-survival ATF family of transcription factors in response to permanent threshold shift-inducing noise trauma, which is the most severe form of NIHL [3]. Furthermore, informatic analysis identified compounds that could potentially be used to pharmacologically induce the ATF transcription factors in neurons. The overarching goal of my proposed research is to develop new treatments for PTS-inducing NIHL. I hypothesize that therapeutic induction of the ATF signaling pathway by cannabidiol (CBD), a known ATF agonist, can extend neuroprotection to the more vulnerable SGN subtypes of 1B and 1C neurons and prevent hearing loss following a PTS-inducing noise exposure. Successful completion of this project will determine whether CBD treatment is a viable therapeutic candidate for protection against NIHL via upregulation of pro-survival pathways in the spiral ganglion neurons.

Specific Aim 1 – Determine if treatment with cannabidiol (CBD), a known agonist of ATF, can be used for the induction of ATF expression in the SGNs of mice. Treatment with CBD in other neuronal cell types outside of the cochlea has been shown to induce robust upregulation of ATF gene expression. Hypothesis: treatment of CBD will induce expression in both the noise resilient type 1A SGNs, as well as the more vulnerable type 1B and 1C subtypes, in the *absence* of noise.

Progress: To assess whether CBD can modulate ATF gene expression within the murine cochlea, 10-week-old adult mice of both sexes were randomly divided into either an experimental or control group. Cannabidiol and vehicle solutions were prepared and administered via intraperitoneal (IP) injections in the experimental and control groups, respectively. Twenty-four hours following injection administration, the cochleae from both groups were collected, fixed and decalcified, and have been embedded for cryosectioning. Samples for both sexes and experimental conditions have been prepared for fluorescent *in situ* hybridization and will next be used to assess the spatiotemporal changes of *Atf3*, *Atf4*, and their targets *Gadd45a* and *Ddit3*. Once staining is completed, differences in ATF expression between groups will be quantitatively assessed with QuPath image analysis software.

Specific Aim 2 – Determine if treatment with cannabidiol (CBD) can be used to reduce permanent threshold shifts following a PTS-inducing noise exposure. The role of ATF TFs in neuroprotection and neuronal recovery in other organ systems presents a potential therapeutic application in the cochlea. Hypothesis: treatment of CBD will induce expression of pro-survival signaling pathways within the spiral ganglion neurons, thereby increasing protection against permanent threshold shifts.

Progress: Mice of both sexes were randomly assigned to either the treatment or control group (n=24, 12 per group) and underwent baseline auditory brainstem response (ABR) testing at 9 weeks of age. At 10 weeks of age, mice were administered either a single dose of CBD (60mg/kg) or vehicle (2% Tween-80 and 0.9% NaCl solution without CBD), then 1 hour following the injection, were exposed to PTS-inducing noise (octave band 8-16 kHz) at 105 dB SPL for 2 hours. Repeat ABR testing was performed 24 hours and 1-week following the noise exposure to assess the compound threshold shift (CTS) and permanent threshold shift (PTS), respectively. Auditory data was analyzed both with males and females together, as well as separately by sex and

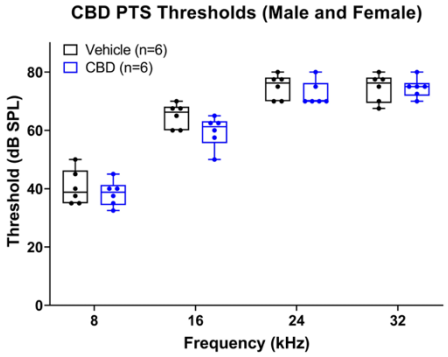


Figure 1. PTS thresholds between CBD-treated and vehicle-treated mice showed no significant difference.

experimental group. Threshold shifts between CBD and vehicle treated mice showed no significant difference in both male and female mice (Figure 1).

Wave I analysis was conducted for males and females, showing statistically significant differences in wave I amplitudes between treatment conditions. In females, wave I amplitude was significantly higher for CBD treated mice at the 85dB and 80dB intensities in the 8kHz, 16kHz, and 24kHz frequencies (Figure 2). Similarly, in males treated with CBD, wave I amplitude was significantly higher at the 85dB and 80dB intensities in the 8kHz and 24kHz frequencies (Figure 3).

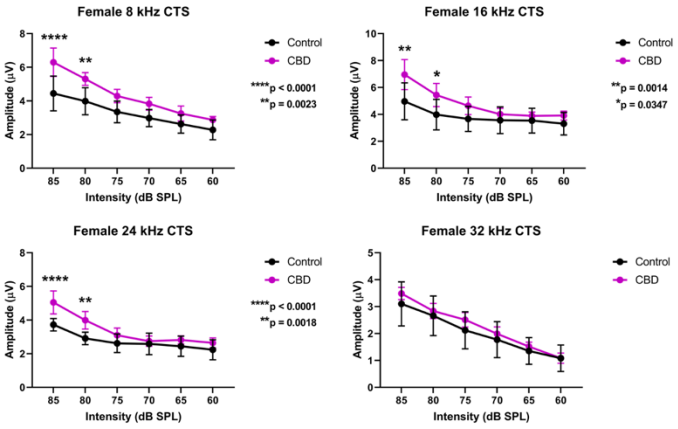


Figure 2. Wave I amplitude was significantly higher in female CBD treated mice at higher intensities in the 8kHz, 16kHz, and 24kHz frequencies.

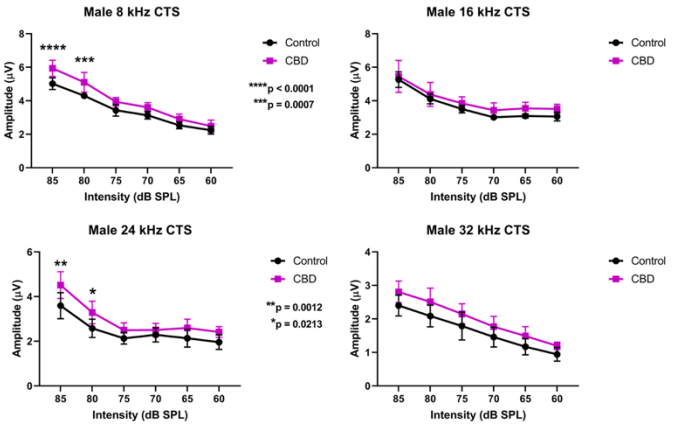


Figure 3. Wave I amplitude was significantly higher in male CBD treated mice at higher intensities in the 8kHz and 24kHz frequencies.

Inner ears were collected from the PTS exposures and are currently being used for further histological analysis, including cytocochleograms and synaptic counts.

References

1. World Health Organization. WHO: 1 in 4 people projected to have hearing problems by 2050. News release. 2021 Mar 2.
2. World Health Organization. New WHO-ITU standard aims to prevent hearing loss among 1.1 billion young people. News release. 2019 Feb 12.
3. Milon B, Shulman ED, So KS, Cederroth CR, Lipford EL, Sperber M, Sellon JB, Sarlus H, Pregernig G, Shuster B, Song Y, Mitra S, Orvis J, Margulies Z, Ogawa Y, Shults C, Depireux DA, Palermo AT, Canlon B, Burns J, Elkon R, Hertzano R. A cell-type-specific atlas of the inner ear transcriptional response to acoustic trauma. Cell Rep. 2021 Sep 28;36(13):109758. doi: 10.1016/j.celrep.2021.109758. PMID: 34592158.

American Otological Society Research Grant
Progress Report: 7/1/22- 1/31/23
PI: Jeffrey D. Sharon, MD
Title: **Characterization of Resting-State and Functional Connectivity Changes in Vestibular Migraine**

Introduction: Vestibular migraine (VM) has been recognized as a distinct subtype of migraine that causes dizziness as the predominant symptom. Criteria for diagnosis have been adopted by the Bárány Society (Lempert et al. 2012). Previous epidemiological research has demonstrated that the lifetime prevalence of vestibular migraine in the general population is estimated at 2.7%, and at least 10% of patients who present to tertiary care vestibular clinics have vestibular migraine (Van Ombergen et al. 2015; Formeister et al. 2018). Yet, despite its high prevalence, VM is poorly understood. Currently, there are no disease biomarkers, and pathophysiology is unclear. Explanatory models need to account for common symptoms, including sensory hypersensitivity, difficulty with multisensory integration, motion sickness, spontaneous vertigo, and dizziness induced by busy visual scenes. Post-concussive dizziness is phenotypically similar to vestibular migraine, including headache, photophobia, phonophobia, dizziness, and visual sensitivity. There have only been a handful of recent studies that have explored alterations in cortical activation or functional connectivity in vestibular migraine, which have suggested that thalamo-pain, thalamo-visual, and thalamo-vestibular pathways may be altered in VM patients (Chen et al. 2021). We have previously reported fMRI changes in patients with dizziness after head trauma, who share many clinical similarities to VM patients, including increased activation of visual-vestibular multisensory processing cortical areas during a visual-vestibular paradigm (Allen et al. 2021) and increased connectivity between these regions during rest (Trofimova et al. 2021). Therefore, we aim to define the functional reorganization that occurs within central vestibular structures and related cortical networks in patients with VM using both rs-fMRI and t-fMRI techniques.

Specific Aims:

Specific Aim 1: To characterize differences in functional connectivity at baseline using resting-state functional MRI (rs-fMRI), comparing those meeting Bárány society criteria for vestibular migraine or probable vestibular migraine to a cohort of normal age- and sex-matched subjects without a history of dizziness, vertigo, or migraine and to correlate rs-fMRI regional brain connectivity to clinical symptom severity using Vestibular Migraine Patient Assessment Tool and Handicap Inventory (VM-PATHI) and Dizziness Handicap Inventory (DHI) scores.

Specific Aim 2: To define differences in task-based functional MRI (t-fMRI) using a visual-vestibular paradigm, comparing those meeting Bárány society criteria for vestibular migraine or probable vestibular migraine to a cohort of normal age- and sex-matched subjects without a history of dizziness, vertigo, or migraine and to correlate regional brain activity to clinical symptom severity using VM-PATHI and DHI scores.

Progress: In the last six months, we accomplished all the preparatory work to begin scanning subjects, and we have just started acquiring fMRI data. This included building and testing a secure REDCAP database for study participants for tracking and also to collect detailed clinical information, acquiring a handheld MRI compatible 5 button response box, developing and beta-testing the Psycho-Py script to run the research protocol, and running through the protocol with healthy volunteers to ensure adequate and quality data collection. We did overcome some early obstacles

where the Psycho-Py script was not properly communicating with the MRI machine, and also program crashes mid-scan. Those issues now appear to be resolved. We have been in constant communication with our collaborators at Emory (Dr. Jason Allen and Dr. Russell Gore), and have ensured data standardization to allow for pooling and direct comparisons to their control population, which has already been acquired. As of today, we have completed three scans in study subjects, and we have a healthy pipeline, with another 6 scans scheduled as of the writing of this report. We believe that we are on track to complete primary data collection before the end of the study. The goal is to scan 20 subjects with vestibular migraine. We do not yet have enough subjects to begin data analysis, but we have confirmed with our Emory colleagues that the scan quality is acceptable, and we have the requisite resting state data, task based data, and subject reported symptoms during the scan for analysis. We are very appreciative of the American Otological Society and their support.

Allen, J. W., A. Trofimova, V. Ahluwalia, J. L. Smith, S. A. Abidi, M. A. K. Peters, S. Rajananda, J. E. Hurtado, and R. K. Gore. 2021. "Altered Processing of Complex Visual Stimuli in Patients with Postconcussive Visual Motion Sensitivity." *AJNR. American Journal of Neuroradiology* 42 (5): 930–37.

Chen, Zhengwei, Lijie Xiao, Haiyan Liu, Qingxiu Zhang, Quan Wang, You Lv, Yujia Zhai, et al. 2021. "Altered Thalamo-Cortical Functional Connectivity in Patients with Vestibular Migraine: A Resting-State fMRI Study." *Neuroradiology*, August. https://doi.org/10.1007/s00234-021-02777-w.

Formeister, Eric J., Habib G. Rizk, Michael A. Kohn, and Jeffrey D. Sharon. 2018. "The Epidemiology of Vestibular Migraine: A Population-Based Survey Study." *Otology and Neurotology* 39 (8): 1037–44.

Lempert, Thomas, Jes Olesen, Joseph Furman, John Waterston, Barry Seemungal, John Carey, Alexander Bisdorff, Maurizio Versino, Stefan Evers, and David Newman-Toker. 2012. "Vestibular Migraine: Diagnostic Criteria." *Journal of Vestibular Research: Equilibrium & Orientation* 22 (4): 167–72.

Trofimova, Anna, Jeremy L. Smith, Vishwadeep Ahluwalia, Julia Hurtado, Russell K. Gore, and Jason W. Allen. 2021. "Alterations in Resting-State Functional Brain Connectivity and Correlations with vestibular/Ocular-Motor Screening Measures in Postconcussion Vestibular Dysfunction." *Journal of Neuroimaging: Official Journal of the American Society of Neuroimaging* 31 (2): 277–86.

Van Ombergen, Angelique, Vincent Van Rompaey, Paul Van De Heyning, and Floris Wuyts. 2015. "Vestibular Migraine in an Otolaryngology Clinic: Prevalence, Associated Symptoms, and Prophylactic Medication Effectiveness." *Otology and Neurotology* 36 (1): 133–38.

PI: Corey Shayman, MD-PhD Student at the University of Utah
Funding Mechanism: Fellowship Grant
Mentor Team: Dr. Creem-Regehr, Dr. Stefanucci, Dr. Fino, Dr. Gurgel, Dr. Hullar
Funding Period: 7/1/22-6/30/23
Progress Report Date: 2/9/23

Title: The Contributions of Auditory Cues to Navigation

1. Background

The ability to navigate through familiar and new environments is central to quality of life[1], but the ability to navigate effectively becomes increasingly challenging with age and sensory pathology[2]. Audition has recently been shown to improve postural control[3] and gait[4]; however, limited data exist on the relationship between audition and navigation outside the realm of echolocation.

Based on the pivotal work of Ernst and Banks[5] as well as Bates and Wolbers[6], we believe that healthy individuals will use all available cues, including audition, to navigate in a manner consistent with the maximum likelihood estimation model[7] (termed optimal integration). Understanding the role of audition in navigation, particularly how and for whom auditory input can provide benefit, will allow us to better assess, treat, and predicted age-related and sensory impairment-related declines in independent mobility, a cornerstone of healthy aging.

2. Specific Aims

Specific Aim 1: Quantify the contribution of spatial auditory cues to navigation and determine whether audition and vision are optimally integrated in individuals without sensory impairment.

Specific Aim 2: Assess the relative benefit of auditory cues in navigation for individuals with acute sensory impairment.

3. Progress Report

Before enrolling participants for these aims, we needed to develop, design, and build the virtual reality immersive environment for our homing paradigm. Our immersive virtual environment needed to be calibrated against our real-world auditory environment. Alongside a fellow graduate computer science student, Hunter Finney, I developed and tested the environments, task, and stimuli for our behavioral experiments. Images of the graphic user interface (GUI) seen by experimenters and the immersive world seen by the participants are pictured in Figure 1. Auditory stimuli were generated based on similar experiments[8] and calibrated to our virtual environment through custom-built software. The homing task was designed such that our human participants only have access to predetermined spatial cues to navigate to encode a target location and successfully return to the target location. These conditions are listed in Table 1. In the past couple of weeks, we successfully collected pilot data for our “vision vs. audition” homing task for our first participant, validating our conditions, software, and stimuli. These data are shown in Figure 2.

Condition	Intervention	Cues Available
"Vision Only"	Auditory stimuli are disabled, and participant is spun in a chair to dissociate self-motion cues.	Vision
"Audition Only"	Visual landmarks are disabled, and participant is spun in a chair to dissociate self-motion cues	Audition
"2 Cue Consistent"	Participant is spun in a chair to dissociate self-motion cues	Vision and Audition
"Conflict"	Auditory cues are covertly shifted 15 degrees while participant is spun in a chair to dissociate self-motion cues	Vision and Audition with conflicted spatial cues

Table 1: Homing task conditions

During the software design and development phase, we simultaneously collected pilot data on the reliability of our cue combination model. We successfully collected data on 40 participants, including groups of younger and older adults to determine any potential effect of age on sensory cue weight as well as integration strategy. We also tested our cue combination model’s test-retest reliability to determine the number of trials we need to include for a stable cue-combination outcome measure. During this pilot phase we also developed a data analysis pipeline in R and validated it against previous cue-combination studies.

With funds from AOS and from my PI’s development account, we constructed a new laboratory space with acoustic dampening, a 40 m^2 space for behavioral testing with the homing task, and a multi-channel audio configuration for presenting spatial auditory cues in sound field. Our pilot testing is now complete, and we

are ready to begin collecting data for both aims 1 and 2 simultaneously. For aim 2, we are currently finishing development and testing of techniques to reduce the reliability of the visual information presented in the virtual environment by reducing display resolution or adding blur.

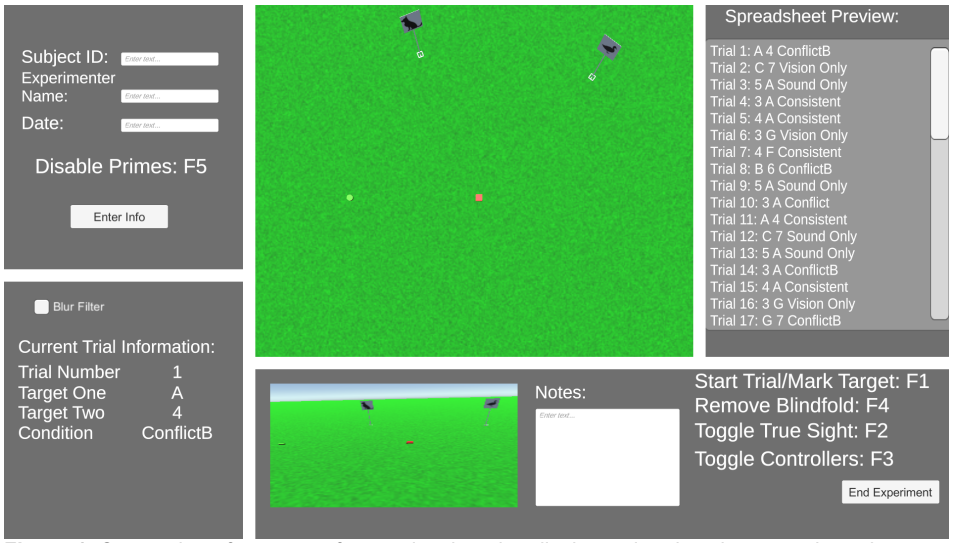


Figure 1: Screenshot of custom software, developed to display a virtual environment through a head-mounted display

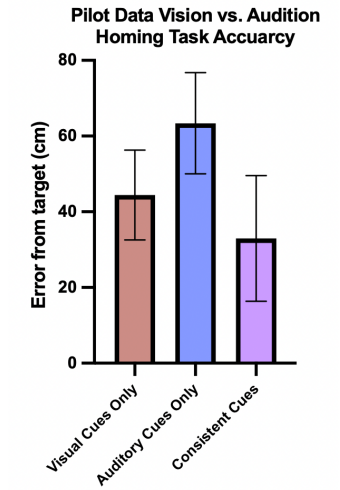


Figure 2: Homing task pilot data 1 participant validating our paradigm and stimuli

4. Training Progress

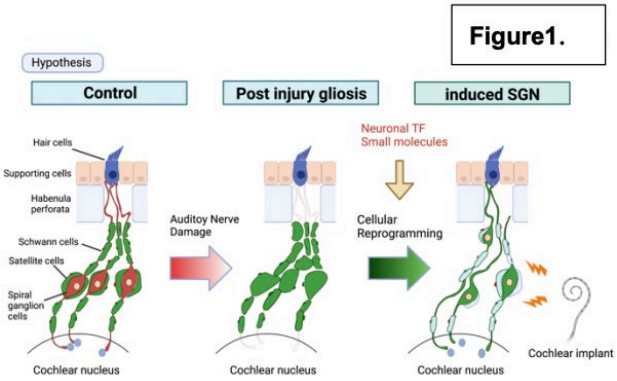
During my AOS fellowship, I have completed a course in systems neuroscience focused on sensory and motor systems. In addition, I have completed an online course in writing code in R. This has allowed me to synthesize a data processing pipeline from our homing task outcomes and compare the data to several models, including the MLE model. I have continued to shadow clinical mentors and have presented my research in multiple forums including the University of Utah Center on Aging Retreat, The Utah Neuroscience Symposium, the IEEE VR international conference in Singapore, and the Psychonomic Society national conference in Boston. In addition to these conferences, I have published a paper, "Multisensory Cue Combination During Navigation: Lessons Learned from Replication in Real and Virtual Environments"[9]. In this time, I have mentored 6 undergraduate students, two of whom wrote proposals and received funding through the University of Utah's Office of Undergraduate Research under my mentorship. I have written up the majority of my first publication on auditory contributions to navigation in VR which will be submitted soon. Lastly, my work from this fellowship has formed the foundation of a now submitted NRSA F30 proposal to the NIDCD that was submitted in December 2022 and is currently under review.

5. References

1. van der Ham IJM, Claessen MHG, Evers AWM, van der Kuil MNA. Large-scale assessment of human navigation ability across the lifespan. *Sci Rep*. 2020;10(1):1-12. doi:10.1038/s41598-020-60302-0
2. Lester AW, Moffat SD, Wiener JM, Barnes CA, Wolbers T. The Aging Navigational System. *Neuron*. 2017;95(5):1019-1035. doi:10.1016/j.neuron.2017.06.037
3. Lubetzky A v, Gospodarek M, Arie L, Kelly J, Roginska A, Cosetti M. Auditory Input and Postural Control in Adults. *JAMA Otolaryngology–Head & Neck Surgery*. 2020;146(5):480. doi:10.1001/jamaoto.2020.0032
4. Weaver TS, Shayman CS, Hullar TE. The Effect of Hearing Aids and Cochlear Implants on Balance During Gait. *Otology & Neurotology*. 2017;38(9):1327-1332. doi:10.1097/MAO.0000000000001551
5. Ernst MO, Banks MS. Humans integrate visual and haptic information in a statistically optimal fashion. *Nature*. 2002;415(6870):429-433. doi:10.1038/415429a
6. Bates SL, Wolbers T. How cognitive aging affects multisensory integration of navigational cues. *Neurobiol Aging*. 2014;35(12):2761-2769. doi:10.1016/j.neurobiolaging.2014.04.003
7. Chen X, McNamara TP, Kelly JW, Wolbers T. Cue combination in human spatial navigation. *Cogn Psychol*. 2017;95:105-144. doi:10.1016/j.cogpsych.2017.04.003
8. Zanchi S, Cuturi LF, Sandini G, Gori M. Interindividual Differences Influence Multisensory Processing During Spatial Navigation. *J Exp Psychol Hum Percept Perform*. 2022;48(2):174-189. doi:10.1037/xhp0000973
9. Shayman CS, Stefanucci JK, Fino PC, Creem-Regehr SH. Multisensory Cue Combination During Navigation: Lessons Learned from Replication in Real and Virtual Environments. In: *2022 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct)*. IEEE; 2022:276-277. doi:10.1109/ISMAR-Adjunct57072.2022.00062

American Otological Society Clinician Scientist Award – Progress Report
Grant Funding Period: 7/1/2023 – 6/30/2024
Progress Report Date: 1/31/2023
Principal Investigator: Seiji B. Shibata MD PhD
Mentors: Justin Ichida
Project Title: Cellular reprogramming of peripheral glial cells to generate auditory neurons

Background: Sensorineural hearing loss (SNHL) is a major public health issue as by 2050, over 900 million people are predicted to have some degree of hearing loss. The auditory nerve plays a crucial role in hearing by transmitting acoustic signals generated from the inner ear to the brain. Degeneration of the auditory nerve can be induced by ototoxic drugs, noise, or aging. Because the auditory nerve lacks intrinsic regenerative capacity, damage to the nerve leads to permanent SNHL. There are no effective treatments that account for the loss spiral ganglion cells (SGC), as observed in auditory neuropathy (AN) or neural deafness. Thus, regenerative medicine to restore the SGC holds enormous potential. Given the plasticity of certain somatic cells, in vivo direct reprogramming is an emerging field in regenerative medicine. One potential source in the inner ear is the peripheral glial cells, primarily composed of Schwann cells and satellite cells. Earlier work has shown that a subpopulation of cochlear glial cells are potent progenitor cells and can be coaxed into neuron-like cells by overexpression of bHLH transcription factors Ascl1, Neurog1, and NeuroD1 in vitro. However, research investigating this approach in vivo and in damaged tissue is limited. ***Hypothesis:*** Direct cell reprogramming of the cochlear glial cells with neuronal transcription factors can generate induced SGC to restore hearing (Fig1).



Aim 1: Explore in vitro and in vivo direct reprogramming using cochlear glial cells.
Specific goals of Aim1:
Aim 1.1, Determine optimal vector and promoter to transduce the cochlear glial cells in vivo. Progress: We have screened the cochlear transduction profile of AAV serotypes 1, 6, 9, PHP.eB, DJ, and DJ/8 that harbor CMV driven GFP. P2-3 neonatal mice have been injected via the posterior semicircular canal. The whole mount and cryosection cochlear tissue were stained for neuronal marker NF200 and glial cell marker Sox10. We determined that AAV1, PHPeB, and DJ transfected the glial cells as well as many of the otic mesenchyme cells (Fig2). The vectors do not affect the auditory function when injected at this age.

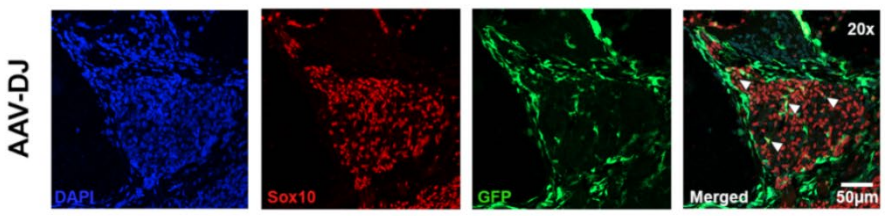


Figure 2. Neonatal cochlea following injection of AAVDJ-CMV-GFP. GFP positive glial cells (arrow head) and otic mesenchyme cells are shown in the Rosenthal's Canal.

Aim 1.2, Explore in vitro direct reprogramming of cochlear glial cells. Progress: We demonstrate that mouse embryo fibroblasts can be induced into sensory neuron with cocktail of transcription factors cloned into retrovirus. The induced neurons have morphological and molecular features consistent with sensory neurons. We initially proposed using the down regulation of Ptbp1 gene to induce neurogenesis as it demonstrated promise in the CNS. However, after stringent lineage tracing of induced neurons was found to be an artifact in recent follow up papers. We have moved away from Ptbp1 and will now focus on neurogenic molecules miRNAs; miR-9/9 and miR-124, that are highly abundant in neuronal tissue and are essential for neural differentiation. Combination treatment of miRNAs with neuronal transcription factors have shown enhanced reprogramming efficiency in the CNS.

Aim 2: Determine the glial cell response to SGN degeneration in the AN model in neonatal mouse. Progress: We sought to develop a neonatal mouse model with primary SGN degeneration to assess reactive gliosis and regenerative competence during the early developmental stage. We hypothesized that Ouabain will

selectively lesion SGNs when administered in the neonatal mice. We injected P1-2 CBA/CaJ mice with 1 µl of Ouabain at concentration of 50-1000 µM into the perilymphatic space through the RWM with canal fenestration. This approach did not lead to SGN neurite loss in the neonatal mice and led to mortality in higher concentrations. However, in P30 adult mice, Ouabain 50 uM leads to destruction of the SGN soma and neurites while sparring the hair cells (Figure 3). From our results, we speculate that the paucity of Na+/K+ ATPase α/β subunit distribution during neonatal development in mouse cochlea may contribute to the reduced damage. We will assess the expression of Na+/K+ ATPase α/β subunits with immunohistochemistry in the neonatal cochlea vs the adult. In summary, in addition to the species variability that has been described with Ouabain deafening, there is likely an age dependency of the ototoxic effect of Ouabain in mice.

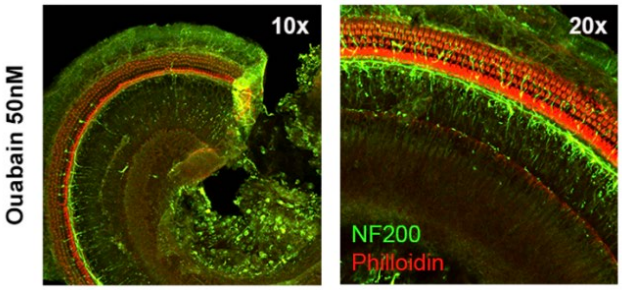


Fig3. Direct Ouabain injection into adult cochlea. Whole mount images stained with NF200 obtained by immunofluorescence microscope. In the apex, spiral ganglion cells (SGC) and neurites morphology, size, and numbers are disrupted. The hair cells shown in Phalloidin are intact.

We next examined secondary SGN loss in the neonatal mice following the administration aminoglycoside Neomycin into the scala media. Rapid and complete degeneration of the inner and outer HCs occurred as early as 3 days post-injection. Subsequently, time- and dose-dependent degeneration patterns were observed along the axis of the cochlear membranous labyrinth. Likewise, the SGN histology demonstrated a significant reduction of cell density at 2 and 4 weeks. The ABR threshold measurements confirmed profound deafness at 4 weeks (Fig4). This single injection chemically-induced deafening model in neonatal mice allows us to investigate the processes of neural degeneration and regeneration during early cochlear development.

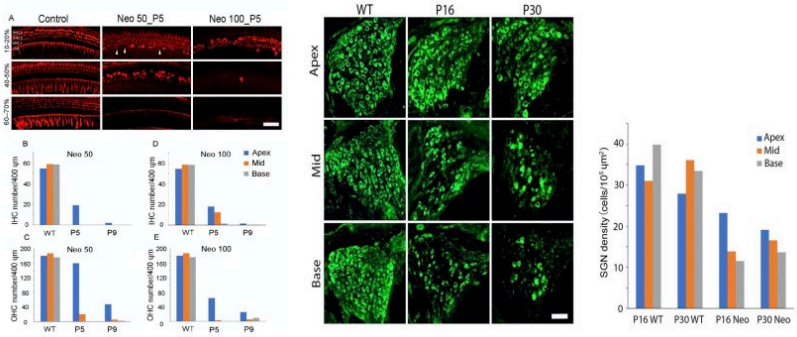


Fig4. Single injection of neomycin induces rapid HC loss and secondary spiral ganglion cell loss. Whole mount images stained with Myo7a and quantification of the HC demonstrate time and dose dependent degeneration patterns. Cryosection of neomycin injected ears at P16 and P30 show significant SGN reduction in mid and basal turns. Quantification of cell density shows significant loss compared to age matched controls in all turns.

Future directions:

For Aim 1.1, our preliminary data with screening different AAV serotypes with ubiquitous promotors demonstrate limited glial cell transduction in the inner ear, to further target the glial cells, we will explore different promoters to increase the selectivity of glia transduction. For Aim1.2, we have identified several candidate neuronal transcription factors that reprogram mouse fibroblasts into induced-neurons, we will investigate the reprogramming capacity of miRNAs in conjunction with these neuronal transcription factors in the inner ear glial cells *in vitro* and *in vivo*. For Aim 2, our preliminary data highlights the difficulty of creating a AN model in neonatal mouse. To develop a AN model in neonatal mice with selective SGN loss, we are currently investigating a novel approach using cre dependent AAV-hSYN-Flex-DTA. The AAV vector and cre dependent Flex sequence is driven by hSYN promoter which induces DTA expression selectively in PV expressing neurons. We anticipate that AAV-hSYN-Flex-DTA injection into the inner ear will selectively and rapidly ablate neurons in the PV Cre mice creating a novel AN model in neonatal mouse.

PAST PRESIDENTS OF THE

AMERICAN OTOLOGICAL SOCIETY

1868 - 69 Elkanah G. Williams, MD

1870 - 73 Henry D. Noyes, MD

1874 - 76 Daniel Bennet St. John Roosa,MD

1877 - 78 Clarence J. Blake, MD

1879 - 80 Albert H. Buck, MD

1881 - 83 John O. Green, MD

1884 - 85 Charles H. Burnett, MD

1886 - 89 J.S. Prout, MD

1890 Oren D. Pomeroy, MD

1891 - 94 Gorham Bacon, MD

1895 - 99 Arthur Mathewson, MD

1900 - 02 Horace.G. Miller, MD

1903 - 05 B. Alex Randall, MD

1906 - 07 Emil Gruening, MD

1908 – Charles .J. Kipp, MD

1909 - 10 Frederick L. Jack, MD

1911 - 12 Edward B. Dench, MD

1913 - 14 James .F. McKernon, MD

1915 - 16 Charles .W. Richardson, MD

1917 - Christen R. Holmes, MD

1918 Norval H. Pierce, MD

1919 Ewing W. Day, MD

1920 Robert Lewis, MD

1921 Wells P. Eagleton, MD

1922 Herbert S. Birket, MD

1923 George E. Shambaugh, Sr., MD

1924 John B. Rae, MD

1925 Eugene A. Crockett, MD

1926 Thomas J. Harris, MD

1927 Arthur B. Duel, MD

1928 Max A. Goldstein, MD

1929 John G. Wilson, MD

1930 S. MacCuen Smith, MD

1931 D. Harold Walker, MD

1932 Lee W. Dean, MD

1933 George I. Tobey, Jr., MD

1934 John R. Page, MD

1935 Samuel J. Crowe, MD

1936 Francis R. Packard, MD

1937 Edmund P. Fowler, MD

1938 Harris P. Mosher, MD

1939 Isidore Friesner, MD

1940 Horace Newhart, MD

1941 George M. Coates, MD

1942 Ernest M. Seydell, MD

1943 - 44 Wesley C. Bowers, MD

1945 - 46 Gordon Berry, MD

1947 William E. Grove, MD

1948 Bernard J. McMahon, MD

1949 Marvin F. Jones, MD

1950 Philip E. Meltzer, MD

1951 Kenneth M. Day, MD

1952 Gordon D. Hoople, MD

1953 Albert C. Furstenberg, MD 1954

1954 Frederick T. Hill, MD

1955 D.E. Staunton 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 George E. 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 D. Bradley Welling, MD, PhD

2016 Debara L. Tucci, MD, MS, MBA

2017 Samuel H. Selesnick, MD

2018 Roberto A. Cueva, MD

2019 Carol A. Bauer, MD

2020 John P. Carey, MD

2021 Patrick J. Antonelli, MD

2022 Marlan R. Hansen, MD

2023 Lawrence R. Lustig, 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 - 2017	Steven A. Telian, MD
2017 - 2023	Sujana S. Chandrasekhar, MD

AWARD OF MERIT RECIPIENTS (1949 - 2022)

1949	George M. Coates, MD
1951	Barry J. Anson, PhD
	Theodore H. Bast, PhD
1952	Edmund P. Fowler, Sr., MD
1953	Julius Lempert, MD
1954	Stacy Guild, PhD
1957	Georg von Bekesy, PhD
1959	Ernest Glen Wever, PhD
1960	Hallowell Davis, MD
1961	John R. Lindsay, MD
1962	William J. McNally, MD
1965	Anderson C. Hilding, MD
1966	Gordon D. Hoople, MD
1967	Merle Lawrence, PhD
1968	Lawrence R. Boles, MD
1969	Sir Terence Cawthorne
1970	Senator Joseph A. Sullivan, MB
1971	Samuel Rosen, MD
1972	Howard P. House, MD
1973	Moses H. Lurie, MD
1974	George E. Shambaugh, Jr., MD
1975	Catherine A. Smith, PhD
1976	Harry Rosenwasser, MD
1977	Frank Lathrop, MD
1978	Juergen Tonndorf, MD
1979	John Bordley, MD
1980	Ben H. Senturia, MD
1981	J. Brown Farrior, MD
1982	William F. House, MD
1983	Victor Goodhill, MD
1984	Harold F. Schuknecht, MD
1985	Wesley H. Bradley, MD
1986	John J. Shea, Jr., MD
1987	Jack V. Hough, MD
1988	George D. Nager, MD
1989	Brian F. McCabe, MD
1990	Eugene L. Derlacki, MD
1991	Richard R. Gacek, MD
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

2016 Charles M. Luetje, MD

2017 Clough Shelton, MD

2018 Paul R. Lambert, MD

2019 John W. House, MD

2020 Steven A. Telian, MD

2021 Miriam I. Redleaf, MD

2022 Lloyd Brooks Minor, MD

ACCME ACCREDITED WITH COMMENDATION

AMERICAN COLLEGE OF SURGEONS
Inspiring Quality: Highest Standards, Better Outcomes
100+years

AMERICAN COLLEGE OF SURGEONS
DIVISION OF EDUCATION
Blended Surgical Education and Training for Life®

DISCLOSURE INFORMATION

AMERICAN OTOLOGICAL SOCIETY: 156TH ANNUAL SPRING MEETING
MAY 5-7, 2023
BOSTON, MA

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity (planners and speakers/authors/discussants/moderators) has disclosed all financial relationships with any commercial interest (termed by the ACCME as an "ineligible company", defined below) held in the last 24 months (see below for definitions). Please note that first authors were required to collect and submit disclosure information on behalf all other authors/contributors, if applicable.

Ineligible company: Any entity producing, marketing, re-selling, or distributing health care goods or services used on or consumed by patients. Providers of clinical services directly to patients are NOT included in this definition.
Financial Relationships: Relationships in which the individual benefits by receiving a salary, royalty, intellectual property rights, consulting fee, honoraria, ownership interest (e.g., stocks, stock options or other ownership interest, excluding diversified mutual funds), or other financial benefit. Financial benefits are usually associated with roles such as employment, management position, independent contractor (including contracted research), consulting, speaking and teaching, membership on advisory committees or review panels, board membership, and other activities from which remuneration is received, or expected. ACCME considers relationships of the person involved in the CME activity to include financial relationships of a spouse or partner.
Conflict of Interest: Circumstances create a conflict of interest when an individual has an opportunity to affect CME content about products or services of an ineligible company with which he/she has a financial relationship.

The ACCME also requires that ACS manage any reported conflict and eliminate the potential for bias during the educational activity. Any conflicts noted below have been managed to our satisfaction. The disclosure information is intended to identify any commercial relationships and allow learners to form their own judgments. However, if you perceive a bias during the educational activity, please report it on the evaluation.

SPEAKERS / MODERATORS / DISCUSSANTS/AUTHORS	NOTHING TO DISCLOSE	DISCLOSURE		
		COMPANY	ROLE	RECEIVED
Lawrence R. Lustig, MD	*x*			
Prof. Karen B. Avraham	*x*			
Ronna Hertzano, MD, PhD	x			
Sharon J. Feng, BA, BS	x			
Samantha Frank, MD	x			
Sonia M. Scaria, PhD	x			
Daniel D. Bu, MPP, MBA	x			
Zachary D. Urdang, MD PhD	x			
Nancy M. Young, MD	x			
John P. Marinelli, MD	x			
Charlotte K. Hughes, MD, MPH	x			
Sahar Assi, MD	x			
Catherine L. Kennedy, MD	x			
David R. Friedland, MD, PhD	x			
Debara L. Tucci, MD, MS, MBA	x			
Francis "Pete" X. Creighton, MD	x			
Wade Chien, MD	x			
Sarek A. Shen, MD	x			
James R. Dornhoffer, MD	x			
Rustin G. Kashani, MD	x			

Emily C. Wong, MD	x			
Chloe E. Swords, MBBS, MRCS	x			
Chioma Anidi BA	x			
Prof. Stefan K. Plontke	x			
Ana H. Kim, MD	x			
Joshua E. Fabie, MD	x			
Vivian F. Kaul, MD	x			
Ankita Patro, MD, MS	x			
Christian M. Shannon, MS, MPAff	x			
Emily K. Gall, MD	x			
Brandon Isaacson, MD	x			
Madison V. Epperson, MD	x			
Mark Nyaeme, BS	x			
Marwin Li, BS	x			
Gavriel Kohlberg, MD	x			
Matthew L. Bush, MD, PhD, MBA	x			
Yuri Agrawal, MD, MPH	x			
Jacob Hunter, MD	x			
Susan Emmett, MD, MPH	x			
Cedric Pritchett, MD	x			
Adam Thompson-Harvey, MD	x			
PLANNING COMMITTEE	**NOTHING TO DISCLOSE**	**DISCLOSURE**		
		COMPANY	**ROLE**	**RECEIVED**
Lawrence R. Lustig, MD	x			
Sujana Chandrasekhar, MD	x			
David R. Friedland, MD, PhD	x			
Nancy M. Young, MD		MEDEL MEDEL Advanced Bionics	Advisory Board; Consultant Contracted research (FDA clinical trials) of which I am PI Advisory Board	Consulting fee My institution is paid, I receive sponsored travel when presenting results of study Consulting fee
Marlan R. Hansen, MD	x			
Patrick J. Antonelli, MD	x			
William H. Slattery III, MD	x			
Nikolas H. Blevins, MD	x			
Marc L. Bennett, MD	x			
Matthew L. Bush, MD, PhD		Stryker	Neurotology Bootcamp Course Instructor	Travel Expenses, Meals
Wade W. Chien, MD	x			
Hamid R. Djalilian MD		Elinava Technologies Cactus Medical LLC NXT Biomedical	Co-Founder Co-Founder Consultant	Equity Equity Consulting fee
Ronna Hertzano MD, PhD		Regeneron	I am in charge of designing the audiological assessment of hearing in a population studied by the university (Department of	I am a co-investigator on a grant that they sponsor. I receive less than 3% effort support to my salary. This is a minor project. I am in charge of

			Genetics) in collaboration with Regeneron.	designing the audiological assessment of hearing in a population studied by the university (Department of Genetics) in collaboration with Regeneron.
Brandon Isaacson, MD		Alcon Medtronic	Consulting Consulting, course instructor	Consulting fees Consulting fees
Akira Ishiyama, MD	x			
David M. Kaylie, MD	x			
Ana H. Kim, MD		Advanced Bionics	Medical Advisory Council	Travel and consulting fee
J. Walter Kutz, MD		Eloxx Alcon Medtronic	Consultant Consultant Course instructor	Monetary compensation Monetary compensation Monetary compensation
Philip D. Littlefield, MD	x			
Mia E. Miller, MD	x			
Alejandro Rivas, MD		Grace Medical Stryker Cook Medical Cochlear	Inventions Consultant Consultant Industry sponsored studies PI	Royalties Instrument Honorarium Honorarium Grant
Erica Woodson, MD	x			
George B. Wanna, MD	x			

AMERICAN OTOLOGICAL SOCIETY

2023 Membership Roster

(Includes the 2023 Candidates inducted at the AOS 2023 Spring Meeting)

Kedar Adour, MD
San Francisco, California
Emeritus

Oliver F Adunka, MD
Columbus, Ohio
Active

Yuri Agrawal, MD
Lutherville, Maryland
Active

Pedro Albernaz,
Sao Paulo, Brazil
Honorary

P. W. Alberti, MD
Toronto, Ontario, Canada
Emeritus

Sean R Althaus, MD
Georgetown, Texas
Emeritus

Ronald G Amedee, MD
New Orleans, Louisiana
Active

Simon I Angeli, MD
Miami, Florida
Active

Patrick J Antonelli, MD
Gainesville, Florida
Active

Edward Applebaum, MD
Chicago, Illinois
Emeritus

Moises A Arriaga, MD
Metairie, Louisiana
Active

H. Alexander Arts, MD
Ann Arbor, Michigan
Active

Marcus D Atlas, MBBS, FRACS
Subiaco, Australia
Corresponding

Douglas D Backous, MD
Edmonds, Washington
Active

Thomas J Balkany, MD
Dillon, Colorado
Emeritus

Manohar Bance, MD
Cambridge, United Kingdom,
Active

David M Barrs, MD
Phoenix, Arizona
Senior

Loren J Bartels, MD
Tampa, Florida
Senior

Gregory J Basura, MD, PhD
Ann Arbor, Michigan
Active

Carol A Bauer, MD
Springfield, Illinois
Emeritus

Charles W Beatty, MD
Rochester, Minnesota
Emeritus

James E Benecke, MD
Scottsdale, Arizona
Senior

Marc L Bennett, MD
Nashville, Tennessee
Active

Ricardo F Bento, MD, PhD
Sao Paulo, Brazil
Associate

Karen Berliner, PhD
Marina Del Rey, California
Senior Associate

Brian Blakley, MD
Winnipeg, Canada
Senior

Nikolas H Blevins, MD
Stanford, California
Active

Charles D Bluestone, MD
Pittsburgh, Pennsylvania
Emeritus

Derald E Brackmann, MD
Los Angeles, California
Senior

B. Hill Britton, MD
San Antonio, Texas
Emeritus

Hilary A Brodie, MD, PhD
Sacramento, California
Senior

Kevin D Brown, MD, PhD
Chapel Hill, North Carolina
Active

Craig A Buchman, MD
St. Louis, Missouri
Active

Matthew L Bush, MD, PhD
Lexington, Kentucky
Active

Rinaldo F Canalis, MD
Santa Monica, California
Emeritus

Robert W Cantrell, MD
Charlottesville, Virginia
Emeritus

John P Carey, MD
Baltimore, Maryland
Active

Stephen P Cass, MD
Aurora, Colorado
Active

Margaretha L Casselbrant, MD, PhD
Pittsburgh, Pennsylvania
Senior

Sujana S Chandrasekhar, MD
New York, New York
Active

Kay W Chang, MD
Stanford, California
Active

Douglas A Chen, MD
Wexford, Pennsylvania
Active

Steven W Cheung, MD
San Francisco, California
Active

Wade W Chien, MD
Baltimore, Maryland
Active

Edgar L Chiossone, MD
Miami, Florida
Honorary

Richard A Chole, MD, PhD
St. Louis, Missouri
Emeritus

Daniel Choo, MD
Cincinnati, Ohio
Active

Graeme M Clark, PhD
Eltham, Victoria, Australia
Honorary

Jack D Clemis, MD
Wilmette, Illinois
Emeritus

Daniel H Coelho, MD
Richmond, Virginia
Active

Newton J Coker, MD
Santa Fe, New Mexico
Emeritus

Benjamin T Crane, MD, PhD
Rochester, New York
Active

Roberto A Cueva, MD
San Diego, California
Senior

Sharon L Cushing, MD, MSc
Toronto, Canada
Active

Charles C Della Santina, MD, PhD
Baltimore, Maryland
Active

Jennifer Derebery, MD
Los Angeles, California
Senior

Sandra G Desa Souza, MBMS
Chowpatty, Mumbai, India
Corresponding

Vicente G Diamante, MD
Buenos Aires, Argentina
Corresponding

Joseph R DiBartolomeo, MD
Santa Barbara, California
Emeritus

John R Dickins, MD
Little Rock, Arkansas
Emeritus

Hamid R Djalilian, MD
Orange, California
Active

Joni K Doherty, MD, PhD
Los Angeles, California
Active

Katsumi Doi, MD, PhD
Mino, Japan
Corresponding

John L Dornhoffer, MD
Little Rock, Arkansas
Active

Karen Jo Doyle-Enright, MD, PhD
Fenton, Michigan
Active

Colin L Driscoll, MD
Rochester, Minnesota
Active

Judy R Dubno, PhD
Charleston, South Carolina
Associate

Larry G Duckert, MD
Seattle, Washington
Emeritus

Arndt J Duvall III, MD
Minneapolis, Minnesota
Emeritus

Thomas L Eby, MD
Jackson, Mississippi
Active

David J. Eisenman, MD
Baltimore, Maryland
Active

Hussam K El-Kashlan, MD
Ann Arbor, Michigan
Active

John R Emmett, MD
Germantown, Tennessee
Senior

Adrien A Eshraghi, MD
Weston, Florida
Active

Abraham Eviatar, MD
Scarsdale, New York
Emeritus

Jay B Farrior, III, MD
Tampa, Florida
Senior

Jose N Fayad, MD
Dhahran, Saudi Arabia
Active

Joseph G Feghali, MD
Bronx, New York
Active

Howard W Francis, MD
Durham, North Carolina
Active

Bernard Gil Fraysse, MD
Toulouse, France
Emeritus

David R Friedland, MD, PhD
Milwaukee, Wisconsin
Active

Rick Friedman, MD, PhD
La Jolla, California
Active

Michael H Fritsch, MD
Indianapolis, Indiana
Active

Richard R Gacek, MD
Worcester, Massachusetts
Emeritus

Arun K Gadre, MD, MS
Danville, Pennsylvania
Active

Bruce J Gantz, MD
Iowa City, Iowa
Active

L. Gale Gardner, Jr., MD
Shreveport, Louisiana
Senior

George A Gates, MD
Boerne, Texas
Emeritus

Soha N Ghossaini, MD
Astoria, New York
Active

Gerard J Gianoli, MD
Covington, Louisiana
Active

Paul W Gidley, MD
Houston, Texas
Active

Joel A Goebel, MD
St. Louis, Missouri
Emeritus

Robert A Goldenberg, MD
Dayton, Ohio
Emeritus

Jerome C Goldstein, MD
Lake Worth, Florida
Honorary

Malcolm D Graham, MD
Atlanta, Georgia
Emeritus

J. Douglas Green Jr., MD
Jacksonville, Florida
Active

John H Greinwald Jr., MD
Cincinnati, Ohio
Active

Andrew J Griffith, MD, PhD
Memphis, Tennessee
Associate

Samuel P Gubbels, MD
Aurora, Colorado
Active

A. Julianna Gulya, MD
Locust Grove, Virginia
Emeritus

Richard K Gurgel, MD
Salt Lake City, Utah
Active

Thomas J Haberkamp, MD
Pepper Pike, Ohio
Emeritus

Paul E Hammerschlag, MD
New York, New York
Senior

Marlan R Hansen, MD
Iowa City, Iowa
Active

Lee A Harker, MD
Omaha, Nebraska
Emeritus

Jeffrey P Harris, MD, PhD
San Diego, California
Senior

Cecil W Hart, MD
Palm Springs, California
Emeritus

George T Hashisaki, MD
Charlottesville, Virginia
Active

David S Haynes, MD
Nashville, Tennessee
Active

Ronna Hertzano, MD, PhD
Baltimore, Maryland
Active

Jacques Herzog, MD
St. Louis, Missouri
Active

Keiko Hirose, MD
St. Louis, Missouri
Active

Barry E Hirsch, MD
Pittsburgh, Pennsylvania
Senior

Michael Hoa, MD
Washington, DC
Active

Michael E Hoffer, MD
Miami, Florida
Active

Ronald A Hoffman, MD
New York, New York
Senior

James J Holt, MD, MS
Marshfield, Wisconsin
Emeritus

Karl L Horn, MD
Santa Fe, New Mexico
Senior

John W House, MD
Los Angeles, California
Senior

Timothy E Hullar, MD
Portland, Oregon
Active

Makoto Igarashi, MD
Tokyo, Japan
Senior Associate

S. Armagan Incesulu, MD
Eskisehir, Turkey
Corresponding

Brandon Isaacson, MD
Dallas, Texas
Active

Akira Ishiyama, MD
Los Angeles, California
Active

Huseyin Isildak, MD
Stony Brook, New York
Active

Juichi Ito, MD, PhD
Shiga, Japan
Corresponding

Salvatore J Iurato, MD
Bari, Italy
Senior Associate

Robert K Jackler, MD
Stanford, California
Active

Carol A Jackson, MD
Newport Beach, California
Active

Abraham Jacob, MD
Tucson, Arizona
Active

Adrian James, MD
Toronto, Canada
Active

Herman A Jenkins, MD
Aurora, Colorado
Senior

Lars-Goran Johnsson, MD
Helsinki, Finland
Senior Associate

Raleigh O Jones Jr., MD
Lexington, Kentucky
Active

Steven K Juhn, MD
Minneapolis, Minnesota
Senior Associate

Timothy T K Jung, MD, PhD
Riverside, California
Senior

Donald B Kamerer, MD
Pittsburgh, Pennsylvania
Emeritus

David M Kaylie, MD
Durham, North Carolina
Active

Bradley W Kesser, MD
Charlottesville, Virginia
Active

Nelson Y Kiang, PhD
Boston, Massachusetts
Emeritus

Paul R Kileny, PhD
Ann Arbor, Michigan
Senior Associate

Ana H Kim, MD
New York, New York
Active

Harold H Kim, MD
Portland, Oregon
Active

Hung J Kim, MD
Washington, District of Columbia
Active

Darius Kohan, MD
New York, New York
Active

Horst R Konrad, MD
Naples, Florida
Senior

Richard D Kopke, MD
Oklahoma City, Oklahoma
Senior

J. Walter Kutz, MD
Dallas, Texas
Active

Robert F Labadie, MD, PhD
Charleston, South Carolina
Active

Anil K Lalwani, MD
New York, New York
Active

Paul R Lambert, MD
Charleston, South Carolina
Senior

Daniel J Lee, MD
Brookline, Massachusetts
Active

K. J. Lee, MD
Guilford, Connecticut
Emeritus

Kenneth H Lee, MD, PhD
Plano, Texas
Active

John P Leonetti, MD
Maywood, Illinois
Senior

S. George Lesinski, MD
Cincinnati, Ohio
Emeritus

Samuel C Levine, MD
Eden Prairie, Minnesota
Senior

Charles J Limb, MD
San Francisco, California
Active

Vincent YW Lin, MD
Toronto, Canada
Active

Roger C Lindeman, MD
Mercer Island, Washington
Emeritus

Thomas E Linder, MD
Luzern, Switzerland
Corresponding

William H Lippy, MD
Warren, Ohio
Emeritus

Philip D Littlefield, MD
San Diego, California
Active

Ward B Litton, MD
Bonita Springs, Florida
Emeritus

Brenda L Lonsbury-Martin, PhD
Loma Linda, California
Senior Associate

Charles M Luetje, MD
Olathe, Kansas
Senior

Larry B Lundy, MD
Ponte Vedra Beach, Florida
Senior

Lawrence R Lustig, MD
New York, New York
Active

John D Macias, MD
Phoenix, Arizona
Active

Charles A Mangham Jr., MD
Hailey, Idaho
Emeritus

Wolf J Mann, MD, PhD
Mainz, Germany
Emeritus

Sam J Marzo, MD
Maywood, Illinois
Active

Douglas E Mattox, MD
Atlanta, Georgia
Active

Jennifer L Maw, MD
San Jose, California
Active

John T McElveen Jr., MD
Raleigh, North Carolina
Active

Michael McGee, MD
Oklahoma City, Oklahoma
Senior

Michael J McKenna, MD
Boston, Massachusetts
Active

Brian J McKinnon, MD, MBA
Galveston, Texas
Active

Sean O McMenomey, MD
Seattle, Washington
Active

Cliff A Megerian, MD
Cleveland, Ohio
Active

Michael Merzenich, PhD
San Francisco, California
Senior Associate

William L Meyerhoff, MD
Dallas, Texas
Emeritus

Alan G Micco, MD
Chicago, Illinois
Active

Mia E Miller, MD
Encino, California
Active

Josef M Miller, PhD
Ann Arbor, Michigan
Senior Associate

Lloyd B Minor, MD
Stanford, California
Active

Richard T Miyamoto, MD
Indianapolis, Indiana
Senior

Aaron C Moberly, MD
Nashville, Tennessee
Active

Edwin M Monsell, MD, PhD
Rochester Hills, Michigan
Senior

Stephanie Moody Antonio, MD
Norfolk, Virginia
Active

Gary F Moore, MD
Omaha, Nebraska
Active

William H Moretz Jr., MD
Augusta, Georgia
Senior

Tetsuo Morizono, MD DMS
Fukuoka City, Japan
Senior Associate

Terry P Murphy, MD
Baton Rouge, Louisiana
Senior

Eugene N Myers, MD
Pittsburgh, Pennsylvania
Emeritus

Joseph B Nadol Jr., MD
Boston, Massachusetts
Emeritus

Hideko H Nakajima, MD, PhD
Boston, Massachusetts
Associate

Julian M Nedzelski, MD
Toronto, Ontario, Canada
Emeritus

Brian A Neff, MD
Rochester, Minnesota
Active

Erik G Nelson, MD
Lake Forest, Illinois
Active

Rick F Nelson, MD, PhD
Indianapolis, Indiana
Active

Ralph A Nelson, MD
Manchester, Washington
Emeritus

Brian D Nicholas, MD
Syracuse, New York
Active

John S Oghalai, MD
Los Angeles, California
Active

Robert C O'Reilly, MD
Philadelphia, Pennsylvania
Active

Michael M Paparella, MD
Minneapolis, Minnesota
Senior

James J Pappas, MD
Little Rock, Arkansas
Emeritus

Dennis Pappas, MD
Emeritus

Dennis G Pappas Jr., MD
Birmingham, Alabama
Active

Blake C Papsin, MD
Toronto, Ontario, Canada
Active

Simon C Parisier, MD
New York, New York
Senior

James L Parkin, MD
Salt Lake City, Utah
Emeritus

Steven M Parnes, MD
Albany, New York
Active

Lorne S Parnes, MD
London, Ontario, Canada
Senior

Myles L Pensak, MD
Cincinnati, Ohio
Active

Rodney Perkins, MD
Woodside, California
Senior Associate

Brian P Perry, MD
McAllen, Texas
Active

Harold C Pillsbury, MD
Banner Elk, North Carolina
Emeritus

Dennis S Poe, MD
Boston, Massachusetts
Active

Leonard R Proctor, MD
Bel Aire, Maryland
Emeritus

Steven D Rauch, MD
Watertown, Massachusetts
Active

Miriam I Redleaf, MD
Chicago, Illinois
Active

Alejandro Rivas, MD
Cleveland, Ohio
Active

Jose A Rivas, MD
Bogota, Colombia
Emeritus

Pamela C Roehm, MD, PhD
Jenkintown, Pennsylvania
Active

Peter S Roland, MD
Eden, Utah
Senior

John T Roland Jr., MD
New York, New York
Active

Max L Ronis, MD
Philadelphia, Pennsylvania
Emeritus

Seth Rosenberg, MD
Sarasota, Florida
Active

John J Rosowski, PhD
Boston, Massachusetts
Senior Associate

Edwin W Rubel, PhD
Seattle, Washington
Senior Associate

Robert J Ruben, MD
New York, New York
Senior

Allan M Rubin, MD, PhD
Perrysburg, Ohio
Senior

Jay T Rubinstein, MD, PhD
Seattle, Washington
Active

Michael J Ruckenstein, MD
Philadelphia, Pennsylvania
Active

Christina L Runge, PhD
Milwaukee, Wisconsin
Associate

Leonard P Rybak, MD, PhD
Springfield, Illinois
Emeritus

Hamed Sajjadi, MD
Los Gatos, California
Active

Masafumi Sakagami, MD, PhD
Hyogo, Japan
Corresponding

Ravi N Samy, MD
Cincinnati, Ohio
Active

Robert T Sataloff, MD
Philadelphia, Pennsylvania
Active

James E Saunders, MD
Lebanon, New Hampshire
Active

Jochen Schacht, PhD
Ann Arbor, Michigan
Senior Associate

Arnold G Schuring, MD
Warren, Ohio
Emeritus

Mitchell K Schwaber, MD
Nashville, Tennessee
Senior

Michael D Seidman, MD
Celebration, Florida
Active

Samuel H Selesnick, MD
New York, New York
Active

Clough Shelton, MD
Walla Walla, Washington
Senior

Neil T Shepard, PhD
Missoula, Montana
Senior Associate

Jack A Shohet, MD
Newport Beach, California
Active

Herbert Silverstein, MD
Sarasota, Florida
Senior

George T Singleton, MD
Gainesville, Florida
Emeritus

Aristides Sismanis, MD
Richmond, Virginia
Senior

Henryk Skarzynski, MD, PhD
Warsaw, Poland
Corresponding

William H Slattery III, MD
Los Angeles, California
Active

Richard J Smith, MD
Iowa City, Iowa
Honorary

Eric E Smouha, MD
New York, New York
Active

Gershon J Spector, MD
St. Louis, Missouri
Emeritus

Hinrich Staecker, MD, PhD
Kansas City, Kansas
Active

Konstantina M Stankovic, MD, PhD
Palo Alto, California
Active

Olivier Sterkers, MD, PhD
Paris, France
Emeritus

Steven A Telian, MD
Ann Arbor, Michigan
Senior

Fred F Telischi, MD
Miami, Florida
Active

Norman Wendell W Todd Jr., MD
Marietta, Georgia
Senior

Daniel J Tollin, PhD
Aurora, Colorado
Associate

Debara L Tucci, MD, MS
Durham, North Carolina
Senior

Andrea Vambutas, MD
New Hyde Park, New York
Active

Jeffrey T Vrabec, MD
Houston, Texas
Active

P. Ashley Wackym, MD
New Brunswick, New Jersey
Active

George B Wanna, MD
New York, New York
Active

Jack J Wazen, MD
Sarasota, Florida
Senior

Peter C Weber, MD, MBA
Boston, Massachusetts
Active

Roger E Wehrs, MD
Tulsa, Oklahoma
Emeritus

D. Bradley Welling, MD, PhD
Boston, Massachusetts
Active

Stephen J Wetmore, MD
Morgantown, West Virginia
Emeritus

Richard J Wiet, MD
Sawyer, Michigan
Emeritus

Eric P Wilkinson, MD
Boise, Idaho
Active

Erika Woodson, MD
Shaker Heights, Ohio
Active

Sabina R Wullstein, MD
Wurzburg, Germany
Senior Associate

Thomas P Wustrow, MD
Munchen, Germany
Emeritus

Naoaki Yanagihara, MD
Matsyama, Japan
Honorary

Eiji Yanagisawa, MD
New Haven, Connecticut
Emeritus

Nancy M Young, MD
Chicago, Illinois
Active

in Memoriam

(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.

Sam E. Kinney, MD
Inducted in 1981
AOS President 2005
Award of Merit 2011
DOD - August 29, 2022

James B. Snow Jr., MD
inducted in 1973
Award of Merit 2003
DOD - May 28, 2022

Ronald Steenerson, MD
Inducted in 2020
DOD - May 2, 2022