PROGRAM and ABSTRACTS of the

AMERICAN OTOLOGICAL SOCIETY, INC.

April 29 - 30, 2017

SEAPORT DE
SEAPORT TOWER
LEVEL 2

Manchester Grand Hyatt
San Diego, CA

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JULY 1, 2016 - JUNE 30, 2017

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Debara L. Tucci, M.D., M.S., M.B.A.
Durham, NC

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Baltimore, MD

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American College of Surgeons and American 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 6.75 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

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AMERICAN COLLEGE OF SURGEONS
DIVISION OF EDUCATION
Accredited with Commendation by the Accreditation Council for Continuing Medical Education

American Otological Society, Inc.
Mission Statement

Purpose

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

Target Audience

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

Activities

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

Content

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

Expected Results

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

2017 AOS Spring Meeting CME Activity Planning

Practice gaps in Otology are identified through polling the AOS attendees at the close of each CME activity by way of an exit evaluation at the close of the activity; this evaluation is required to receive CME credit, so the response rate is good. The response rate from the 2016 American Otological Society meeting was 67%. The responses of the attendees are discussed in meetings of the AOS Council and Program Advisory committee. The evaluation is used as a tool to determine the success of the CME program in meeting program objectives, addressing professional practice gaps and educational needs. The responses are peer-reviewed by the Council prior to the next meeting to assist the Program Committee in developing future AOS Continuing Medical Education programs. The educational program is designed to address the topics identified as practice gaps through individual presentations and in depth panel discussions. Based on the response, the following data regarding professional practice gaps among attendees were noted:

- Maximizing the use of interventions that may reduce the risk of falls does not occur consistently. Identifying patients who may benefit by appropriate use of amplification is important to reduce the risk of falls.
- The differential response of patients with Meniere's disease with and without migraine, to intratympanic gentamicin, is not routinely recognized. Lack of knowledge of this differential response impacts treatment choice and expected treatment outcomes.
- The pathologic events underlying device failure are not completely known. In some cases, a distinct pattern of subjective symptoms and objective changes in impedances on device interrogation are observed. Optimal treatment for specific causes of device failure is not routinely employed.

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

The 150th Annual Meeting of the American Otological Society will begin Saturday afternoon, April 29th. AOS President, Samuel H. Selesnick, MD, FACS will honor the following individuals with a Presidential Citation.

Philip H. Gutin, MD
Robert K. Jackler, MD
Simon C. Parisier, MD
Myles L. Pensak, MD
Michael G. Stewart, MD, MPH
D. Bradley Welling, MD, PhD

Kicking off the program will be an address given by Dr. Selesnick highlighting some fascinating facts about the AOS over the last 150 years. Dr. Selesnick selected Dr. John W. House as the AOS Guest of Honor of the 150th AOS annual meeting. Dr. House's presentation is entitled, "Otosclerosis Treatment – A Journey through the Last Century and a Half".

Program highlights on Saturday include a panel entitled "Evolution of the American Otological Society: Reflections at our Sesquicentennial" led by Robert K. Jackler, with presentations by AOS members, Lawrence R. Lustig, D. Bradley Welling, Richard A. Chole, and Bruce J. Gantz. On Sunday, a special Saumil Nalin Merchant Memorial Lecture entitled, "The Active Ear: How Hair Cells Provide a Biological Hearing Aid" will be given by Dr. A. James Hudspeth at 8:30 AM. Later on Sunday a panel entitled "Evolving Strategies in Restoring and Preserving Middle Ear Ventilation and Function" will be moderated by Dr. Howard Francis.

Dr. Renee M. Banakis Hartl and Dr. Yuan F. Liu were selected as recipients of an AOS Resident Research Travel Award, each will receive a $2000 honorarium. Both presentations will take place on Sunday morning.

Be sure to visit the Grand Hall and Foyer where you will find an outstanding display of AOS poster submissions. Posters will be available for viewing on Friday & Saturday, 9:00-4:00. Recipients of the AOS poster awards will be announced at the close of the ANS Scientific program on Friday, April 28th at 5:00 PM. The Combined Poster Reception/Meet the Authors will take place Friday evening in the Grand Hall/Foyer from 5:30-7:00 P.M.

This year the AOS President's Reception and Dinner/Dance will take place on Saturday evening, April 29th at the iconic Hotel Del Coronado. A cocktail reception will take place from 6:30 - 7:30 PM on the Garden Patio followed by food & libations and, of course, dancing in the stunning Oceanside Ballroom til 11PM. Transportation to and from the Hyatt to the Del will be provided. Who will be chosen as the Award of Merit recipient during its 150th year, we'll have to wait on Dr. Brad Welling to reveal! This promises to be a memorable evening.

In an effort to include all AOS members, one complimentary banquet ticket is included with your paid AOS/COSM registration. You may purchase additional tickets in advance before April 20, 2017. No onsite tickets will be available. (The banquet is exclusive to members and invited guests only).

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

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

- Patients at increased risk of falls are assessed and treated for concomitant hearing function.
- The choice of initial treatment of Meniere's disease patients is informed by the presence or absence of associated migraine.
- Cochlear implantation may result in inflammatory foreign body reaction with sequelae of serous labyrinthitis. Recognition and treatment with steroids is instituted as management of serous labyrinthitis post-implantation.

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

- Recognize the impact of hearing loss on balance function.
- Optimize management of Meniere's disease with and without migraine.
- Distinguish cochlear implant failure related to inflammatory reaction with serous labyrinthitis from other non-inflammatory causes of failure and treat accordingly.

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

- This activity will be increase the practitioner's awareness of the impact of hearing loss on balance function.
- This activity will increase the practitioner's knowledge of the differential response to intratympanic gentamicin treatment expected in patients with migraine and Meniere's disease.
- This activity will increase the practitioner's knowledge of the inflammatory reaction that can occur after cochlear implantation.

Patient outcomes will be improved in the following ways:

- Practitioner's will include hearing testing and treatment when evaluating patients for imbalance and gait disturbance.
- Practitioner's will determine if Meniere's patients have associated migraine vertigo and choose the treatment approach that maximally controls symptoms and functional outcomes.
- Practitioner's will implement treatment that reduces the inflammatory reaction associated with serous labyrinthitis after cochlear implantation.

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

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

Disclosure Information

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

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

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

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

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

PUBLICATION STATEMENT

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

Author's Signature (required All authors were advised that the submitted paper becomes the property of *Otology & Neurotology* and cannot be reprinted without permission of the Journal.

THE AMERICAN OTOLOGICAL SOCIETY WOULD LIKE TO THANK THE FOLLOWING MEMBERS FOR THEIR CONTRIBUTION TO THE 2017 AOS SCIENTIFIC PROGRAM

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AMERICAN OTOLOGICAL SOCIETY
150th Annual Meeting
April 29-30, 2017
San Diego, CA

SATURDAY, APRIL 29, 2017

1:00 **Business Meeting** *(New member introduction) (Members Only)*

1:20 **Scientific Program**
(*Open to registered Members and Non-members – Badge required for admittance*)

1:20 **Welcome & Opening Remarks by the President**
Samuel H. Selesnick, MD

Presidential Citations
Philip H. Gutin, MD
Robert K. Jackler, MD
Simon C. Parisier, MD
Myles L. Pensak, MD
Michael G. Stewart, MD, MPH
D. Bradley Welling, MD, PhD

1:38 **Presidential Address**
Samuel H. Selesnick, MD

1:53 **GUEST OF HONOR LECTURE**
Otosclerosis Treatment – A Journey through the Last Century and a Half
John W. House, MD

2:23 **Mesenchymal Stem Cell Therapy for Chronic Tympanic Membrane Perforations**
Ariel B. Grobman, MD
Michael E. Langston
Stefania Goncalves, MD
Esperanza Bas, PharmD, PhD
Bradley J. Goldstein, MD, PhD
Simon I. Angeli, MD

2:31 **Atomic Force Microscopy for Quality Control of Intraoperative Otologic Autografts with 3D Subtractive CAD/CAM**
Glenn W. Knox, MD
Daniel Woodard, MD

2:39 **DISCUSSION**

2:45 **BREAK WITH EXHIBITORS**

NOTES

3:15 **Immunohistochemical Identification of Human Spiral Ganglia Neurons: Implication in Aging and Cochlear Implantation**
Janice E. Chang, MD, PhD
Ivan A. Lopez, PhD
Gail Ishiyama, MD
Fred H. Linthicum, MD
Akira Ishiyama, MD

3:23 **Foreign Body Response to Silicone in Cochlear Implant Electrodes in The Human**
Jennifer T. O'Malley
Barbara J. Burgess
Donald Galler
Joseph B. Nadol, Jr., MD

3:31 **Medicaid Reimbursement for Cochlear Implantation: Is it Fair?**
Daniel H. Coelho, MD
Joseph Conduff

3:39 **Cochlear Implant Insertion Axis into the Basal Turn: A Critical Factor for Electrode Array Translocation**
Yann Nguyen, MD, PhD
Renato Torres, MD
Mylène Drouillard, MD
Daniele De Seta, MD, PhD
Evelyne Ferrary, MD, PhD
Daniele Bernardeschi, MD, PhD
Olivier Sterkers, MD, PhD

3:47 **Novel Approaches in The Development of an Optogenetically-Driven Cochlear Implant**
Maria J. Duarte
Xiankai Meng, PhD
Vivek Kanumuri, MD
Ariel E. Hight
Elliott D. Kozin, MD
M. Christian Brown, PhD
Daniel J. Lee, MD

3:55 **DISCUSSION**

4:00 **PANEL**
Evolution of the American Otological Society: Reflections at our Sesquicentennial
Robert Jackler, MD, Moderator
Lawrence R. Lustig, MD
D. Bradley Welling, MD, PhD
Richard A. Chole, MD, PhD
Bruce J. Gantz, MD

5:00 **ADJOURNMENT**

6:30 **AOS PRESIDENTS RECEPTION AND BANQUET**
(Advanced Reservations Required)
(Members and Invited Guests only)
Hotel Del Coronado

SUNDAY, APRIL 30, 2017

7:00 **Business Meeting/Committee Reports**

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

7:35 **Audition's Effect on Balance in Gait for Hearing Aid Patients**
Tyler S. Weaver, MD
Corey S. Shayman
Bahir H. Chamseddin
Martina Mancini, PhD
Timothy E. Hullar, MD

7:43 **Dizziness Handicap Inventory Score Is Highly Correlated with Markers of Gait Disturbance**
Damiano Zanotto, PhD
Erin M. Mamuyac
Adam R. Chambers
John A. Stafford, MD
Sunil K. Agrawal, PhD
Anil K. Lalwani, MD

7:51 **RESIDENT RESEARCH TRAVEL AWARD**
Efficacy of Intratympanic Gentamicin in Meniere's Disease with and without Migraine
Yuan F. Liu, MD
Elizabeth Renk, MD
Steven D. Rauch, MD
Helen X. Xu, MD

7:59 **Histologic Grade of Otosclerosis Correlates with Computed Tomography Densitometry Measurements in Human Temporal Bone Specimens**
Alicia M. Quesnel, MD
Reuven Ishai, MD
Timothy Meehan, MD
Jennifer Shin, MD
Joseph B. Nadol Jr., MD
Michael J. McKenna, MD
Amy Juliano, MD

8:07 **Paget 's Disease of the Temporal Bone: A Single-Institution Review of 23 Cases**
Nicholas L. Deep, MD
Jake G. Besch-Stokes
Colin L.W. Driscoll, MD
Matthew L. Carlson, MD

8:15 **Validation of A Novel Summative Temporal Bone Dissection Scale**
Michael Gousseau, MD
Bertram Unger, MD, PhD
Justyn Pisa, AuD
Brian Westerberg, MD, MHSc
Jordan Hochman, MD

8:23 DISCUSSION/INTRODUCTION

8:30 SAUMIL N. MERCHANT MEMORIAL LECTURE
The Active Ear: How Hair Cells Provide a Biological Hearing Aid
A. James Hudspeth, MD, PhD

9:00 A Comprehensive Analysis of Hearing Loss Among Children with Low Birth Weight
Akash N. Naik
Forest W. Weir
Christopher M. Discolo, MD, MSCR
Shaun A. Nguyen, MD
Ted A. Meyer, MD, PhD

9:08 Safety of Autologous Human Umbilical Cord Therapy for Acquired Sensorineural Hearing Loss in Children
WITHDRAWN
Linda Baumgartner, MS CCC-SLP, LSLS Cert-AVT
Ernest Moore, PhD
Davis Shook, MD
Steven Messina, MD
Michael Seidman, MD
James Baumgartner, MD

9:16 Short-term and Long-term Hearing Outcomes with the Middle Cranial Fossa Approach for Resection of Vestibular Schwannoma
Sameer Ahmed, MD
H. Alexander Arts, MD
Hussam El-Kashlan, MD
Gregory J. Basura, MD, PhD
B. Gregory Thompson, MD
Steven A. Telian, MD

9:24 Occupational Noise Exposure and a Potential Risk for Noise Induced Hearing Loss Among Otologist and Neurologist due to Temporal Bone Drilling
Yona Vaisbuch, MD
Jennifer C. Alyono, MD
Steven D. Losorelli
Stan H. Wu, CIH
Robert K. Jackler, MD

9:32 Factors Associated with Benefit of Active Middle Ear Implants and Conventional Hearing Aids
Theodore R. McRackan, MD
William Clinkscales
Jayne B. Ahlstrom, MS
Shaun A. Nguyen, MD, MSCR
Judy R. Dubno, PhD

9:40 DISCUSSION

9:45 BREAK

10:07 **RESIDENT RESEARCH TRAVEL AWARD**
Drill-induced Cochlear Injury during Otologic Surgery: Intracochlear Pressure Evidence of Acoustic Trauma
Renee M. Banakis Hartl, MD, AuD
Jameson K. Mattingly, MD
Nathaniel T. Greene, PhD
Nyssa F. Farrell, MD
Samuel P. Gubbels, MD
Daniel J. Tollin, PhD

10:15 **Transcanal Endoscopic Ear Surgery - Utility and Ease of Surgical Technique from a Resident Surgeon's Perspective**
Andrew K. Johnson, MD
Cameron C. Wick, MD
Nicolas-George Katsantonis, MD
Daniel J. Lee, MD
Alejandro A. Rivas, MD
Brandon Isaacson, MD
Joe Walter Kutz Jr, MD

10:23 **Effects of Time and Level Difference Inputs to Bilaterally Placed Bone-conduction Systems on Cochlear Input**
Nyssa F. Farrell, MD
Renee M. Banakis Hartl, AuD, MD
Victor Benichoux, PhD
Andrew D. Brown, PhD
Stephen P. Cass, MD
Daniel J. Tollin, PhD

10:31 **Cochlear Implant Electrode Localization Using an Ultra-High Resolution Scan Mode On Conventional 64-Slice and New Generation 192-Slice Multi-Detector CT Scanners**
Matthew L. Carlson, MD
Shuai Leng, PhD
Felix E. Diehn, MD
Robert J. Witte, MD
Karl Krecke, MD
Kelly K. Koeller, MD
John I. Lane, MD

10:39 **"Delayed Cochlear Implant Serous Labyrinthitis" A Previously Unrecognized Phenomenon with a Distinct Clinical Pattern**
Deeyar Itayem
Douglas Sladen, PhD
Colin L.W. Driscoll, MD
Brian A. Neff, MD
Charles W. Beatty, MD
Matthew L. Carlson, MD

10:47 Does Intraoperative Testing During Cochlear Implantation Impact Surgical Decision-making?
Joshua Cody Page, MD
Linda Murphy
Sarah Kennett, AuD
Aaron Trinidade, MD
Robert Frank, MD
Matthew Cox, MD
John L. Dornhoffer, MD

10:55 DISCUSSION

11:00 PANEL
Evolving Strategies in Restoring and Preserving Middle Ear Ventilation and Function
Howard Francis, MD, Moderator
Prof. Dr. med. Karl-Bernd Hüttenbrink
Sujana S. Chandrasekhar, MD
Dennis S. Poe, MD
Alejandro Rivas, MD
John L. Dornhoffer, MD

12:00 ADJOURNMENT

AOS President's Reception & Banquet
Saturday, April 29, 2017
Hotel Del Coronado

Reception - 6:30 pm
Garden Patio

Dinner/Dance - 7:30 to 11pm
Ocean Ballroom

Formal attire/Black tie preferred
(Advanced Reservations Required)
(Members and Invited Guests only)

Round trip transportation to
Hotel Del Coronado will be provided

Combined Poster Reception
AOS, ANS, AAFPRS, TRIO
Friday, April 28, 2017
5:30 pm - 7:00 pm
Grand Hall A-D and Grand Hall Foyer

UPCOMING MEETINGS

151st AOS Spring Meeting
(in conjunction with COSM)
April 20-21, 2018
Gaylord National Resort and Convention Center
National Harbor, Maryland

AAO-HNSF Annual Meeting & OTO EXPO
September 10-13, 2017
Sheraton Grand - Chicago, IL

The Abstract deadline for the AOS 151st Annual meeting is Sunday, October 15, 2017

Abstract Instructions and submission form will be available on website on July 17
Website - www.americanotologicalsociety.org

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

Journal Requirements/Instructions to Primary Authors
Manuscripts are required of **ALL ORAL** presentations. Manuscripts must be submitted online **a minimum of four weeks** prior to the annual meeting, via the journal's website. Instructions for registering, submitting a manuscript, and the author guidelines can be found on the Editorial Manager site:
https://www.editorialmanager.com/on/

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

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

For Society business, please forward all inquiries to:

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Mesenchymal Stem Cell Therapy for Chronic Tympanic Membrane Perforations

Ariel B. Grobman, MD; Michael E. Langston, BS
Stefania Goncalves, MD; Esperanza Bas, PharmD, PhD
Bradley J. Goldstein, MD, PhD; Simon Angeli, MD

Hypothesis: To create a reproducible mouse model of chronic tympanic membrane perforation (TMP), and a repair technique that involves the use of mesenchymal stem-cells (MSCs) embedded in a hyaluronate bio-scaffolding.

Background: Chronic TMPs are defined as stable and present for at least 3 months; typical repair consists of tympanoplasty.

Methods: Subtotal TMPs were created with micro-forceps in C57BL/6 mice, and treated with topical dexamethasone and mitomycin C (DXM/MC; 10 mg/ml, 0.4 mg/ml). TMPs were photographed for 8 weeks or until closure. Murine MSCs were co-cultured with hyaluronate scaffolds. Animals with TMPs that remained open after 8 weeks were assigned to one of two groups: Control-TMPs received no treatment; experimental-TMPs received MSC embedded scaffolds. On day 14, mice were examined by otoscopy then euthanized; tympanic bullae were harvested, prepared for microscopy and immunohistochemistry. Investigators blinded to the treatment groups graded the percent of TMP by digital otoscopic images on day 14.

Results: All TMPs treated with DXM/MC remained open by week 8. On post-treatment day 14, none of the control TMPs closed; 50% of the TMPs in the experimental group closed.
Histologic analysis of TMPs treated with MSCs revealed a neo-tympanum with distinct epithelial and mucosal layers and normal lamina propria with a well-organized fibrous layer

Discussion: We were able to create a mouse model of chronic TMP through the topical application of DXM/MC to manually created perforations. Using this animal model, we showed a greater percentage of TMP closure and the reestablishment of the normal histological appearance of MSC-treated TM.

Define Professional Practice Gap and Educational Needs: 1. There is no standard animal model for studying tympanic membrane perforations.There is a lack of non-surgical wound healing options for chronic tympanic membrane perforations. This would benefit patients who do not wish to undergo surgery or are unfit for general anesthesia for example.Tissue engineering & bio-active scaffolding has not been widely examined in the Otology literature.Stem cells have been used in many other specialties to enhance wound healing, our recent work suggests that they integrate into the healing tympanic membrane perforations to restore the typical TM architecture.

Learning Objective: 1. Design a reproducible mouse model of chronic tympanic membrane perforation (TMP) 2. To explore the use of bone marrow mesenchymal stem cells (MSCs) on a biological scaffold to heal chronic tympanic membrane perforations (TMPs) 3. To understand how MSCs integrate into the TM and demonstrate their ability to restore the tri-laminar structure of the native TM. 4. Discuss the application of this therapy as a future alternative to surgical tympanoplasty.

Desired Result: After attending our presentation attendees will firstly recognize the usefulness of a non-surgical wound healing method for chronic tympanic membrane perforations. Through our existing and upcoming work the attendees will see how our MSC tissue scaffolding shows potential for repair of persistent tympanic membrane perforations. Next, through our histological methods they will see how tympanic membrane regeneration with MSCs helps restore the native tympanic membrane rather than through fibrosis and scarring.

IRB or IACUC Approval: Approved

Atomic Force Microscopy for Quality Control of Intraoperative Otologic Autografts with 3D Subtractive CAD/CAM

Glenn W. Knox, MD; Daniel Woodard, MD

Hypothesis: Ossicular replacement prostheses are expensive and can extrude. Computer-assisted manufacture during surgery could quickly produce inexpensive autografts. Atomic force microscopy can provide quality control.

Background: Ossiculoplasty utilizes alloplastic materials such as hydroxyapatite, homografts, or autografts. Expensive alloplastic materials often must be covered with cartilage to prevent extrusion. Homografts are also expensive. Autologous materials do not require inventory, are free, and are less likely to extrude. 3D CAD/CAM (computer assisted design/manufacture) can produce autografts in the operating room. This can reduce operating room time, and eliminate inventories. Atomic force microscopy can provide quality control.

Methods: A Roland MDX-40A milling machine was utilized. A Richards Centered PORP Prosthesis was selected. Models of the PORP were produced with machinist's wax, bovine bone and human cadaveric bone. The prosthesis was subtractively milled. Cadaveric bones were then examined via atomic force microscopy analysis consisting of areas of approximately 40 x 40 micrometers squared. Roughness data were processed for 15 different areas randomly selected on the surface of each prosthesis.

Results: Bovine bone and human cadaveric bone reliably produced prototype prosthetics. The human cadaveric prosthetics examined via atomic force microscopy showed nanoscale roughness with the root mean square roughness being approximately 1 micrometer per square area analyzed.

Conclusion: 3D CAD/CAM can potentially produce accurate autografts during surgery. This can save money on prostheses, inventory, and operating room time. Autografts are less likely to cause extrusion or infection. Nanoscale roughness is important for obtaining good contact between surfaces and avoiding slippage of the prosthesis.

Define Professional Practice Gap and Educational Needs: Lack of awareness of innovative methods of ossiculoplasty

Learning Objective: To become familiar with innovative methods of ossiculoplasty such as computer assisted design and manufacture of autografts on demand in the operating room, along with the use of atomic force microscopy for quality control

Desired Result: Attendees will become aware of these new ossiculoplasty techniques and apply them in their practice as they become available

IRB or IACUC Approval: Approved

Immunohistochemical Identification of Human Spiral Ganglia Neurons: Implication in Aging and Cochlear Implantation

Janice E. Chang, MD, PhD; Ivan A. Lopez, PhD
Gail Ishiyama, MD Fred H. Linthicum, MD
Akira Ishiyama, MD

Hypothesis: Persistent expression of structural and functional proteins in human spiral ganglia neurons (hSGNs) suggest that they may be active, even in absence of hair cells.

Background: hSGNs persist in the human cochlea after hair cell loss, in contrast to SGNs in the cochlea of animal models. Here we investigate the differential expression of specific structural and functional proteins in hSGNs in normal aging and inner ear pathologies.

Methods: Temporal bones from 32 patients (age: 8-80 years; n=11 normal hearing, n=21 hearing loss) were identified. Mouse monoclonal antibodies against Calbindin, pan-neurofilaments, acetylated-tubulin and mGLUR7 were applied for immunohistologic analysis.

Results: Calbindin was detected in the cytoplasm of the hSGNs, but not in satellite cells. Calbindin distribution was similar on the basal, middle, and apical turns of the cochlea. Calbindin was found in the hSGN in patients with several degrees of hearing loss and older age individuals, and was expressed specifically in hair cells of the organ of Corti. Neurofilaments were also present in hSGNs. Acetylated tubulin and mGLuR7 were consistently present in hSGNs.

Conclusion: The specific and persistent expression of functional and structural proteins in hSGNs suggests these neurons may be functional despite absent hair cells, supporting an important role in inner ear function. Immunoreactive patterns of these proteins in the human cochlea paralleled those in animal models. The consistent and reliable detection of these neural markers in human temporal bone specimens implicate their use in investigating normal inner ear cytoarchitecure, and their changes with age, disease and cochlear implantation.

Define Professional Practice Gap and Educational Needs: Lack of knowledge regarding pathologic changes in the HUMAN temporal bone in the context of normal versus inner ear pathologies, and their changes with interventions such as cochlear implantation.

Learning Objective: Better understand the role of structural and functional proteins in the normal and diseased inner ear, and their implications with interventions such as cochlear implants.

Desired Result: A better understanding of molecular changes within the normal and diseased human inner ear will lead to understanding of disease processes, aid in patient selection for interventions, and lead to a better understanding of the implications of medical and surgical interventions for particular pathologies.

IRB or IACUC Approval: Approved

Foreign Body Response to Silicone in Cochlear Implant Electrodes in The Human

Jennifer T. O'Malley; Barbara J. Burgess; Donald Galler Joseph B. Nadol, Jr., MD

Hypothesis: Silicone as part of a cochlear implant electrode may be responsible for a foreign body response in the human. Background: Clinical evidence of a foreign body response to a cochlear implant has been reported. In a previous study, particulate material found within the fibrous sheath and within macrophages surrounding a cochlear implant has been identified as being consistent with platinum. However, to date there has been no histologic evidence of a role for silicone in this cellular immune response.

Methods: A total of 44 temporal bone specimens from 36 cases were reviewed by light microscopy for evidence of presumed platinum and/or silicone foreign bodies in an extracellular or intracellular location. Identification of cell type involved in phagocytosis of foreign body material was accomplished using CD163 immunostaining. The identity and source of the foreign body material was confirmed using energy dispersive X-ray spectroscopy and scanning electron microscopy.

Results: Evidence for both platinum and silicone was found in all 44 specimens. In three cases, anti-CD 163 immunostaining demonstrated phagocytized platinum and silicone foreign bodies. In five specimens, energy dispersive X-ray spectroscopy demonstrated that the birefringent foreign bodies were consistent with silicone. Scanning electron microscopy of two electrodes removed from temporal bones demonstrated small cracks, fragmentation, and small circular defects in the silicone carrier.

Conclusion: Histologic evidence of a foreign body response to the presence of platinum and silicone in a cochlear implant has been demonstrated and may be responsible for some reported delayed failures or extrusion.

Define Professional Practice Gap and Educational Needs: Lack of awareness of causes of foreign body response after cochlear implantation.

Learning Objective: Learn the identity of cochlear implant components causing cellular immune response.

Desired Result: Increased awareness of causes of cellular immune response after cochlear implant and possible cause of delayed failure of extrusion of cochlear implant.

IRB or IACUC Approval: Exempt

Medicaid Reimbursement for Cochlear Implantation: Is it Fair?

Daniel H. Coelho, MD; Joseph Conduff, BS

Objective: To study state (Medicaid) reimbursement rates for cochlear implant and related services and to compare with federal benchmarks (Medicare).

Data sources: State (Medicaid) and Federal (Medicare) websites with publicly searchable procedure reimbursement files.

Study selection: Based on Medicare (MCR) claims data, CPT Codes used for cochlear implantation and related services were selected. These were further divided into audiology, surgery, and speech services.

Data extraction: Medicaid (MCD) payment schemes were queried for the same services in forty-nine states and Washington, D.C.

Data synthesis: The difference in MCD and MCR payment in dollars and percent was determined and reimbursement per relative value of work (RVW) calculated. MCD reimbursement differences (by dollar amount and by percentage) were qualified as a shortfall or excess as compared to the MCR benchmark.

Conclusions: Marked differences in MCD and MCR reimbursement exist for all cochlear implant related services, most commonly as a substantial shortfall. The MCD shortfall varied in amount between states and great variability in reimbursement exists within and between audiology, surgery, and speech services. Shortfalls and excesses were not consistent between procedures or states.
The variation in MCD payment models reflects marked differences in the value of the same work provided which in many cases is far less than federal benchmarks. These results question the fairness of the MCD reimbursement scheme in cochlear implantation with potential serious implications on access to care for this underserved patient population.

Define Professional Practice Gap and Educational Needs: 1. Lack of awareness of Medicaid coverage gaps between states 2. Lack of awareness of Medicaid coverage between children and adults 3. Incomplete understanding of differences between cochlear implant and related service reimbursement when compared to federal benchmarks (Medicare)

Learning Objective: 1. To better understand Medicaid coverage gaps between states 2. To be aware of Medicaid coverage between children and adults 3. To highlight differences between cochlear implant and related service reimbursement when compared to federal benchmarks (Medicare)

Desired Result: By understanding the differences between Medicaid and Medicare reimbursement attendees will be better able to budget within their own implant programs but also to advocate for changes within their own home states.

IRB or IACUC Approval: Exempt

Cochlear Implant Insertion Axis into the Basal Turn: A Critical Factor for Electrode Array Translocation

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Hypothesis: Inappropriate insertion axis leads to intracochlear lesions during cochlear implantation (CI).

Background: Influence of a robot-based electrode insertion with a planned axis in the basal turn on electrode scalar location has never been assessed.

Methods: Pre-implantation cone-beam CT (CBCT) was performed on twelve human temporal bones. In five temporal bones, optimal axis was planned, aiming for the scala tympani (ST) centerline and adjusted to the fallopian canal anatomy. In seven other temporal bones an inaccurate axis was intentionally planned (optimal axis +15° error). Automated CI array insertion according to the planned axis was performed with a motorized insertion tool driven by navigated robot-based arm. Post-implantation CBCT was then performed. The cochlea and the basilar membrane were manually segmented from the pre-implantation CBCT and the array model from the post-implantation CBCT to reconstruct a merged final 3D model. Microscopic analysis of the cochlea was performed to determine the scalar position of each electrode.

Results: A strong reliability between microscopy and 3D model electrode position analysis was observed (Cohen's kappa k=0.67). The number of electrodes located in the ST was significantly higher in optimal axis insertions group than in inaccurate axis group (59% vs. 42%; $p<0.05$).

Conclusion: We have validated a 3D reconstruction method to assess electrode array positions. Preimplantation planning of CI insertion with a robot-based arm bearing an insertion tool can lead to a lower risk of electrode translocation.

Professional Practice Gap & Educational Need: Lack of knowledge the importance of the insertion axis during cochlear implantation

Learning Objectives: Understand the importance of the insertion axis during cochlear implantation Desired Results: An insertion in an inaccurate axis is more traumatic than an optimal axis insertion IRB or

IACUC Approval: Exempt

Novel Approaches in The Development of an Optogenetically-Driven Cochlear Implant

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Hypothesis: High levels of opsin expression can be achieved in spiral ganglion cells (SGCs) in vivo via novel ancestral adeno-associated virus-mediated gene delivery as the basis of a mouse model of an optogenetically-driven cochlear implant.

Background: The activity of photosensitized neurons using optogenetic approaches can be controlled with millisecond precision using pulsed light stimulation. Previous studies have demonstrated low levels of opsin expression in SGCs using virally-mediated gene therapy compared to transgenic murine lines. Herein, we aim to quantify SGC opsin expression in mice systemically injected via novel adeno-associated viral vectors (ancestral AAV) compared to older AAV (AAV2/9) and transgenic lines (Bhlhb5:ChR2.) and compare light-driven responses as measured by optically-evoked ABRS (oABRs) and recordings in inferior colliculus (IC).

Methods: AAV2/9 or Anc80 viral vector with opsin, GFP reporter and CAG promoter was injected into superficial temporal vein of wild type CBA/CaJ mice, and allowed to incubate for 4-10 weeks. Optically-driven responses were recorded using fiberoptic delivery of pulsed light to cochlea. Histologic analysis was performed.

Results: Bhlhb5 transgenic mice demonstrate high expression of opsin in both soma and processes of the SGCs with robust oABRs. Mice injected with Anc80 demonstrated strong GFP expression in and around SGCs, and greater extracellular fluorescence compared to transgenics. Mice injected with AAV2/9 showed little opsin expression in SGCs or inner ear, with most fluorescence concentrated in non-neuronal tissue.

Conclusions: Opsin expression in the spiral ganglion of Anc-80 injected mice is robust and offers a minimally-invasive, translatable model for a cochlear implant based on light.

Define Professional Practice Gap and Educational Needs: 1) Lack of awareness about the use of optogenetic technology to drive the development next-generation light based neuroprostheses 2) Lack of awareness of new viral vectors that can be used for gene therapy, drug delivery

Learning Objective: 1) Learn how optogenetics can be used to create optically-activated cochlear implants.
2) Be exposed to a new viral vector that can be used to deliver target genes more efficiently to the cochlea

Desired Result: Attendees will be able to describe optogenetics and its role in the field of otology, specifically as it pertains to the development of neuroprostheses. Attendees will also learn about a novel viral vector method for gene delivery, and will be able to contribute to further otology research and innovation through the use of this methodology.

IRB or IACUC Approval: Approved

Audition's Effect on Balance in Gait for Hearing Aid Patients

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Hypothesis: Audition has a positive influence on balance during ambulation.

Background: Traditionally, balance is determined by vestibular, visual, and proprioceptive inputs. Emerging evidence suggests hearing also plays a role in balance. We have previously shown that audition has a positive effect on balance in bilateral hearing aid (HA) users. The effect of audition on balance in ambulation is unknown. This is particularly important because ambulation is when most falls occur.

Methods: Experience bilateral HA users were recruited. Point-source noise, blindfold, and inertial sensors were used to examine gait measurements associated with increased risk of falls (swing time variability, stride length variability, double support phase, gait velocity) in each patient in both aided and unaided setting.

Results: Swing time variability decreased with HA in place (95% CI: 0.024-0.042) compared to no hearing aids (95% CI: 0.027-0.059), measured by coefficient of variation (p-value = 0.032). Other parameters including stride length variability (95% CI: 0.032-0.057 vs 0.039-0.053), double support phase (95% CI: 25.79-30.82 vs 24.37 -33.25), and gait velocity (95% CI: 1.67-2.26 vs 1.55-2.26) did not show significance in aided vs unaided states.

Conclusions: The presence of hearing aids may lead to improved gait measurements associated with lower fall risk. The growing elderly population at risk for falls may benefit in balance with hearing aids.

Define Professional Practice Gap and Educational Needs: Lack of awareness that audition may have an effect on balance.

Learning Objective: To understand that audition may have an effect on balance during ambulation.

Desired Result: To understand that audition, and therefore hearing aids, may have an effect on balance during ambulation.

IRB or IACUC Approval: Approved

Dizziness Handicap Inventory Score Is Highly Correlated with Markers of Gait Disturbance

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Objective: To evaluate the association between DHI-S score and spatiotemporal gait parameters using SoleSound, a newly developed, inexpensive, portable footwear-based gait analysis system.

Study design: Cross-sectional

Setting: Outpatient Otology Clinic

Patients: 123 patients >60 years (M=58, F=65, mean age 73.4 years, range 60-95), with and without complaints of dizziness

Intervention(s): Subjects completed the DHI-S survey. Wearing SoleSound instrumented footwear, each subject completed four uninterrupted walking laps on a hard, flat surface for a total of 100m.

Main outcome measure(s): DHI-S score was calculated from survey results. For each subject, mean and coefficient of variation (CV) of stride length, cadence, walking speed, foot-ground clearance, double-support time, swing period and stance-to-swing were computed by considering 40 strides of steady-state walking within each lap. Correlations between these variables and DHI-S were computed using Kendall rank correlation coefficient (τ).

Results: Patients who reported higher DHI-S score walked at slower speed (τ=-0.15, p=0.022) and took less steps per minute (τ=-0.16, p=0.019) than patients with a lower DHI-S score. Patients with higher DHI-S scores also showed larger variability in double support time (τ=0.15, p=0.028), swing time (τ=0.16, p=0.020), and stance to swing (τ=0.18, p=0.008).

Conclusions: Perception of a vestibular handicap is correlated with significant changes in measurable gait parameters. This finding provides new significance for the use of the DHI-S score, a commonly used screening tool for disability. SoleSound was effective in measuring wide range of gate parameters and thus represents an exciting advance in gait analysis technology in the ambulatory setting.

Define Professional Practice Gap and Educational Needs: 1) Strong correlation has been found between DHI and various tests such as the dynamic gait index, computerized dynamic posturography, electronystagmography, functional reach, and head impulse test. Lack of contemporary knowledge regarding relationship of spatiotemporal gait parameters and DHI or DHI-S (screening version of DHI- highly correlated with DHI results) Assessment of gait in the clinical setting is currently hampered by lack of portable assessment tools, high cost, and large and expensive equipment requirements of traditional computerized gait analysis.

Learning Objective: 1) To assess the utility of SoleSound, an inexpensive, portable footwear-based gait analysis system, in the clinical assessment of gait disturbance among patients with and without vestibular deficits.2) To examine the association between DHI -S score and spatiotemporal gait parameters of subjects with complaints of dizziness.

Desired Result: 1) Attendees will have an increased awareness of gait disturbance in patients with dizziness. Attendees will have a better understanding of the relationship between DHI scores and gait analysis, and the meaning of this information in the clinical management of dizziness. Attendees will have a concept of SoleSound as a potential valuable clinical tool for the assessment of gait in the clinical setting.

IRB or IACUC Approval: Approved

RESIDENT RESEARCH TRAVEL AWARD

Efficacy of Intratympanic Gentamicin in Meniere's Disease with and without Migraine

Yuan F. Liu, MD; Elizabeth Renk, MD
Steven D. Rauch, MD; Helen X. Xu, MD

Objective: To compare the efficacy of intratympanic gentamicin injection (ITG) on drop attacks, vertigo attacks, and functional level in Meniere's disease patients with and without migraine.

Study design: matched-pair, retrospective review.

Setting: Tertiary hospital.

Patients: Meniere's disease patients (patients with migraine and age- and sex-matched patients without migraine) treated from 2002-2012 who failed medical management and received ITG, with a minimum 2 -year follow up.

Intervention(s): ITG

Main outcome measure(s): Control of drop attacks, change in vertigo class, and change in functional level (1995 Committee on Hearing and Equilibrium Guidelines).

Results: Twenty-eight Meniere's disease patients were included in this study (14 with migraine and 14 matched patients without migraine). There were 3 males and 11 females in each groups, with a mean age of 53 years. Other baseline characteristics (Meniere's stage, drop attacks, vertigo class, and functional level) before ITG were not significantly different between the 2 groups. Two years after ITG, 85% of migraine patients versus 100% of non-migraine patients had complete control of drop attacks ($p=0.462$). The distribution of vertigo class was also similar ($p=1$). However, there were significantly fewer migraine patients with functional level 1 or 2 (4, 28.6%) compared to non-migraine patients (10, 71.4%) ($p =0.008$).

Conclusions: ITG is equally effective in treating drop attacks and vertigo in Meniere's disease with and without migraine. However, migraine patients derive less benefit in terms of functional level.

Define Professional Practice Gap and Educational Needs: Lack of knowledge about effect of intratympanic gentamicin on Meniere's disease patients who have concurrent vestibular migraine.

Learning Objective: Gain awareness of differences in outcomes of intratympanic gentamicin in Meniere's disease patient with and without migraine.

Desired Result: Be more judicious about using intratympanic gentamicin in Meniere's disease patients with migraine, and perhaps elect to initiate vestibular migraine treatments first before attempting intratympanic gentamicin. Be able to educate patients with Meniere's disease and migraine that intratympanic gentamicin may not be as helpful in improving functional outcomes as expected in patients without migraine.

IRB or IACUC Approval: Approved

Histologic Grade of Otosclerosis Correlates with Computed Tomography Densitometry Measurements in Human Temporal Bone Specimens

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Hypothesis: Computed tomography (CT) densitometry (CTD) can be used to objectively distinguish otosclerosis from normal bone and to determine histologic grades of otosclerosis.

Background: Otosclerotic foci result in subtle radiolucent areas on CT. An objective radiologic measurement (i.e.CTD) that corresponds to known otosclerosis pathology may improve diagnostic accuracy and enable determination of histologic grade of otosclerosis during life.

Methods: Blinded, randomized review of human temporal bone specimens (TBs) that underwent high-resolution multi- detector CT prior to histologic processing. Pathology review/histologic grading and CTD measurements were performed at 11 regions of interest (ROIs) in the otic capsule.

Results: Thirty-two TBs with otosclerosis and 46 TBs without otosclerosis (controls) were reviewed. At ROI#2 (located anterior to the oval window), the density measurement mean (Hounsfield Units) ± standard deviation was 2198 ±154 for grade 0 (no otosclerosis), 1697 ±294 for grade 1 (inactive otosclerosis), 1543 ±351 for grades 2 (mixed activity) and 3 (active otosclerosis) combined. There was a strong inverse correlation of density to histologic grade ($p<0.05$). The same inverse correlation was seen at all ROIs, although small numbers of various grades of otosclerosis at ROI#4 - #9 limited statistical analysis. The inter-rater reliability for CTD was excellent (correlation coefficient 0.87, $p<0.05$).

Conclusions: In human temporal bone specimens, CT densitometry can be used to distinguish normal bone from otosclerosis. Increasing histologic grade (i.e. indicating a more active otosclerotic focus) was correlated with decreasing density measurements. A radiologic measure of disease activity in otosclerosis may enable more informed application of medical and surgical treatments and assessment of treatment efficacy.

Define Professional Practice Gap and Educational Needs: 1. Diagnosis of otosclerosis based on computed tomography (CT) is often subjective and based on subtle hypo densities in the otic capsule. An objective measurement, such as CT densitometry measurements, may assist in the radiologic diagnosis of otosclerosis, but should be based on known correlations with pathology. 2. The ability to estimate histologic grade of otosclerosis by CT has not been previously examined. A radiologic assessment of disease activity may inform management decisions and allow monitoring of disease progression/ improvement.

Learning Objective: 1. To demonstrate, based on radiologic-pathologic correlations using human temporal bone specimens, that CT densitometry can be used as an objective measure to aid in the diagnosis of otosclerosis. 2. To demonstrate that CT densitometry may help distinguish inactive disease from mixed and active disease in otosclerosis.

Desired Result: Use CT densitometry when assessing temporal CTs for patients with otosclerosis, as an aid in diagnosis, for estimating histologic activity, for assessing disease progression or regression if any serial CTs are performed.

IRB or IACUC Approval: Exempt

Paget's Disease of the Temporal Bone:
A Single-Institution Review of 23 Cases

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Objectives: Evaluate presentation, management, and clinical outcomes of patients with Paget's disease of the temporal bone (PDTB).

Study Design: Retrospective chart review.

Setting: Tertiary referral center

Patients: All patients with Paget's disease and radiographically-confirmed involvement of the temporal bone (2000- 2016).

Main Outcome Measures: Clinical presentation, audiometric data, radiological features, disease course, and interventions are analyzed.

Results: A total of 43 temporal bones in 23 patients (9 males) were diagnosed with PDTB. Symptoms at presentation included hearing loss (n=15, 66%), tinnitus (n=5, 23%), chronic otitis media (n=1, 4%), vertigo (n=1, 4%), multiple cranial neuropathies (n=1, 4%), and a multiply recurrent giant cell tumor (n=1, 4%). Hearing loss was most commonly sensorineural in origin though approximately 40% demonstrated a mixed loss. In two patients followed for over 25 years, a 30dB (SD 10 dB) decline in PTA was noted. One patient underwent successful cochlear implantation. Radiographic features of temporal bone involvement are reviewed and illustrated.

Conclusion: This is the largest clinical series examining patients with PDTB in the English literature. Variable patterns of temporal bone involvement by Paget's disease are observed leading to a diverse set of clinical symptoms, including slowly progressive hearing loss, tinnitus, compressive cranial neuropathies, and benign or malignant tumor degeneration. Involvement of the IAC, otic capsule, stapes or other temporal bone structures leads to differences in the type and degree of hearing loss, based on mechanism. Hearing aids are beneficial for the majority of patients while cochlear implantation can be performed in patients with advanced hearing loss.

Define Professional Practice Gap and Educational Needs: Lack of contemporary knowledge on the presentation, progression, and treatment options of Paget's disease of the temporal bone, due to the rarity of disease. Current literature is limited to case reports and older histopathologic studies, but few large clinical series on this patient population.

Learning Objective: To recognize the diagnosis of Paget's disease of the temporal bone. To understand the possible mechanisms of hearing loss. To be able to counsel patients on long term hearing prognosis and rehabilitation options, including cochlear implantation. To differentiate it from otosclerosis.

Desired Result: Expanded awareness of the diagnosis and treatment options will translate to improved patient care and counseling.

IRB or IACUC Approval: Approved

Validation of A Novel Summative Temporal Bone Dissection Scale

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Jordan Hochman, MD

Hypothesis: A novel temporal bone dissection assessment tool can distinguish resident performance by skill and will illustrate consistency across reviewers.

Background: The increasing emphasis on patient safety has created the need for quality assessment of fundamental surgical skills. Existing temporal bone rating scales are laborious, subject to evaluator fatigue and contain fundamental inconsistencies when conferring points. A novel binary assessment tool with twelve variables was designed to be comprehensive and brief while addressing these deficiencies.

Methods: Resident surgeons attending a National Otolaryngology Conference completed a mastoidectomy with posterior tympanotomy on identic 3D printed temporal bone models. Two independent Neurotologists at separate academic institutions evaluated drilled specimens using a previously validated scale [Welling Scale] as well as a new scale, with scoring repeated at a 6-week interval.

Results: Twenty-one Residents participated (11M,10F), representing nine postgraduate programs. PGY level of participants was bell-shaped. Assessment was clustered into junior (PGY1,2), intermediate (PGY3) and senior resident (PGY4,5) cohorts. ANOVA analysis found significant differences between the cohorts performance ($p<0.05$) for the new scale. The established scale did not find significance between intermediate and senior resident performance ($p=0.13$). Cohen's Kappa found strong intra-rater reliability [0.985] with moderate inter-rater score [0.422] for the new scale.

Conclusions: This scale is facile and differentiated performance by PGY level with strong intra-rater, and reasonable inter-rater reliability. Future plans include validation in the operating room.

Define Professional Practice Gap and Educational Needs: The increasing emphasis on patient safety has created the need for quality assessment of fundamental surgical skills among trainees. Existing temporal bone rating scales are laborious, subject to evaluator fatigue and contain fundamental inconsistencies when conferring points.

Learning Objective: Attendees will gain an understanding of the challenges with existing dissection scales. Attendees will learn about the attributes of a novel temporal bone dissection scale that has been field tested by trainees nationally.

Desired Result: Attendees may consider integrating the novel scale into their assessments within individual programs and for licensure at state and national levels.

IRB or IACUC Approval: Approved

A Comprehensive Analysis of Hearing Loss Among Children with Low Birth Weight

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Objective: To evaluate the prevalence, type, and severity of hearing impairment in pediatric patients born of low birth weight (LBW)

Study Design: Retrospective analysis

Setting: Tertiary academic referral center

Patients: Pediatric patients in the AudGen Database with a diagnosis of LBW

Intervention: Diagnostic

Main Outcome Measures: Pure tone air- and bone-conduction audiometry, pure-tone average (PTA), change in PTA

Results: 1329 patients met inclusion criteria and 645 patients had hearing loss. 73.2% had bilateral hearing loss and 26.8% had unilateral loss. Pure conductive hearing loss was the most common type of defined hearing loss (20.5%, n=217). Children with very low birth weight (<1500 g) had worse initial hearing loss than children with low birth weight (1500-2499 g) ($p=0.02$). Mixed type I hearing loss was significantly more severe than the other defined types of hearing loss (Tukey HSD, $p<0.001$). Conductive and mixed type II hearing loss had significantly better hearing improvement over time compared to sensorineural and mixed type II (Tukey HSD, $p<0.02$).

Conclusion: To our knowledge, this study presents the largest comprehensive analysis of hearing loss in children born of LBW. Of defined hearing loss types, conductive is by far the most common type, and otolaryngologic causes of conductive hearing loss are prevalent in this patient population. Therefore, children born of LBW warrant thorough and close management by pediatricians in order to promote early intervention when necessary. Future studies with more consistent serial audiograms are necessary to fully examine the trend of hearing improvement among children with LBW.

Define Professional Practice Gap and Educational Needs: Limited studies and understanding about the type and severity of hearing loss among children born of low birth weight.

Learning Objective: To evaluate the prevalence, type, and severity of hearing impairment in pediatric patients born of low birth weight.

Desired Result: Attendees will be able to describe the type, severity, and improvement of hearing loss among children born of low birth weight to help improve management and early intervention of these patients.

IRB or IACUC Approval: Exempt

Safety of Autologous Human Umbilical Cord Therapy for Acquired Sensorineural Hearing Loss in Children

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Short-term and Long-term Hearing Outcomes with the Middle Cranial Fossa Approach for Resection of Vestibular Schwannoma

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Objective: To analyze the short-term and long-term (5 and 10 years post-operative) hearing outcome data in patients who have undergone hearing preservation surgery with the middle cranial fossa (MCF) approach for the resection of vestibular schwannomas.

Study Design: Retrospective case series.

Setting: Tertiary academic referral center.

Patients: Adult patients with isolated/sporadic vestibular schwannoma

Intervention: Surgical treatment with a middle cranial fossa approach Main Outcome Measure: Comparison of pre- and post-operative audiometric data in accordance with the most recent AAO-HNS guideline for reporting of hearing outcomes.

Results: From 1999 to 2016, 155 patients underwent the MCF approach for the sake of hearing preservation. Of the 140 patients who presented with serviceable hearing pre-operatively, 105 (75%) maintained serviceable hearing initially after surgery. Long-term hearing data was analyzed for those patients who had 5-year and 10-year post-operative audiometric data. The hearing in the contralateral ear was utilized to correct for progressive sensorineural hearing loss. The following hearing preservation factors were analyzed: maximal tumor dimension, age of the patient, pre-operative audiometric and vestibular testing, and the presence of fundal fluid.

Conclusion: The majority of patients with serviceable hearing pre-operatively initially maintained hearing post- operatively with the MCF approach. The long-term hearing data becomes sparse as the interval of time increases from the time of surgery. In those patients with long-term data available, delayed hearing loss occurs in a small percentage. Patients with intracanalicular tumors that spare the fundus have better rates of hearing preservation using the MCF approach.

Define Professional Practice Gap and Educational Needs: The literature on long-term hearing outcome data after the middle cranial fossa (MCF) approach for vestibular schwannoma resection is not as robust as that of short-term hearing outcome data.

Learning Objective: To analyze the short-term and long-term (5 and 10 years post-operative) hearing outcome data in patients who have undergone hearing preservation surgery with the MCF approach for the resection of vestibular schwannomas.

Desired Result: The information from this project will help surgeons to better counsel their patients about the prospects of durable hearing preservation after undergoing the MCF approach.

IRB or IACUC Approval: Approved

Occupational Noise Exposure and a Potential Risk for Noise Induced Hearing Loss Among Otologist and Neurologist due to Temporal Bone Drilling

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Background: Noise induced hearing loss is one of the most common occupational hazards in United States. Several studies have described noise induced hearing loss in patients following mastoidectomy in the contralateral ear. Although otolaryngologists care for patients with noise induced hearing loss, no studies in the English literature have examined surgeons occupational risk.

Methods: Sound level meters with octave band analyzers were used to assess noise exposure during drilling of preserved temporal bones. Frequency specific sound intensities were recorded. Sound produced using burrs of varying size and type were compared. Differences while drilling varying anatomic structures were assessed using drills from two manufacturers. Pure tone audiometry was performed on 10 otolaryngology residents before and after a temporal bone practicum to assess for temporary threshold shifts.

Results: Noise exposure during otologic drilling can exceed over 100 dB for short periods of time, and is especially loud using large diameter burrs > 4 mm, with cutting as compared to diamond burrs, and while drilling denser bone such as the cortex or otic capsule. Intensity peaks were found at 2,500. 5,000 and 6,300 Hz. Drilling on the tegmen and sigmoid sinus revealed peaks at 10,000 and 12,500 Hz. No temporary threshold shifts were found at 3,000-6,000 Hz.

Conclusions: Hearing protection covering 2500-8000 Hz should be considered if prolonged drilling is expected, which would still allow the surgeon to appreciate pitch changes associated with drilling on sensitive structures and to allow communication with surgical team members.

Define Professional Practice Gap and Educational Needs: Unawareness of Otology/Neurotology surgeons of their own occupational risk for noise induced hearing loss

Learning Objective: characterize occupational noise exposure during otology/neurotology procedures Desired Result: Consideration of actions to reduce noise exposure among Otological/Neurotological surgeons

IRB or IACUC Approval: Exempt

Factors Associated with Benefit of Active Middle Ear Implants and Conventional Hearing Aids

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Objective: To report outcomes of a multicenter FDA clinical trial for an active middle ear implant (MEI) and identify factors associated with benefit for MEIs and conventional hearing aids (HAs).

Study design: Independent review of audiological data from an MEI FDA clinical trial

Setting: Multicenter prospective FDA clinical trial

Patients: Ninety-one adult active MEI recipients

Interventions/main outcomes measured: Pre-operative earphone, unaided/aided/implanted pure tone thresholds, word recognition scores, self-report benefit (APHAB), and speech intelligibility index.

Results: Overall, 73 patients (80.2%) reported larger benefit (APHAB) with active MEI than conventional HAs. Fifty- two patients (57.1%) showed larger increases in word recognition with MEI than with conventional HAs. However, improvements in self-report benefit and word recognition from HAs to MEIs were not significantly correlated ($r=0.09$, $p=0.40$) and were unrelated to magnitude of hearing loss ($p=0.22$). Moreover, patients with larger MEI benefit than HA benefit also had larger disparities in word recognition measured under earphones and with hearing aids. This suggests that routine earphone measures of word recognition are not predictive of success with MEIs. Other patient-and device-related factors, including sentence recognition in babble, and unaided and aided speech audibility, that predict differences in HA and MEI benefit will be discussed.

Conclusion: Word recognition and self-report benefit derived from conventional HAs and MEIs from this large, multi- center trial provide further evidence of the importance of aided word recognition in clinical decision making, such as determining candidacy for and success with MEIs.

Define Professional Practice Gap and Educational Needs: 1) Lack of understanding of which patients are likely to achieve greater benefit with active middle ear implants over conventional hearing aids Lack of understanding of the auditory benefits of active middle ear implants as compared to conventional hearing aids Lack of understanding how active middle ear implants impact patient quality of life as compared to conventional hearing aids Lack of awareness of the need to perform aided word recognition testing to determine individual patient hearing aid benefit

Learning Objective: 1) Attendees will be better able to identify which patients are likely to get greater benefit of active middle ear implant over conventional hearing aids Attendees will have better understanding of the auditory benefits of active middle ear implants
Attendees will better understand how active middle ear implant impact patient quality of life
Attendees will be more aware of the importance of performing aided word recognition testing in the hearing aid population

Desired Result: 1) Attendees will be able to use this information to better select which patients should receive active middle ear implants over conventional hearing aids
Attendees will be better able to counsel their patients as to the likely outcomes of active middle ear implants
Attendees will start to consider more regular use of aided word recognition testing to better understand the hearing performance of their hearing aid population

IRB or IACUC Approval: Exempt

RESIDENT RESEARCH TRAVEL AWARD

Drill-induced Cochlear Injury during Otologic Surgery: Intracochlear Pressure Evidence of Acoustic Trauma

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Hypothesis: Drilling on the incus produces intracochlear pressure changes comparable to pressures created by high- intensity acoustic stimuli.

Background: New-onset sensorineural hearing loss (SNHL) following mastoid surgery can occur secondary to inadvertent drilling on the ossicular chain. To investigate the cause, we test the hypothesis that high sound pressure levels are generated when a high-speed drill contacts the ossicular chain.

Methods: Human cadaveric heads underwent mastoidectomy, and fiber-optic sensors were placed in scala tympani and vestibuli to measure intracochlear pressures (PIC). Stapes velocities (Vstap) were measured using single-axis laser Doppler vibrometry. PIC and Vstap were measured while a high-speed otologic surgical drill was placed on the incus. 4- mm diamond and cutting burrs were used at drill speeds of 20k, 50k, and 80k RPM.

Results: No differences in peak equivalent ear canal noise exposures (135-167 dB SPL) were seen between drill speeds or burr types when drilling on the incus; however, the root-mean-square PIC amplitude calculated in third-octave bandwidths around 0.5, 1, 2, 4, and 8 kHz revealed equivalent ear canal levels of 105 and 101 dB SPL with diamond and cutting burrs, respectively. These levels decreased by ~9 dB with increasing drill speeds from 20k to 80k RPM.

Conclusion: Our results suggest that incidental drilling on the ossicular chain can generate PIC comparable to high- intensity acoustic stimulation. Both drill speed and burr type affect the magnitude of PIC generated when drilling on the incus. Inadvertent drilling on the ossicular chain produces intense cochlear stimulation that could cause SNHL.

Define Professional Practice Gap and Educational Needs: Limited understanding of the intracochlear environment during inadvertent drilling on the ossicular chain in mastoid surgery.

Learning Objective: Appreciate the potential for causing cochlear trauma during mastoid surgery due to incidental drilling on the ossicular chain.

Desired Result: 1. Participants will improve understanding of the potential intraoperative causes of new-onset SNHL after mastoid surgery. 2. Participants will consider iatrogenic cochlear trauma from incidental drilling on the ossicular chain in analyzing their own patient outcomes.

IRB or IACUC Approval: Exempt

Transcanal Endoscopic Ear Surgery - Utility and Ease of Surgical Technique from a Resident Surgeon's Perspective

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Alejandro A. Rivas, MD; Brandon Isaacson, MD
Joe Walter Kutz Jr, MD

Objective: To delineate the impact of transcanal endoscopic ear surgery (TEES) on trainee education and future practice patterns.

Study Design: Survey of current otolaryngology residents and neurotology fellows.

Setting: Three tertiary care academic centers.

Results: Of the 68 trainees that received the survey, 33 responded. Twenty of the 33 (61%) who responded were PGY-4 and above. Fifteen trainees (46%) reported using TEES for tympanoplasty more than half of the time, while 7 (21%) reported using the endoscope for cholesteatoma more than half of the time. Twenty-nine trainees (88%) reported slightly or definitely preferring the endoscope for ease of understanding surgical anatomy, while only 3 (9%) preferred the microscope. While 16 (48%) responded slightly preferring or definitely preferring the endoscope for ability to understand surgical technique, 15 (45%) noted slightly preferring or definitely preferring the microscope for ease of performing the surgery. Thirteen (39%) felt that endoscopic technique added between 26-75% more time to the case. Notably 21 (64%) planned to use endoscopic technique in future practice either “frequently”, “very frequently”, or “every case”. Only 3 residents responded they would never use endoscopic technique in practice, 2 of which were PGY-2 and below.

Conclusions: Despite a perceived increase in operative time, the overwhelming majority of residents at training centers with high volume of TEES cases felt it was beneficial for learning ear anatomy and nearly half thought it improved their conceptualization of the surgical technique. The majority plan on using the technique in their future practice.

Define Professional Practice Gap and Educational Needs: Lack of awareness - transcanal endoscopic ear surgery is a new technique which deviates from traditional microscopic ear surgery.

Learning Objective: 1. To understand the impact that transcanal endoscopic ear surgery has in surgical training, both in understanding anatomy as well as surgical technique. 2. To be aware that most trainees in current otolaryngology residency programs anticipate utilizing this technique in future practice.

Desired Result: More institutions will incorporate transcanal endoscopic ear surgery into their surgical training programs.

IRB or IACUC Approval: Exempt

Effects of Time and Level Difference Inputs to Bilaterally Placed Bone-conduction Systems on Cochlear Input

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Hypothesis: Stimulation with bilaterally-placed bone conduction hearing devices (BCHD) with varying time (ITD) and level differences (ILD) will show intracochlear pressures (PIC) that are unique from responses to unilateral stimulation with either ipsilaterally- or contralaterally-placed BCHD.

Background: BCHD are traditionally implanted unilaterally, assuming that low transcranial attenuation would reduce binaural cues; however, recent studies have demonstrated both subjective and objective improvements with bilateral BCHD.

Methods: PIC was measured in scala vestibuli and tympani with fiber -optic pressure sensors in cadaveric specimen. Bilateral bone-conduction transducers were coupled to the mastoid via implanted titanium abutments and driven with pure-tone stimuli between 250-4000 Hz. ITDs and ILDs between the inputs to the bilateral devices were varied from -1 to 1 ms and -20 to 20 dB, respectively.

Results: Since each cochlea receives input from both BCHDs, various ITDs produced constructive and destructive interference patterns in PIC. The precise nature of interference depended upon frequency and effectively converts the timing difference between bilaterally-placed BCHDs to a level difference in PIC. For each frequency, a common peak in PIC was found offset from the 0 Âµs delay condition, reflecting the relative interaural delay in signal transmission between the BCHDs. Stimulation with ILDs produced responses within PIC that varied directly with ILD.

Conclusion: Bilateral BCHDs generate unique cochlear pressures to varied ILD and ITD. Since each cochlea receives two inputs, one from each BCHD, cochlear inputs could be quite complex, creating interaural pressure differences that may contribute to improved thresholds, sound localization and performance on speech testing.

Define Professional Practice Gap and Educational Needs: Bone-anchored hearing devices are traditionally implanted unilaterally despite evidence that supports improved subjective and objective outcomes with bilateral implantation.

Learning Objective: The objective of this study is to demonstrate the unique intracochlear pressure responses to bilaterally placed bone-conduction hearing devices with varying interaural time and level differences.

Desired Result: The results of our experimentation will aid in determining how bilateral stimulus conditions for bone- anchored hearing devices permit the use of spatial acoustic information. In addition, our experimentation will highlight the limitations of bilateral bone-anchored hearing devices.

IRB or IACUC Approval: Exempt

Cochlear Implant Electrode Localization Using an Ultra-High Resolution Scan Mode On Conventional 64-Slice and New Generation 192-Slice Multi-Detector CT Scanners

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Hypothesis: A new generation 192-slice multi-detector computed tomography (MDCT) clinical scanner provides enhanced image quality and superior electrode localization over conventional MDCT.

Background: Currently, accurate and reliable cochlear implant electrode localization using conventional MDCT scanners remains elusive.

Methods: Eight fresh-frozen cadaveric temporal bones were implanted with conventional length cochlear implant electrodes. Specimens were subsequently scanned with conventional 64-slice and new generation 192-slice MDCT scanners utilizing ultra-high resolution modes, with matched radiation dose. Additionally, all specimens were scanned with micro-CT to serve as the reference standard. Images were reconstructed according to routine temporal bone clinical protocols. Three neuroradiologists, blinded to source scanner, reviewed images independently to assess resolution of individual electrodes, scalar localization, and severity of metal artifact.

Results: Serving as the gold standard, micro-CT identified scalar crossover in 1 specimen; imaging of all remaining cochleae demonstrated complete scala tympani insertions. The 192-slice MDCT scanner exhibited enhanced resolution of individual electrodes ($p<0.01$), superior scalar localization ($p<0.01$), and reduced blooming artifact ($p<0.05$), compared to conventional 64-slice MDCT. There was no difference between platforms when comparing streak or ring artifact. Representative examples of image quality are presented.

Conclusion: The new generation 192-slice MDCT scanner offers several notable advantages for temporal bone and inner ear imaging compared to conventional MDCT. This technology provides important feedback regarding electrode location that can assist in optimizing surgical technique and electrode design.

Define Professional Practice Gap and Educational Needs: The utility of ultra-high-resolution temporal bone imaging using a new generation 192-slice multi-detector CT has not yet been reported.

Learning Objective: To understand the potential advantages of utilizing a new generation clinical 192-slice multi- detector CT scanner for temporal bone imaging.

Desired Result: These data may be used by the clinician to determine whether this technology would be beneficial to their practice/patients in the future.

IRB or IACUC Approval: Approved

"Delayed Cochlear Implant Serous Labyrinthitis"
A Previously Unrecognized Phenomenon with a Distinct Clinical Pattern

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Colin L.W. Driscoll, MD; Brian A. Neff, MD
Charles W. Beatty, MD; Matthew L. Carlson, MD

Objectives: To report a unique clinical entity "delayed cochlear implant serous labyrinthitis", characterized by a distinct constellation of clinical symptoms and pattern of electrode impedance fluctuations.

Study Design: Retrospective chart review.

Methods: All patients that underwent cochlear implantation between March 2015 and March 2016 were retrospectively reviewed. All subjects with acute onset dizziness, device performance decline, and characteristic sawtooth pattern of electrode impedances occurring after an asymptotic postoperative interval were identified and reported.

Results: Five patients (4 men, 5 left ears) with the above criteria were identified, representing 3% of all implant surgeries performed during this time. The median age at time of implantation was 65 years, and the median time interval between implantation and onset of symptoms was 88 days. All patients exhibited acute onset dizziness, subjective performance deterioration, sawtooth impedance pattern and 3 experienced worsening tinnitus. Three of 5 patients underwent subsequent CT imaging, where good electrode placement was confirmed. Four of 5 patients received oral prednisone therapy and all patients reported a subjective improvement in symptoms. Four of 5 patients experienced stabilization of electrode impedances. Three patients subsequently received vestibular testing, where significantly reduced peripheral vestibular function was identified.

Conclusions: We describe a unique clinical entity, "delayed cochlear implant serous labyrinthitis", characterized by a distinct constellation of clinical symptoms and corresponding electrode impedance anomalies. The exact cause for this event remains unknown, but may be related to foreign body reaction to the electrode, electrical stimulation injury, or viral illness. Future studies are needed to further elucidate cause and optimal management.

Define Professional Practice Gap and Educational Needs: Lack of awareness concerning a unique clinical entity with a distinct patient presentation and sawtooth impedance pattern.

Learning Objective: To describe the clinical presentation of "delayed cochlear implant serous labyrinthitis" which consists of acute onset dizziness, subjective performance deterioration, and sawtooth impedance pattern.

Desired Result: Learners will be able to identify the clinical and corresponding impedance patterns of previously unrecognized "delayed cochlear implant serous labyrinthitis."

IRB or IACUC Approval: Approved

Does Intraoperative Testing During Cochlear Implantation Impact Surgical Decision-making?

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Aaron Trinidade, FRCS; Robert Frank, MD; Matthew Cox, MD
John L. Dornhoffer, MD

Objective: To review our use of intraoperative testing during cochlear implantation (CI) and determine its impact on surgical decision-making.

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

Patients: A total of 197 children and adults who underwent a total of 266 primary and/or revision CI by a single surgeon from 2010 to 2015.

Intervention: Intraoperative electrophysiologic monitoring including evoked compound action potentials (ECAP) and electrical impedances (EI).

Main Outcome Measures: Whether surgical management was changed based on intraoperative testing.

Results: In only 2 of 266 cases (0.8%), the back-up device was used due to findings on intraoperative testing. In 3 cases (1.1%), X-ray was performed intraoperatively to confirm intracochlear electrode placement, which was found to be normal in all cases.

Conclusion: Our data suggest that routine intraoperative testing in adult and pediatric CI is unnecessary. The implications of this are discussed and a review of the literature presented.

Define Professional Practice Gap and Educational Needs: We believe there is an overuse of intraoperative CI testing as it rarely alters surgical decision making.

Learning Objective: We present our experience with intraoperative testing, survey the current literature and hope to open the conversation regarding more judicious use of intraoperative cochlear implant testing.

Desired Result: Our hope is that attendees will consider a more judicious approach in the use of intraoperative CI testing in order to save time and cost, without sacrificing patient care or outcomes.

IRB or IACUC Approval: Approved

AOS POSTERS

G001

Tumor-Penetrating Nanocomplexes for Delivery of Sirna Therapeutics to Human Vestibular Schwannomas

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Hypothesis: Vestibular schwannomas (VSs) express unique receptors that can be harnessed for tumor-targeted drug delivery. Nanoparticle delivery of siRNA therapeutics can suppress expression of genes that mediate secretion of ototoxic cytokines.

Background: Ninety-five percent of patients with VS present with sensorineural hearing loss. The mechanism of this loss is multifactorial. Recent studies have identified VS-secreted factors in patients with significant SNHL that mediate ototoxicity. However, few therapies exist for VS-associated SNHL.

Methods: Immunofluorescence and fluorescence-activated cell sorting (FACS) were performed on VS-derived human cell line and primary human VS cultures to identify surface receptors for nanoparticle targeting. Tumor-specific nanoparticle delivery was assessed by fluorescent microscopy and FACS. Dose-dependence of uptake was evaluated. Gene knockdown was measured by qRT-PCR and ELISA. Analysis of variance and Tukey post hoc testing were used for statistical analysis.

Results: There is a significant overexpression of av integrins and neuropilin-1 receptors. Compared to great auricular nerve controls, histological specimens from patients with VSs demonstrate similar patterns of expression. Tumor- penetrating nanocomplexes (TPNCs) carrying siRNA therapeutics selectively home to primary VS cultures in a dose- dependent fashion compared to untargeted controls. TPNC-mediated delivery of siRNA against tumor necrosis factor alpha (TNFÎ±), an ototoxic molecule found in VS secretions, resulted in nearly 90% suppression of gene expression ($p<0.001$) and 50% reduction in protein secretion ($p<0.05$). Gene silencing is both receptor- and siRNA sequence-specific.

Conclusion: Tumor-targeted nanoparticle-mediated delivery of siRNA therapeutics suppresses TNFÎ± secretion in vitro. This presents a novel and promising strategy in the clinical management of VS-associated hearing loss.

Define Professional Practice Gap and Educational Needs: There is a lack of understanding of the underlying biological mechanisms of vestibular schwannoma (VS) growth and VS-associated hearing loss. Recent evidence suggest several new molecules that may be responsible for VS survival and mediate ototoxicity. This activity will help close gaps in physician knowledge of new molecular targets in vestibular schwannomas.

Learning Objective: 1) Describe molecular pathways underlying VS proliferation and survival Describe one pathway by which VS-secreted molecules can mediate hearing loss Discuss therapeutic potential of short interfering RNA in VS Discuss benefits of applying nanotechnology to deliver siRNA therapeutics to tumors

Desired Result: To improve understanding of VS pathobiology and the role of nanotechnology in delivering therapeutics against VS-associated hearing loss

IRB or IACUC Approval: Approved

G002

Cochlear Implant Encoding Implications of Simulated Spiral Ganglion Neuron Pathology

Jesse M. Resnick; Jay T. Rubinstein MD, PhD

Hypothesis: Spiral ganglion axon demyelination alters encoding of information passed by extracellular electrode stimulation.

Background: Cochlear implant function involves direct depolarization of spiral ganglion neurons (SGNs) by injected current, suggesting neuron health may be critical to outcomes. This expected relationship has been difficult to confirm in humans. Animal studies demonstrate progressive SGN death, ultrastructural changes, and altered physiology following deafening; however, these phenomena are complex and sensitive to deafening mechanism, developmental stage at deafening, and deafness duration. A conceptual understanding of the distinct impacts of SGN cell loss and axon dysfunction on electrical stimulation efficacy remains elusive.

Methods: SGN peripheral axons are modeled as segmented wires with passive internode segments and voltage- dependent, stochastic nodal segments. Using Kirchoff's Law, we solve for membrane potential via a finite differencing method. Varying internode membrane resistance and capacitance facilitates simulation of gradations of demyelination. Fibers are stimulated proximally with biphasic pulses from extracellular disc electrodes and monitored for spikes centrally.

Results: Axon sensitivity generally decreased with demyelination, resulting in elevated thresholds. Relative insensitivity to modest demyelination is noted. Both latency and jitter of responses show similar resilience but exhibit non-monotonic relationships to more profound demyelination. Comparison of threshold crossing between segments demonstrates altered spike initiation with severe demyelination.

Conclusions: Simulated demyelination leads to complex changes in fiber sensitivity, spike timing, and spike initiation site due to asymmetry in axon electrical properties. This highlights the importance of exploring both SGN loss and ultrastructural change outcomes of a disease process to predict cochlear implantation outcomes.

Define Professional Practice Gap and Educational Needs: Conventional understanding of how cochlear implants produce hearing involves direct depolarization of spiral ganglion neuron axons or cell bodies by injected current. Implicit in this description is the necessity for neurons capable of conducting action potentials, suggesting neuron health may be an important factor in implant outcomes. Unfortunately, this theoretical relationship has been difficult to confirm in practice leaving a large amount of unexplained performance variability.

Learning Objective: Here we use a biophysical modeling approach, grounded in current literature, to provide a conceptual framework for understanding the physical processes governing how spiral ganglion neuron axon ultrastructure might impact their response to different extracellular stimulation paradigms.

Desired Result: Our work will provide our audience with a strong physical intuition regarding the importance of spiral ganglion neuron integrity for cochlear implant function and suggest experimental approaches for addressing unresolved aspects of this relationship.

IRB or IACUC Approval: Exempt

G003

AzBio Speech Understanding Performance in Quiet and Noise in High Performing Cochlear Implant Users

Jason A. Brant, MD; Hannah Kaufman, AuD
Michael J. Ruckenstein, MD

Objective: To correlate the characteristics of cochlear implant patient's performance on AzBio sentence testing in quiet and noise.

Study Design: Retrospective review of a prospectively collected database.

Setting: Tertiary care hospital.

Patients: All patients who underwent unilateral cochlear implantation at a single center with AzBio testing.

Interventions: Cochlear implantation.

Main Outcome Measures: AzBio performance scores in quiet at +10 and +5 decibels signal to noise (dB S/N).
Results: 185 subjects met inclusion criteria with scores for AzBio in quiet, 114 at + 10 dB S/N, and 66 at +5 S/N. Linear mixed effects models showed a significant correlation of performance with time since activation in all conditions (8.4%/year; $p < 0.0001$). Strong correlations between mean performance by subject in quiet and at +10 dB S/N ($r = 0.77$, $p< 0.0001$), and between +10 dB S/N and +5 dB S/N ($r = 0.73$, $p < 0.0001$) were found. However the correlation between quiet and +5 dB S/N ($r = 0.45$, $p = 0.01$) was less robust. Shapiro-Wilks test of normality found only +10 dB S/N to correspond to a normal distribution. Skew analysis demonstrated values of -0.64, -0.11, and 0.8 for quiet, +10 dB S/N, and +5 dB S/N, respectively.

Conclusions: AzBio scores in noise at +10 dB S/N show a strong correlation with those in quiet but avoid the ceiling effects that may limit the utility of the latter. Thus, we recommend AzBio administered in +10 dB S/N as the primary evaluation for adult patients undergoing cochlear implant assessment.

Define Professional Practice Gap and Educational Needs: Lack of a gold standard for the testing and reporting of cochlear implant user performance for clinical and research purposes.

Learning Objective: Further define the best tool to measure the performance of cochlear implant users.

Desired Result: Consideration of the AzBio sentence test in +10 dB S/N as the preferred test for cochlear implant user performance.

IRB or IACUC Approval: Approved

G004

Optimizing Auditory Performances and Programming Parameters with Scala Vestibuli Cochlear Implantation in Partially Ossified Cochleae

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Noémie Villemure-Poliquin, BS; Daniel Philippon, MD
Richard Bussières, MD

Objectives: To compare scala vestibuli versus scala tympani cochlear implantation in terms of postoperative auditory performances and programming parameters in patients with severe scala tympani ossification.

Study design: Retrospective case-control study

Setting: Tertiary referral center

Patients: 97 pediatric and adult patients who underwent cochlear implant surgery since 2009. Three groups were formed: a scala vestibuli group, a scala tympani with ossification group, and a scala tympani without ossification group. Patients were matched based on their age, gender, duration of deafness and side of implantation (ratio of 1:2:2).

Interventions: Postoperative evaluation of auditory performances and programming parameters following intensive functional rehabilitation program completion.

Main outcome measures: Multimedia Adaptive Test (MAT), Hearing in Noise Test (HINT SNR +10dB), electrical impedances, neural responses treshold (NRT), C-level and T-level were compared between groups.

Results: 19 patients underwent scala vestibuli cochlear implantation: 17 adults and 2 children. Auditory performances were similar between groups, although sentence recognition in both a quiet and a noisy environment were slightly improved in the scala vestibuli group (MAT = 76.6% vs. 69.2%; HINT SNR +10dB = 62.1% vs. 57.2%). Programming parameters were also similar between groups and no statistically significant difference in electrical impedances, NRT, C-level and T-level could be found.

Conclusion: We present the largest series of patients with scala vestibuli cochlear implantation. This approach allows optimization of auditory performances, without having any deleterious effects on programming parameters. This viable and useful insertion route might be the primary surgical alternative when facing partial cochlear ossification.

Define Professional Practice Gap and Educational Needs: Lack of contemporary knowledge regarding impacts of scala vestibuli cochear implantation on postoperative auditory performances and programming parameters in patients with severe scala tympani ossification.

Learning Objective: To describe postoperative auditory performances and programming parameters in patients with severe scala tympani ossification implanted in the scala vestibule, and to compare these results with scala tympani cochlear implantation.

Desired Result: Attendees will understand the potential clinical benefits and the surgical role of scala vestibuli cochlear implantation in partially ossified cochleae.

IRB or IACUC Approval: Exempt

G005

Do Adaptive Dual-Microphone Beamformers Improve Understanding Speech in Noise for Cochlear Implant Recipients and Bimodal Listeners?

Richard Gurgel, MD; Lisa Dahlstrom, AuD
Smita Agrawal, PhD

Objective: To evaluate the performance of adaptive dual-microphone beamformers for understanding speech in noise in cochlear implant (CI) recipients and in bimodal listeners who use a CI in one ear and a hearing aid (HA) designed specifically for use with that CI in the contralateral ear.

Study design: Prospective within-subjects repeated-measures.

Setting: Tertiary-care center

Patients: Ten adult CI recipients (3 unilateral, 7 bilateral; median age 73 years) and eight adult bimodal listeners (CI plus contralateral HA; median age 81 years).

Main outcome measure: Sentence perception in multi-talker babble (S0N0) was compared between omnidirectional microphones (T-Mics) and adaptive dual-microphone beamformers. Bimodal participants were tested with a HA compatible with the CI. The HA was programmed with a unique bimodal fitting formula and implemented a beamformer matched to that of the CI sound processor. Each subject was tested at an individually determined signal-to-noise ratio that reduced the speech score to approximately one-half the score in quiet (range: -2 to 11 dB SNR).

Results: Both groups demonstrated significant improvement in sentence recognition when listening with adaptive dual- microphone beamformers compared to omnidirectional microphones (CI users: 33.5%, bimodal listeners: 27.7%; $p<0.001$). Bimodal listeners also reported immediate acceptance and improved sound quality with the matched HA. A 13% bimodal benefit ($p<0.005$) was experienced even when using just the omnidirectional microphones in the CI and HA.

Conclusion: Adaptive beamforming technology can make hearing in noisy environments significantly easier for CI users and bimodal listeners.

Define Professional Practice Gap and Educational Needs: Lack of awareness of the degree of communication benefit that can be experienced when using adaptive dual-microphone beamforming technology (1) in cochlear implants and (2) in bimodal listeners who use a cochlear implant and a new hearing aid specifically designed to work in concert with a cochlear implant.

Learning Objective: To describe speech in noise hearing outcomes in CI recipients and bi-model listeners using dual- microphone beamforming technology.

Desired Result: Attendees will appreciate how enabling matched beamforming technology makes hearing easier for individuals who use cochlear implants or who use a cochlear implant plus a compatible hearing aid.

IRB or IACUC Approval: Approved

G006

Failure Rate in Pediatric Cochlear Implantation, and Hearing Results following Revision Surgery

Philip Gardner, MD; Brian P. Perry, MD
Robyn Shanley, PhD, AuD

Objective: To demonstrate the failure rate and hearing results following pediatric cochlear re-implantation. Study Design: Retrospective chart review of all pediatric cochlear implant surgery done between 2004-2014. Setting: Private Neurotology Practice
Patients: All patients under the age of 18 years having cochlear implantation performed between 2004 and 2014, with a device failure. A total of 579 implants were performed during the study period. 27 patients had implant device failures. Four patients experienced failure bilaterally (sequentially), for a total of 31 device failures. Of these, 2 devices were replaced due to infection and an additional 2 devices were replaced due to electrode migration. The remaining 27 failures were due to device malfunction.

Interventions: Revision cochlear implantation surgery. Audiometric testing pre and post operatively.

Main outcome measure: 1) rate and etiology of cochlear implant failure 2) Pure tone average, speech discrimination score, and sentence testing results prior to implant failure, and after re-implantation.

Results: An overall failure rate of 5.4% was identified. The most common reason for failure was device malfunction, followed by infection, and electrode migration. Audiometric data demonstrate equivalent or better results post- operatively, when compared to pre-failure data.

Conclusions: The device failure rate of pediatric cochlear implantation is 5.4%, making it the most common long term complication. Fortunately, audiometric data demonstrate equivalent or better results following revision surgery, than pre- failure data.

Define Professional Practice Gap and Educational Needs: The device failure rate of pediatric cochlear implantation is poorly documented in the literature. There is limited data on the hearing outcomes following revision cochlear implant surgery.

Learning Objective: We will report our experience with cochlear implant device failure due to malfunction, electrode extrusion, and infection in a large pediatric population. Additionally, we will report hearing results following revision surgery, in comparison to the best aided responses prior to device failure.

Desired Result: Participants will be able to discuss the risks of device failure, as well as potential hearing results following failure, with family members preoperatively.

IRB or IACUC Approval: Exempt

G007

Verbal Learning and Memory Abilities in Adults with Cochlear Implants

Arthur Broadstock, BS; Aaron C. Moberly, MD

Hypothesis: Verbal learning and memory abilities, measured using the California Verbal Learning Test-II (CVLT), will predict speech recognition abilities in postlingually deafened adult cochlear implant (CI) users. Secondly, adults with prolonged, severe-to-profound hearing loss will exhibit poorer verbal learning and memory abilities than age-matched normal hearing (NH) adults.

Background: To understand degraded speech, such as through a CI, the listener must utilize language knowledge and cognitive abilities to interpret the incoming signal. This study investigated verbal learning and memory abilities as predictors of sentence recognition in adults with CIs.

Method: Thirty adults with CIs and thirty age-matched NH controls underwent testing of verbal learning and memory abilities using a visual presentation of the CVLT. Speech recognition abilities were measured using word and sentence recognition in quiet. NH controls listened to 8-channel vocoded versions of the same speech materials.

Results: Primary CVLT outcomes did not differ between CI and NH adults. Duration of deafness in CI users was negatively correlated with process measures of learning (Total Learning Slope), delayed recognition of visually presented words (Yes/No Recognition), and cued recall (Short-Delay Cued Recall, SDCR) scores were positively correlated with speech recognition measures only in the CI group.

Conclusions: Duration of deafness negatively impacted verbal learning and memory abilities in CI users, independent of age-related cognitive decline. Components of the CVLT, namely Yes/No Recognition and SDCR, may possess utility as prognostic indicators of speech recognition abilities and could function as a pre-operative screening tool for CI outcomes.

Define Professional Practice Gap and Educational Needs: 1. Lack of knowledge of the effects of hearing loss on non- auditory verbal learning and memory processes. 2. Lack of awareness of the role of non-auditory verbal processing skills on speech recognition outcomes for adults with cochlear implants.

Learning Objective: 1. Attendees will have a better understanding of the effects of a prolonged period of hearing loss on non-auditory verbal processing skills. 2. Attendees will be more aware of the role of non-auditory processing skills in speech recognition outcomes for adults who use cochlear implants.

Desired Result: Attendees will be more aware of the effects of hearing loss on underlying verbal processing skills for their patients with cochlear implants, and they will consider during patient counseling that these skills contribute to cochlear implant speech recognition outcomes.

IRB or IACUC Approval: Approved

G008

Sentence Recognition in Noise and Two-Talker Speech: Effects of Listener Age and Semantic Context

Sarah E. Hodge, MD; Kevin D. Brown, MD, PhD
John H. Grose, PhD; Emily Buss, PhD

Hypothesis: Semantic context affects masked sentence recognition differently depending on masker type and listener age.

Background: Complex auditory environments limit a listener's ability to perceive target speech. Young children and older adults are more susceptible to masking than young adults. Previous data on adults indicate that semantic context facilitates speech recognition, but it is unknown how context affects performance for young children.

Methods: Listeners were children (5-17 yrs), young adults (18-45 yrs), and older adults (>65 yrs), all with normal or near-normal hearing. The task was to repeat target sentences presented either in a steady speech-shaped noise or a two- talker masker. Target sentences were either semantically correct (high context) or semantically anomalous (low context). The masker was presented at 60 dB SPL, and the signal level was adjusted adaptively to estimate threshold.

Results: Thresholds were lower for young adults than either children or older adults. This age effect was more pronounced for the two-talker masker than the noise masker. As previously observed in adults, thresholds tended to be lower for targets with high rather than low semantic context. The one exception was for young children tested in the two- talker masker, where little or no effect of semantic context was observed.

Conclusion: Both target and masker features impact speech perception, with different effects observed at different points across the lifespan. While the two-talker masker was particularly challenging for young children and older adults, it also appears to limit the use of semantic context preferentially in young children.

Define Professional Practice Gap and Educational Needs: There's growing recognition in the literature that speech perception is severely limited by speech maskers. However, current clinical assessments do not typically assess performance in those types of conditions. This study focuses on evaluating speech perception performance in a two-talker masker for listeners across the lifespan.

Learning Objective: To understand age effects for sentence recognition in both high and low semantic context sentences in two types of background maskers: noise and two-talker speech. Semantic context (the situational meaning of words in a sentence) can reduce masking under certain conditions though it requires cognitive resources for utilization which vary across age groups.

Desired Result: Ultimately, a better ability to evaluate functional hearing across the lifespan. The results of this study could additionally help by stressing the need for better counseling and education of patients and their families regarding complex auditory environments and how these can affect their understanding of speech.

IRB or IACUC Approval: Approved

G009

Development and Preliminary Validation of the Speech Enjoyment Instrument (SEI): A Tool to Assess Speech Quality

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John S. Nemer, BS; Jaclyn B. Spitzer, PhD
Anil K. Lalwani, MD

Objective: While speech perception tests are commonly used to evaluate hearing, no standardized test exists to quantify speech quality. The objective is to develop a new tool to evaluate the quality of speech.

Study design: Prospective instrument validation.

Setting: Tertiary referral center.

Patients: 20 normal hearing adults.

Intervention: Subjective rating of speech excerpts.

Main outcome measures: Participants listened to 44 speech clips of male/female voices reciting the "Rainbow" passage. Speech clips included original and manipulated excerpts capturing goal qualities such as "mechanical" and "garbled". Listeners rated clips on a 10-point visual analog scale (VAS) of 18 characteristics (e.g. cartoonish, garbled).

Results: Skewed distribution analysis identified mean ratings in the upper and lower 2-point limits of the VAS (ratings of 8-10, 0-2 respectively); items with inconsistent responses were eliminated. The test was pruned to a final instrument of 9 speech clips that clearly define qualities of interest: speech-like, male/female, cartoonish, echo-y, garbled, tinny, mechanical, rough, breathy, soothing, hoarse, like, pleasant, natural. Mean ratings were highest for original clips (8.46) and lowest for "not speech" manipulation (1.98). Principal factor analysis identified two subsets of characteristics (Scree); internal consistency demonstrated Cronbach's alpha of 0.93 and 0.70 per subset. Validity was achieved during instrument design and confirmed using correlation analysis (Spearman's coefficient>0.4).

Conclusions: The Speech Enjoyment Instrument (SEI) is a concise, valid tool for assessing speech quality as an indicator for hearing performance. SEI may be a valuable outcome measure for cochlear implantees who despite achieving excellent speech perception, often experience poor speech quality.

Define Professional Practice Gap and Educational Needs: Lack of standardized test to evaluate speech quality Learning Objective: Gain knowledge of a valuable tool that may be used clinically to evaluate the quality of speech Desired Result: Application of the tool to evaluate patients as another metric for hearing performance

IRB or IACUC Approval: Approved

G010

First Impressions Matter in Ménière's Disease: Observation from Early vs Late Head Thrusts

Nicole T. Jiam, BA; John P. Carey, MD

Objective: To evaluate changes in angular vestibulo-ocular reflexes (AVOR) and refixation saccades (RFS) during serial head thrust (HTs) in patients with unilateral Ménière's disease (MD).

Study Design: Cross-sectional study

Setting: Tertiary referral center

Patients: 15 subjects with poorly controlled unilateral MD prior to gentamicin treatment

Main Outcome Measures: We measured the three-dimensional horizontal AVOR with scleral search coils during a series of ~20 HTs in 15 patients and compared results from the first three and the last three trials in each direction. AVOR gains were obtained by averaging the ratio of eye velocity/head velocity during the 30 ms prior to peak head velocity for each trial. Refixation saccades were recorded for up to 500 ms after onset of the head impulse.

Results: For HTs exciting the ipsilateral (MD) horizontal canal, the number of RFS decreased over time between first three and last three trials ($p=0.018$), whereas no decrease was found for HTs exciting the contralateral side ($p=0.4$). There was a trend for the first three trials toward the ipsilateral ear to have higher RFS velocity ($p=0.055$), as well as a trend within the first 3 trials for lower gain ipsilaterally (0.84 ± 0.20) vs contralaterally (0.93 ± 0.12, $p=.059$).

Conclusion: Patients with Ménière's disease demonstrate subtle evidence of AVOR weakness during the first three head thrusts toward the ipsilateral ear. Rapid adaptation to repeated stimuli can actually obscure the deficit. Thus, in bedside testing, careful attention must be given to proper execution and interpretation of RFSs for the first few trials.

Define Professional Practice Gap and Educational Needs: 1. A lack of awareness of the differences in early versus late head thrusts in people with Ménière's Disease. 2. Inconsistencies within the execution and interpretation of refixation saccades in serial head thrusts.

Learning Objective: To better understand the changes in angular vestibulo-ocular reflexes (AVOR) and refixation saccades (RFS) during serial head thrust (HTs) in patients with unilateral Ménière's disease (MD).

Desired Result: Attendees will be familiar with the subtleties and observable differences in early versus late head thrusts in people with Ménière's disease. They will understand the importance of proper execution of the head impulse test and interpretation of refixation saccades early on in bedside testing.

IRB or IACUC Approval: Approved

G011

Heat Generated During Temporal Bone Drilling: Is The Facial Nerve at Risk?

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Jason Mitchell, MS; Robert F. Labadie, MD, PhD

Hypothesis: During mastoidectomy, bone temperatures can rise to unsafe levels presenting risk of injury to the facial nerve.

Background: Prior work in animal models has shown that temperature elevation above 60°C for 20-30 seconds may result in injury to motor cranial nerves. With new drill technology (specifically high-speed electric drills) and minimally- invasive and endoscopic approaches where irrigation becomes increasingly difficult to maintain, we sought to quantify temperatures associated with clinically-relevant mastoid drilling conditions.

Methods: Temperature recordings of mastoidectomies were performed using a thermal camera (FLIR Systems, Inc.) at three different locations of three temporal bone specimens (cortical bone, pneumatized bone, and facial recess bone), using different drill bits (fluted versus diamond), applying varying levels of pressure to the bone (regular and aggressive), and with/without irrigation.

Results: Drilling cortical and pneumatized bone with fluted drill bits raised the temperature to 30-35°C without irrigation when applying regular pressure to the bone. Drilling with diamond bits in these areas and at the level of the facial recess resulted in temperature recordings above 90°C within 2 seconds while applying regular pressure in the absence of irrigation.

Conclusions: Temperatures that represent a risk for thermal injury to the facial nerve may be reached within 2 seconds when drilling with diamond bits without irrigation. Continuous irrigation is recommended when drilling in close proximity to the facial nerve to minimize risk of heat injury. From a heat standpoint, irrigation is not necessary when drilling pneumatized bone.

IRB or IACUC Approval: Exempt

Define Professional Practice Gap and Educational Needs: 1. Lack of awareness of amount of heat generated during routine temporal bone drilling and whether or not this may represent a real risk to produce heat injury to the facial nerve. 2. Lack of contemporary knowledge of how much water can cool down high temperatures during drilling.

Learning Objective: 1. Participants will recognize circumstances when high and "risky" temperatures are more likely to occur during temporal bone drilling. 2. Participants will interpret the coolant effect of water and the benefits of its use during temporal bone drilling.

Desired Result: 1. Participants will use a particular drill bit in combination with a coolant (water) during critical portions during a mastoidectomy. 2. Participants will estimate how often small breaks can and should be provided while drilling along the facial nerve recess in order to avoid risk of heat injury to the facial nerve.

IRB or IACUC Approval: Exempt

G012

Delineating Hearing Loss at Radiographic Diagnosis in EVAS (Enlarged Vestibular Aqueduct Syndrome)

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Maroun Semaan, MD

Objectives: 1: Compare audiometric data between two radiographic diagnostic criteria for enlarged vestibular aqueduct syndrome (EVAS). 2: Determine relationship between air bone gap (ABG) with the size of vestibular aqueduct.

Study design: Retrospective chart review

Setting: Tertiary academic otology practice

Patients: Patients with hearing loss who had imaging of temporal bone

Intervention(s): None

Main outcome measure(s): Correlating speech recognition threshold (SRT), word recognition score (WRS), air bone gap (ABG) with the size of vestibular aqueduct (VA)

Methods: Linear models predicting SRT or WRS using VA midpoint width were studied. A Welch two-sample t-test with continuity correction was performed to evaluate for a difference in VA midpoint width for patient with versus without an ABG. A linear model predicting ABG using VA midpoint width was also constructed. All analysis was performed using R statistical programming language version 3.3.0.

Results: 102 ears were identified. Fifty-eight had EVA according to the Valvassori criterion (midpoint ≥1.5 mm), 75 had EVA according to the Cincinnati criteria (midpoint ≥0.9 mm or operculum ≥1.9 mm) and 27 ears did not meet any criteria for EVAS. Of the 102 ears, 46 ears were found to have sufficient audiometric data to calculate ABG. Out of these 46 ears, 24 demonstrated an ABG. SRT and WRS were not significantly related to diagnosis by Cincinnati criteria alone versus diagnosis by Cincinnati and Valvassori criteria ($p = 0.21$ and 0.09 respectively). The mean VA size in ears with ABG was 2.42 mm, compared to 2.28 mm in without ABG ($p = 0.63$). There was also no statistically significant relationship between VA midpoint size and size of ABG ($p = 0.24$).

Conclusions: In patients with EVAS, there is no statistically significant difference in SRT and WRS between the two radiographic diagnostic criteria. In this same patient population, ABG does not correlate with VA size.

Define Professional Practice Gap and Educational Needs: At present, audiometric significance of different radiographic criteria for EVAS in unknown.

Learning Objective: To analyze audiometric outcomes between two commonly used criteria for radiographic diagnosis of EVAS

Desired Result: There is no significant difference in the size of vestibular aqueduct and degree of hearing loss at the time of radiographic diagnosis of EVAS

IRB or IACUC Approval: Approved

G013

Preoperative Imaging Findings and Cost in Adults with Postlingual Deafness Prior to Cochlear Implant

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Objective: To assess the imaging findings of computed topography (CT) and magnetic resonance imaging (MRI) in adults with post-lingual deafness and otherwise normal clinical history and physical exam. Additionally, determine the effects and implications of these findings with respect to surgical outcomes and cost.

Study Design: Retrospective case review

Setting: Tertiary referral hospital

Patients: Adults with post-lingual deafness that had no history of prior ear surgery, meningitis, otosclerosis, or head trauma.

Interventions: Cochlear implantation of one or both ears, having received preoperative workup with CT, MRI, or both.

Main outcome measures: Imaging results were classified as normal, abnormal affecting surgery, incidental requiring follow up, or incidental not requiring follow up. The average cost of each imaging modality was determined.

Results: A total of 128 patients met the inclusion criteria. Of these, 82 (64.1%) had both CT and MRI performed, 33 (25.8%) had CT, and 13 (10.2%) had MRI prior to cochlear implant (CI). Scans were normal in 114 (89.1%) of cases. Of the remaining 14, 11(8.6%) had incidental findings not requiring follow up, therefore 97.7% of scans did not provide any benefit. Three (2.3%) had incidental findings requiring follow up. All implants were placed successfully, and in no instance did the results of the scan influence the surgery. Average cost of imaging per patient was $5146 USD.

Conclusion: In adults with post-lingual deafness with an otherwise benign clinical history, CT and MRI are unlikely to demonstrate findings that affect or preclude surgery. With new MRI safe cochlear implants, imaging can be performed safely post-operatively if needed.

Define Professional Practice Gap and Educational Needs: There is currently a lack of standardization of practice in obtaining imaging prior to cochlear implant. Multiple studies have shown that MRI and CT scans can identify abnormalities that alter surgical planning in pediatric patients. However, this same principle has not been proven true or false in adult patients with postlingual deafness. Surgeons obtain scans based on their own clinical experience, but there is not consensus amongst providers or institutions.

Learning Objective: To provide evidence that the findings on CT and MRI in adults with postlingual deafness with an otherwise benign clinical history do not influence surgical planning.

Desired Result: To give providers evidence to support decision making when considering what, if any, scans to obtain prior to cochlear implant surgery.

IRB or IACUC Approval: Approved

G014

Evaluation of Trainee Drill Motion Patterns during Temporal Bone Simulation with 3D Printed Models

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Hypothesis: Resident surgeon drill motion patterns during dissection of a printed and cadaveric temporal bone model are anticipated to be dissimilar owing to material properties.

Background: Virtual haptic and physical printed temporal bone simulations are commonly used to augment cadaveric training. Assessment of these tools is ongoing with a strong trainee preference for physical simulations. Trainees using virtual haptic models illustrate disparate drill motion patterns compared to cadaveric opportunities, which could result in maladaptive skill development.

Methods: Resident surgeons dissected printed bones generated from microCT data and cadaveric specimens. Skill assessment was clustered into cortical mastoidectomy, thinning procedures (sigmoid sinus, dural plate, posterior canal wall) and development of a posterior tympanotomy. A magnetic position tracking system (TrakSTAR, Ascension) captured drill position and orientation at 200Hz. Dissection was performed by 8 trainees ($n=5 < PGY3 > n=3$) using kcos-metrics to analyze drill strokes within position recordings.

Results: t-tests between models showed no significant difference in drill stroke frequency (cadaveric=1.36/s, printed =1.50/s $p=0.420$) but demonstrate significantly shorter duration (cadaveric=0.37s, printed =0.16s $p<0.05$) and a higher percentage of curved strokes (cadaveric= 31, printed =67 $p<0.05$) used in printed dissection procedures. Junior staff used a higher number of short strokes (junior = 0.54, senior =0.38, $p<0.05$) and higher percent of curved strokes (junior = 35%, senior =21%, $p<0.05$).

Conclusion: Significant differences in hand motions were present between the cadaveric specimens and printed simulations, questioning the employ of printed simulations as viable teaching instruments. Junior staff appear to adopt a more cautious approach to dissection.

Define Professional Practice Gap and Educational Needs: 1. Lack of experience incorporating alternate surgical training modalities. Lack of knowledge in describing potential (dis)advantages to using 3D and Haptic temporal bone models. Lack of experience in describing potential differences between 3D/Haptic models and cadaveric bone for training purposes.

Learning Objective: 1. Identify and describe alternate models for temporal bone surgical training. Explain the advantages and disadvantages of using 3D versus Haptic temporal bone models. Explain the potential advantages and disadvantages of using an artificial temporal bone model versus cadaveric specimens for surgical training.

Desired Result: 1. Potentially incorporating the use of 3D or Haptic temporal bone models in their programs as a comparison to cadaveric bone. 2. Evaluating surgical skill on temporal bone drilling on different platforms (cadaveric versus 3D/Haptic bone models) based on surgeon's experience level.

IRB or IACUC Approval: Approved

G015

High-Fidelity 3-Dimensional Middle Ear Model for Stapedectomy Simulation

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Hypothesis: Development of a high-fidelity stapedectomy model that will prove to be beneficial in providing the training necessary for actual stapedectomy surgical cases can be accomplished utilizing micro-computed tomography, computer- aided design and 3-dimensional printing techniques.

Background: Stapedectomy is a technically challenging procedure, and hearing outcomes have repeatedly been correlated with surgeon experience. Simulation of critical steps during this procedure allows for the progressive training necessary to enhance hearing outcomes. Micro-computed tomography and refinements in the 3-dimensional printing process facilitate the modeling of intricate middle ear anatomy at low cost.

Methods: From a high resolution render of a temporal bone captured using micro-computed tomography, a 3D model of the middle ear was generated utilizing a combination of Slicer 4.4 and MeshLab 1.3 software. Multi-material models of the middle ear were then printed with an Objet350 Connex (Stratasys) with attention to anatomic details relevant to critical steps in the stapedectomy procedure. Pressure sensors were integrated to allow for determination of maximum and cumulative force during fenestration and prosthesis placement.

Results: Middle ear anatomic detail and replication of critical steps in the stapedectomy procedure are reliably represented by the model developed for this study.

Conclusions: Simulated stapedectomy surgical models created by this process will have benefit in development of technical skill required during this challenging otologic procedure. Improvement in task performance may be tracked over time with serial utilization of this surgical model. 3D printed technology allows for inexpensive model reproduction, making it easily accessible for use in multiple teaching institutions.

Define Professional Practice Gap and Educational Needs: 1. No current ubiquitously utilized stapedectomy model in practice 2. Inconsistencies with focus of existing stapedectomy simulators

Learning Objective: Improved surgical technique during critical steps of a challenging otologic procedure Desired Result: Integration of high-fidelity, low-cost stapedectomy simulator as part of training program

IRB or IACUC Approval: Exempt

G016

Quality of Life following the Management of Paragangliomas of the Head and Neck

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Objective: The objectives of this study were to assess post-treatment quality of life (QOL) associated with head and neck paragangliomas using self-reported quality of life tools.

Methods: 103 patients previously treated for paraganglioma of the head and neck were identified from a clinical database within a large London teaching hospital. Sixty-one patients (58% response rate) with seventy-two tumours accepted a postal invitation to participate and completed seven QOL related measures (Hospital Anxiety and Depression Scale, Tinnitus Handicap Inventory, Hearing Handicap Inventory, MD Anderson Dysphagia Inventory, Swallowing Quality of Life questionnaire, Facial Clinimetric Evaluation Scale, Medical Outcomes Study 36 item Short Form).

Results: Patients previously treated for or with paragangliomas of the head and neck demonstrated a range of impairment of quality of life in all the domains assessed. Significant differences in quality of life were observed across the tumour subtypes.

Conclusion: The findings demonstrate the presence of a degree of functional impairment, associated with a decrease in quality of life in this population. Paraganglioma patients have some residual disability post-treatment emphasizing the importance of appropriate management of expectations.

Define Professional Practice Gap and Educational Needs: Lack of awareness by physicians and patients regarding the multitude of problems faced by paraganglioma patients post operatively

Learning Objective: To make practitioners more aware of the difficulties patients encounter post operatively following paraganglioma surgery so that they may better council their patients and manage expectations

Desired Result: To supplant practitioners who offer paraganglioma surgery to patients with objective evidence regarding the post-operative quality of life issues associated with treatment to help better guide patients treatment decisions and manage post surgical expectations

Level of Evidence: 2b

Keywords: Quality of Life; Paraganglioma, Tympanic Paraganglioma, Jugular Paraganglioma, Vagal Paraganglioma, Carotid Paraganglioma, non-chromaffin

IRB or IACUC Approval: Approved

G017

High-Fidelity Surgical Middle Ear Simulator: A Pilot Study

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Hypothesis: Surgical training using both a low-fidelity and high-fidelity, inexpensive surgical middle ear simulator can improve surgical novices' techniques to a near expert level.

Background: Utilizing additive manufacturing techniques, a high-fidelity three-dimensional middle ear model was created with great face validity as determined by experts. This simulator, in addition with a low-fidelity model, can be used to train novices in basic middle ear surgical technique. This method of training is particularity useful given changes in resident training guidelines.

Methods: Surgical novices (School of Health Sciences students) volunteered to participate in a three-hour training protocol utilizing a training video and both models. Baseline dexterity was determined using pegboard timed tests. Their baseline as well as three additional videos are used to track their progress through the basic steps of otosclerosis surgery. Videos were graded by two blinded experts using a validated scale following objective skills assessment test (OSAT) format. Expert level was determined by grading the video performed by our Principal Investigator.

Results: Twenty-nine novices completed the protocol. Preliminary analysis indicates that subjects improved significantly to near expert levels using only eleven high-fidelity cartridges each (P=0.02 95% CI 0.8-3.78). In addition, improvement in serial pegboard attempts is predictive of improvement on the middle ear simulator.

Conclusions: This pilot demonstrates that novice subjects who have never used an operative microscope before were able to achieve scores similar to an expert by training with the high-fidelity middle ear simulator. The application of this tool is far reaching and may help advance the training of middle ear surgery to a standardized and safe level. In the future, it may serve as a measurement tool to assess surgical capacity of otologic surgeons. Construct validity studies are proceeding after obtaining these encouraging results.

Define Professional Practice Gap and Educational Needs: 1. Lack of high-fidelity middle ear training models

Learning Objective: To train novices in middle ear surgery technique to near expert level using a high-fidelity middle ear training model

Desired Result: To advance the training of middle ear surgery to a standardized and safe level. In the future, it may serve as a measurement tool to assess surgical capacity of otologic surgeons.

IRB or IACUC Approval: Exempt

G018

Anatomical Relationship of the Middle Cranial Fossa Dura to Surface Landmarks of the Temporal Bone

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Hypothesis: The suprameatal crest provides a reliable landmark to the middle fossa dura.

Background: Surface anatomy of the temporal bone is used to guide mastoid surgery, but studies investigating these landmarks are limited. The aim of this study was to examine the anatomical relationship of the middle fossa dura to the suprameatal crest.

Methods: 28 fresh hemi-cephalic temporal bones were prepared by drawing 4 lines along the mastoid including the suprameatal crest (line 1), one line 5 mm above (line 2) and one 5 mm below line 1 (line 3), and at Reid's base line (line 4). 4 points were marked along these lines anterior to posterior 3 mm apart. A 1 mm bur was used to drill perpendicular to these points to examine the relationship to the middle fossa dura.

Results: The dura was found below line 1 in 3.57% at point 1, 3.57% at point 2, 7.14% at point 3, and 17.9% at point 4.
The dura in line 2 was found below point 1 in 57.14%, point 2 in 50%, point 3 in 60%, and point 4 in 68%. Only one specimen (3.57%) had dura lying completely below line 3.

Conclusions: The dura of the middle fossa lies above the suprameatal crest in 95% of specimens and at least 5 mm above in nearly half. The slope of the dura also becomes more inferior more posteriorly. This indicates the suprameatal crest is a reliable landmark for the middle fossa dura.

Define Professional Practice Gap and Educational Needs: Limited studies defining the relationship of the middle fossa dura to surface landmarks of the temporal bone, such as the suprameatal crest

Learning Objective: Understand the relationship of the middle fossa dura to the suprameatal crest Desired Result: Optimize the safety of mastoid surgery regarding localization of the middle fossa dura IRB or

IACUC Approval: Exempt

G019

Electrode Length and Long Term Hearing Preservation in Cochlear Implantation

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Objective: To review the results of hearing conservation and outcomes following implantation with the Cochlear L24, 422 and 522 cochlear implant.

Study design: Retrospective case review

Setting: Tertiary referral center

Patients: Thirteen post-lingual patients (fourteen ears) with bilateral high frequency sensorineural hearing loss who met hybrid cochlear implant criteria. All patients had been previous hearing aid users and had increasing difficulty in hearing aid use.

Intervention: Implantation with the Cochlear L24, 422 and 522 device in patients who met hybrid cochlear implant criteria.

Main outcome measures: Hearing conservation at initial follow up, hearing preservation at subsequent follow-up appointments, and durability of hybrid stimulation following implantation.

Results: Thirteen patients with a total of 14 ears who met hybrid candidacy underwent cochlear implantation with the, L24 422 or 522 array. Initial hearing preservation was achieved in 78.6% of patients. Average follow up for all patients is 13.6 months. Two patients lost hearing in the implanted ear at 21 months (L24) and 35 months (422) respectively. Average follow up with patients utilizing hybrid stimulation is 14.2 months. The patient with delayed hearing loss and the 422 electrode has been successfully reprogrammed for full cochlear coverage; however, the L24 patient will require reimplantation.

Conclusions: For patients meeting hybrid cochlear implant candidacy utilization of the L24,422 and 522 allows for high rates of residual hearing preservation and durability of that conservation. However, for patient with delayed loss of residual hearing, more complete coverage of the cochlea facilitates full cochlear stimulation without additional surgery.

Define Professional Practice Gap and Educational Needs: 1. Discuss long term hearing outcomes with cochlear implants and the impact of electrode array length. 2. Present data which demonstrates that durable hearing preservation and hybrid stimulation is possible with longer length electrodes.

Learning Objective: 1. Attendees will become knowledgeable regarding the utilization of longer length cochlear implant electrode arrays in hearing conservation procedures. 2. Attendees will see that durable hearing preservation is possible with longer electrodes which provide greater cochlear coverage.

Desired Result: 1. Attendees can utilize the information from the presentation in their practice and have a greater selection of electrode arrays to offer patients who are candidates for hybrid stimulation.

IRB or IACUC Approval: Approved

G020

Development and Validation of a Low-Cost Modular Endoscopic Ear Surgery Skills Trainer

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Objective: Endoscopic ear surgery (EES) is an emerging technique requiring single-handed dissection with limited depth perception. Current options for EES simulation are, however, limited. Herein, we introduce a versatile, low-cost surgical skills trainer that aims to improve fine motor control with EES instrumentation.

Study Design: Prospective validation study

Setting: Simulation laboratory

Participants: Seven subjects ranging in experience from medical students to experienced ear surgeons participated in the validation study. Experts (n=3) were defined as performing 10-50 EES cases per year.

Methods: The skills trainer was constructed from a 3" diameter PVC pipe cap modified with two ports for instrument passage. A wooden platform was placed inside at an appropriate working distance for ear surgery. Eight interchangeable skills modules were fabricated on wooden squares (1.5''x1.5'') using materials such as #19 wire brads, 1.6mm glass beads, and 26-gauge jewelry wire. The material cost of this re-usable model was $15. Subjects completed each timed skills module in triplicate and completed a Likert-based survey.

Results: Expert performance was superior to novices in 100% (8/8) of skills modules, i.e. threading beads on a wire (43 vs. 127 seconds, $p<0.001$) and placing a simulated prosthesis (13 vs. 68 seconds, $p=0.006$). Most participants (86%) agreed the skills trainer orientation was accurate and all participants (100%) were satisfied with the experience.

Conclusions: This low-cost modular skills trainer may help fill a void in otolaryngology education by allowing efficient, deliberate practice of validated exercises designed to improve fine motor control with EES instrumentation.

Define Professional Practice Gap and Educational Needs: Lack of available methods to practice endoscopic ear surgery techniques

Learning Objective: Improve knowledge of the role of simulation and surgical trainers for endoscopic ear surgery education.

Desired Result: Improved ability to practice endoscopic ear surgery techniques

IRB or IACUC Approval: Exempt

G021

Self-Reported Executive Functioning and Sentence Recognition Skills in Postlingually Deafened Adult Cochlear Implant Users

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Aaron C. Moberly, MD

Hypothesis: An enormous amount of unexplained variability in speech recognition outcomes exists among postlingually deafened adults following cochlear implantation. Our research hypothesis was that executive functioning (EF) skills account for a portion of this unexplained variance.

Background: Executive functions, such as working memory and inhibition-concentration, are increasingly identified as contributors to speech recognition in older adults with hearing loss, and particularly in CI users. In the present study, we sought to examine the predictive value of self-reported EF skills on sentence recognition scores in adult CI users.

Methods: Thirty postlingually deafened adults with CIs and thirty age -matched normal-hearing (NH) peers were enrolled. Participants completed two well-validated checklists examining EF in everyday life: the BRIEF (Behavior Rating Inventory of Executive Function) and the LEAF (Learning, Executive, and Attention Functioning) scales. CI users' speech recognition skills were assessed in quiet using several measures of sentence recognition along with recognition of isolated words. NH peers were tested using noise-vocoded versions of the same speech stimuli.

Results: Compared with NH peers, CI users self-reported more difficulty on tasks requiring comprehension and conceptual learning and reading skills. In quiet, CI users' speech recognition scores were not correlated with self-reported EF skills. However, for NH peers in degraded listening conditions, speech recognition scores were significantly correlated with self-reported working memory skills.

Conclusions: The present findings provide further evidence that neurocognitive factors (namely working memory skills) contribute to speech processing under degraded listening conditions.

Define Professional Practice Gap and Educational Needs:1. Lack of knowledge regarding executive functioning in patients with hearing loss. 2. Lack of awareness of the effects of executive functions in speech recognition outcomes for cochlear implant users.

Learning Objective: 1. The participant will have a better understanding of executive functioning in patients with hearing loss.
2. The participant will be more aware of the impact of executive functions on speech recognition outcomes for patients who use cochlear implants.

Desired Result: Attendees will be better able to apply an understanding of the executive functions that contribute to their patients' abilities to understand speech through cochlear implants.

IRB or IACUC Approval: Approved

G022

How Often Do Cochlear Implants Move After Implantation?

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Hypothesis: Cochlear implants (CI) may show clinically significant migration over time

Background: Both CI electrode array and internal receiver locations are typically assumed to be stable after implantation. Using a large CI imaging database we retrospectively evaluated how often CI electrodes and internal receiver migrate.

Methods: From an IRB-approved database of 303 CI patient CT scans, we identified ten patients with at least two post- implant CTs. In the scans, the center of each contact was identified using previously published image processing algorithms. The two CTs were then fused and electrode migration quantified by calculating the Euclidean distance between corresponding electrodes in the sequential scans. Visual assessment of alignment of the internal receivers in the fused image was used to determine if clinically significant migration had occurred.

Results: Time between scans averaged 615.2 days (range 84-1565 days). The median and mean±standard deviation of the distances between corresponding electrodes was 0.22 and 0.58±1.07mm. In all but 1 patient, distances approached the limits of CT resolution rather than representing clinically significant migration. Only one patient had appreciable electrode migration (3.61±0.92mm) and obvious internal receiver migration over 602 days between scans.

Conclusion: While a limited dataset, using well validated image processing techniques we have shown that 1 of 10 patients had clinically significant CI motion over time without obvious reason (e.g. no MRI, no head trauma), and, perhaps more importantly, that 9 of 10 did not. We continue to expand our dataset and will report the results of such at the conference.

Define Professional Practice Gap and Educational Needs: Lack of the knowledge on the stability of the cochlear implant (CI) electrode array and the internal receiver locations after implantation.

Learning Objective: The attendees will learn how often CI electrodes and internal receiver migrate through a retrospective study by using a large CI imaging database.

Desired Result: 1. Physicians and audiologists will be informed of the probability of the migration of CI electrode array and internal receiver after implantation. 2. With this knowledge, CI programming strategies could be adjusted.

IRB or IACUC Approval: Approved

G023

Hearing Impairment in Children with Congenital Hypothyroidism

Kathryn L. Kreicher, BA; William Carroll, MD
Habib Rizk, MD; Ted A. Meyer, MD, PhD

Objective: Congenital hypothyroidism (CH) occurs in about 1 in every 3,000 to 4,000 births in the United States. Prior to the institution of neonatal screening for CH, an estimated 20-50% of children with CH had sensorineural hearing loss (SNHL). The purpose of this study was to evaluate the current patterns in hearing impairment in children with CH.

Study Design: Retrospective analysis of the public NIH-funded AudGen database generated by Children's Hospital of Philadelphia.

Setting: Tertiary academic referral center.

Patients: Children with congenital hypothyroidism.

Interventions: Appropriate audiologic, otologic, and demographic data were recorded.

Main Outcome Measures: Audiograms were analyzed for type of hearing loss (HL), pure-tone-average (PTA), laterality, and change in hearing over time. Medical charts were reviewed to identify factors that influence development and progression of hearing loss.

Results: 189 patients with congenital hypothyroidism were included in this study. 124 patients (65.6%) had hearing loss on at least one audiogram (101 bilateral HL, 23 unilateral HL). 24.7% of ears with hearing loss were of moderate or worse in severity. Of patients with hearing loss and available bone conduction thresholds, 43.5% had conductive HL, 24.0% SNHL, 24.0% mixed, and 8.5% combined. 50% of these children had decline in hearing loss over time of greater than 10 dB.

Conclusion: To the best of our knowledge, this is the largest comprehensive analysis of hearing loss in children with CH. Despite screening for congenital hypothyroidism, hearing loss remains a problem in these patients.

Define Professional Practice Gap and Educational Needs: Hearing loss significantly impacts quality of life and health care expenditures for many children. Congenital hypothyroidism and its effect of hearing is not well understood and we hope listeners will gain awareness.

Learning Objective: At the conclusion of this presentation, the participants should be able to describe the prevalence, types of hearing loss, and otologic findings in children with congenital hypothyroidism.

Desired Result: Physicians will be able to apply this knowledge to counsel patients with congenital hypothyroidism on the importance of close follow up for hearing loss.

IRB or IACUC Approval: Exempt

G024

Endolymphatic Sac Decompression with Intra-Sac Dexamethasone Injection in Meniere's Disease

Dennis I. Bojrab II, MD; Michael J. LaRouere, MD
Frank S. Chen, MD, PhD; Seilesh C. Babu, MD
Dennis I. Bojrab, MD; Robert S. Hong, MD, PhD

Objective: Endolymphatic sac decompression surgery (ELSD) may be used to treat patients who have Meniere's disease (MD) refractory to medical therapy. In this study, we investigated whether or not the injection of steroid into the endolymphatic sac at the time of ELSD provides additional benefit to patient outcomes.

Study design: Randomized prospective single-blinded placebo-controlled study.

Setting: Tertiary center.

Patients: Patients with Meniere's disease with poorly controlled vertigo despite medical therapy and serviceable hearing that were offered ELSD.

Intervention(s): Patients randomized into 2 groups, with control group (n=17) undergone ELSD without steroid injection and experimental group undergone ELSD with steroid injection (n=18)

Main outcome measure(s): Audiogram, dizziness handicap inventory (DHI), tinnitus handicap inventory (THI), frequency of vertigo spells, functional level scale, and quality of life were obtained at multiple intervals from preoperatively to 24 months postoperatively.

Results: ELSD resulted in a statistically significant improvement in vertigo control whether or not steroid was injected into the endolymphatic sac at the time of surgery. However, no additional benefit was seen with the addition of intra-sac steroid injection. No statistical difference in pure tone average, THI, DHI, or quality of life was observed between the steroid and non-steroid surgical groups up to 24 months post surgery.

Conclusions: ELSD is an effective treatment for Meniere's disease refractory to medical therapy; however, the addition of intra-sac steroid injection at the time of surgery does not appear to result in a further improvement in patient outcomes.

Define Professional Practice Gap and Educational Needs: In patient with Meniere's disease, medical management is often the first line therapy, but when this is unable to control the patient's symptoms there is a wide array of surgical options that can be pursued. One of the conservative options is endolymphatic sac decompression and recent literature has been published exploring the use of intra-sac steroid injection to provide additional benefit in controlling patient symptoms. To test for this possible addition benefit of using a steroid at the time of endolymphatic sac decompression we designed a randomized prospective single-blinded placebo-controlled study with surgeons from the same institute.

Learning Objective: That while vertigo was significantly less after endolymphatic sac decompression, no additional benefit was seen with the addition of intra-sac steroid injection. Also, no statistical difference in pure tone average, dizziness handicap inventory, tinnitus handicap inventory, functional level scale, and quality of life was observed between the steroid and non-steroid surgical groups up to 24 months post surgery.

Desired Result: Endolymphatic sac decompression appears to be an effective treatment for Meniere's disease refractory to medical therapy; however, the addition of intra-sac steroid injection at the time of surgery does not appear to result in a further improvement in patient outcomes as has been shown in other literature. Patient selection with consideration to the patient population and presentation may account for the different results.

IRB or IACUC Approval: Approved

G025

Audiologic Findings in Patients with CT Evidence of Cavitary Cochlear Otosclerosis

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Objective: To characterize the types of hearing loss associated with internal auditory canal diverticula reflective of cavitary cochlear otosclerosis.

Study design: Retrospective review.

Setting: Tertiary referral center.

Patients: Age 18-85 patients who underwent computerized tomography (CT) scan of their temporal bones and were found to have radiologic evidence of cochlear otosclerosis (diverticulum of anterior IAC or lucency of otic capsule) or combined cochlear and fenestral otosclerosis. Third inclusion criterion was a record of audiometric testing.

Intervention(s): None.

Main outcome measure(s): Type and degree of hearing loss, presence of cochlear otosclerosis on CT scan, presence of fenestral otosclerosis on CT scan.

Results: 56 IACs were found to have diverticula of the anterior IAC in patients who had undergone audiometric testing. In 32 (57.1%) diverticula were associated with sensorineural hearing loss (SNHL), 18 (32.1%) with mixed hearing loss, five (8.9%) diverticula were not associated with hearing loss, and one (1.8%) diverticulum with conductive hearing loss.

Conclusions: More than half of the patients with cavitary cochlear otosclerosis were found to have pure SNHL. Many of these losses were identified in workup for cochlear implantation due to the profound nature of their SNHL. These findings suggest that cochlear otosclerosis may occur independent of or along with fenestral otosclerosis. Identification of patients with cochlear otosclerosis without a conductive hearing loss component may also allow early pharmacologic treatment.

Define Professional Practice Gap and Educational Needs: Lack of awareness of isolated cochlear otosclerosis

Learning Objective: 1) Identify diagnostic features of cochlear otosclerosis 2) Review pertinent temporal bone histopathology

Desired Result: The attendees will identify patients with progressive sensorineural hearing that is being caused by otosclerosis.

IRB or IACUC Approval: Approved

G026

Longitudinal Analysis of Sound Exposure and Usage in Cochlear Implant Subjects Using Objective Data Logs: A Multicentered Study

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Ilana P. Cellum, AuD; Stephen Bowditch, MS
Gen Li, PhD

Objective: Despite its importance, usage of cochlear implants (CIs) has been incompletely characterized due to reliance on subjective reporting by patients. Sound exposure, a potentially more informative variable, has not been widely assessed. The objective was to longitudinally assess patterns of CI usage and sound exposure using quantitative, objective data logs.

Study Design: Retrospective multi-institutional study of prospectively collected data

Setting: Two tertiary care academic medical centers

Patients: Postoperative CI patients (n=665), mean age 49.9 (SD=26.7)

Interventions: The intrinsic data logging capability of new generation CI sound processors was enabled

Main outcome measures: Device usage (hrs/day), total sound exposure (dB-hrs/day, i.e., "dose" of sound per day)

Results: The mean duration of followup was 322 days (SD=259). Mean daily usage at the most recent visit was 9.7 hours/day (SD=4.8). There was a 0.13 hr/day increase in usage over the followup period (p=0.02). Mean total sound exposure at the most recent visit was 502 dB-hrs/day (SD=249). There was an 8.2 dB-hr/day increase in total sound exposure over followup (p=0.02).

Conclusion: Daily hours per day of device use was high, lasting the majority of waking hours. Both usage and sound exposure increased slightly over time. This suggests that patients find sustained or increasing utility with the device over time and place themselves in more sound-enriched environments.

Define Professional Practice Gap and Educational Needs: Lack of awareness of (a) data logs as a tool to track objective usage and sound exposure among CI patients (b) objective usage, sound exposure, and trends among CI patients

Learning Objective: To understand that (a) data logs are incorporated into new CIs, and can track usage and sound exposure, (b) usage and sound exposure are relatively high, and trends are stable or slightly increased with time

Desired Result: (a) Attendees will examine the data logs of their patients to know their usage and sound exposure. (b) Researchers will use data logs as a source for objective usage-related variables

IRB or IACUC Approval: Approved

G027

Characterization of Patients Participating in a Staged Tinnitus Habituation Therapy Protocol

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Nicole K. Nguyen, AuD, CISC, FAAA
David J. Eisenman, MD

Objective: Characterize patients undergoing a staged tinnitus habituation therapy (THT) protocol (1. counseling/education, 2. audiometric testing, 3. sound generator use) to understand the role of each stage in tinnitus treatment.

Study design: Single-center retrospective cohort study

Setting: Tertiary care center

Patients: 229 patients participating in THT from January 2013-July 2016.

Intervention(s): Staged THT protocol

Main outcome measure(s): Tinnitus Handicap Inventory (THI) measures before and after each stage, and time between stages and initial follow-up.

Results: Initial THI was not predictive of return for later stages (stage 2, p=0.67; stage 3, p=0.14). Subjects who returned for stage 3 had a higher THI at stage 2 (52.32 ± 20.16), despite having a significant decrease in THI following stage 1 (60.71 ± 20.02 to 52.32 ± 20.16). Duration between stage 1-2 was a median of 31 days (IQR 21-46), from stage 2-3 a median of 41.5 days (IQR 30.25-117.25), and from stage 3 to initial post-THT follow-up a median of 28 days (IQR 5.5-44). There was no correlation between interstage duration and change in THI: (1 to 2: F=0.43, r=0.06; 2 to 3: F=0.90, r=0.02; 3 to initial follow-up: F=0.77, r=-0.06).

Conclusions: THI has varying predictive value in determining the likelihood of patients returning for subsequent stages of the THT protocol. Subjects ultimately fitted with sound generators had a significant benefit from stage 1, but still had higher mean THI prior to stage 2. The lack of correlation between interstage duration and change in THI supports flexible scheduling of THT follow-ups.

Define Professional Practice Gap and Educational Needs: The tinnitus habituation therapy protocol has not been studied since it was divided into stages, and the education/counseling component was changed to a group session vs. a one-on-one format.

Learning Objective: To characterize patients at each stage of the THT protocol to better understand the use of the Tinnitus habituation therapy.

Desired Result: Participants will understand the importance of THT in the treatment of tinnitus and the significance of a staged protocol to provide treatment to a broad patient population.

IRB or IACUC Approval: Approved

G028

The Genetic Basis of Deafness in Populations of African Descent

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Sara E. Bressler, BS; Susan H. Blanton, PhD
Denise Yan, PhD; Xue-Zhong Liu, MD, PhD

Objective: Review the current epidemiology and genetics of hearing loss in black populations of African descent worldwide with a focus on native sub-Saharan African populations.

Data Sources: Pubmed and Google Scholar, English language only, no year restriction

Study Selection: Systematic Reviews, Case series, Cross-sectional studies related to hearing loss in populations of African descent

Results: Environmental etiologies related to poor healthcare access and lack of perinatal care account for the majority of cases of hearing loss in Sub-Saharan populations. Syndromic etiologies have been described in African populations including Waardenburg, Pendred, and Usher syndromes, however they remain uncommon causes of hearing loss in these populations. Of the non-syndromic causes of hearing loss, few of the common GJB2 mutations (i.e. 35delG, 235delC), GJB6, or mitochondrial mutations commonly described in populations worldwide have been implicated in this population. Recent use of next generation sequencing sequencing has showed several candidate deafness genes in black populations of Nigeria and South Africa. Additionally, a dominant mutation in the MYO3a gene has recently been shown to cause non-syndromic genetic hearing loss in an African American family.

Conclusion: The mutations responsible for genetic hearing loss in populations of African descent are unique when compared to common causative mutations worldwide. There is a need for ongoing study in this area and the use of next generation sequencing and population-specific panels will aid in identifying rare and novel mutations in a more cost and time effective manner.

Define Professional Practice Gap and Educational Needs: Lack of contemporary knowledge of specific genetic causes of congenital deafness in patients of African descent worldwide

Learning Objective: Discuss current knowledge about the genetics of hearing loss in populations of African descent including recent findings in Sub-Saharan Africa using next generation sequencing.

Desired Result: Current and future use of next generation sequencing and population-specific gene panels will aid in identifying relatively rare deafness mutations in population of African descent worldwide.

IRB or IACUC Approval: Exempt

G029

Does Intracochlear Electrocochleography during CI Electrode Insertion Predict Changes in Residual Hearing

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Robert Dwyer, AuD; Kanthaiah Koka, PhD
Marc L. Bennett, MD; George B. Wanna, MD
Robert F. Labadie, MD, PhD

Objectives: Determine if changes in the electrocochleography (ECochG), particularly cochlear microphonic(CM) amplitude recorded from an intracochlear electrode during CI insertion, are associated with changes in low-frequency pure-tone average(PTA).

Study Design: Prospective

Methods: Patients with ≤80 dB HL pure-tone thresholds at 250 Hz undergoing CI with Advanced Bionics Mid-Scala Device were studied. Tone bursts(500 Hz,110 dB) were presented into the operative ear during electrode insertion, and ECochG responses were recorded using the implant. CM amplitudes were normalized (in dB) with respect to amplitude at RW. Preserved CMs were defined as those with an appropriate rise in amplitude during insertion and <5 dB change from the sustained peak to final recording. Low-frequency PTA was defined as the average of unaided air-conduction thresholds at 125, 250, and 500 Hz.

Results: Eight patients with residual hearing have been prospectively enrolled. Mean pre-operative low-frequency PTA was 50 ± 14 dB and changed to 87 ± 22 dB at activation. The CM amplitudes varied during insertion. Four (50%) patients demonstrated preserved CM amplitudes during insertion; low-frequency PTA increased 31 dB from pre-op to activation in these cases. Conversely, the CM failed to rise appropriately, or dropped 5 dB or more in four subjects (50%), with a low- frequency PTA increase of 43 dB.

Conclusions: CM amplitudes varied during electrode insertion and appear to be indicative of changes in low-frequency PTA. Prospective enrollment continues and longer-term hearing outcomes will be analyzed.

Define Professional Practice Gap and Educational Needs: Lack of data pertaining to whether intracochlear ECochG during insertion is predictive of hearing preservation.

Learning Objective: Determine if changes in the electrocochleography(ECochG), particularly cochlear microphonic (CM) amplitude recorded from an intracochlear electrode during CI insertion, are predictive of changes in low-frequency pure-tone average(PTA).

Desired Result: Attendees will better understand the role for ECochG during electrode insertion.

IRB or IACUC Approval: Approved

G030

Impact of Patient Customized Cochlear Implant Insertion Plans on Final Intracochlear Position

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Jack H. Noble, PhD

Hypothesis: Using patient-customized cochlear measurements obtained from pre-operative CT scans to guide insertion of cochlear implant (CI) electrode arrays will lead to more optimal intracochlear positioning.

Background: Cochlear duct length is highly variable ranging from 25.26-35.46mm (Hardy, 1938), yet CI electrode arrays are treated as one size fits most. We sought to investigate the impact of patient-customized insertion plans on final location of electrode arrays.

Methods: Ten cadaveric temporal bone specimens were CT scanned and randomly divided into groups A and B. Group A specimens had an optimal customized insertion plan generated including entry site (e.g. round window (RW) versus extended RW), entry vector based on anatomical landmarks (e.g. hug posterior aspect of facial recess and angle 1mm inferior to stapes), depth to begin advancing off stylet, and final insertion depth. Suboptimal plans were chosen for group B by selecting an approach that was within the range of normal yet predicted to result in poor final electrode location. One surgeon, blinded as to group, carried out the CI insertions following which the electrode array was fixed using superglue and the specimen microCT scanned to allow assessment of final electrode location.

Results: Average perimodiolar distance for groups A and B were 0.53 and 0.66mm, respectively. For group A, full scala tympani insertion was achieved in all specimens while in group B, three of five specimens had scalar translocation.

Conclusions: Patient customized cochlear implant insertion plans achieve better perimodiolar positioning and less scalar translocation.

Define Professional Practice Gap and Educational Needs: Lack of awareness of the potential impact of using information gleaned from clinically applicable CT scans to guide cochlear implantation and the impact his has on the final location of cochlear implant location.

Learning Objective: To learn how to use information from CT scans to potentially improve cochlear implant placement and performance.

Desired Result: Understand that one-size fits all paradigms often result in suboptimal cochlear implant electrode placement and how this may be changed using clinically available information.

IRB or IACUC Approval: Approved

G031

Effect of Total Malleus Removal on Cholesteatoma Recurrence and Hearing Outcomes

Scott Shapiro, MD; Donald Bennett, BA
Adam Cassis, MD

Objective: Complete removal of the malleus improves exposure during cholesteatoma removal, but the effects on hearing outcomes after ossicular reconstruction and recurrence rate are unknown. Our objective was to determine the effect of complete removal of the malleus on recurrence rate and hearing outcomes in patients undergoing canal wall up tympanomastoidectomy with ossicular chain reconstruction for cholesteatoma.

Study design: Retrospective chart review

Setting: Academic tertiary care center

Patients: 135 patients who underwent canal wall up tympanomastoidectomy and ossicular chain reconstruction for cholesteatoma between 2008-2015

Intervention: Complete malleus removal

Main outcome measures: Final air-bone gap and recurrence rate

Results: 21 patients had the malleus completely removed (MR group). For patients without recurrence, the MR group had a similar final air-bone gap compared to the group for which at least part of the malleus was left behind (MP group), 24.1+/- 3.9 dB versus 22.6 +/- 2.0 dB respectively ($t = 0.39$, $p = 0.70$). The odds ratio for recurrence for the MR group compared to the MP group was 1.29, though the extent of cholesteatoma was greater for those in the MR group (3.95 vs 2.71 subsites involved), this apparent different in recurrence rate did not reach statistical significance ($p = 0.089$).

Conclusions: During canal wall up tympanomastoidectomy for cholesteatoma, after ossicular reconstruction is performed, hearing outcomes are similar whether the malleus is removed completely or at least partially left behind. Recurrence rates may not reflect the increase in exposure afforded by total removal, which is general reserved for extensive disease.

Define Professional Practice Gap and Educational Needs: Lack of contemporary knowledge regarding the effect of total malleus removal on post-reconstruction hearing outcomes and recurrence after canal wall up tympanomastoidectomy for cholesteatoma.

Learning Objective: Understand the effect that total malleus removal during canal wall up tympanomastoidectomy for cholesteatoma has on post-reconstruction hearing outcomes and recurrence.

Desired Result: Attendees will have knowledge of its effect on hearing outcomes and recurrence when they consider total malleus removal during canal wall up tympanomastoidectomy for cholesteatoma.

IRB or IACUC Approval: Exempt

G032

MRI stability of the Vibrant Soundbridge System (VSB)

Arne Ernst, MD, PhD

WITHDRAWN BY AUTHOR

G033

Expanding Indications for Bone Anchored Hearing Systems in Patients with Single-Sided Deafness

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Devin L. McCaslin, PhD

Objective: Evaluate the Ponto Plus Power (PPP) bone-anchored hearing system (BAHS) with other current systems for speech recognition and quality of life (QOL) in single-sided deafness (SSD) patients with at least mild hearing loss in the better ear.

Study Design: Prospective nonrandomized comparison.

Setting: Tertiary hospital.

Patients: 10 subjects with >6 months using a BAHS with SSD and at least contralateral mild hearing loss.

Interventions: Audiometric testing and QOL instruments were administered using the current BAHS. Patients were then fit with the PPP and retested after 30 days.

Main outcome measures: Free-field speech-in-noise testing was performed using QuickSIN and AzBio Sentences in unaided, aided-omnidirectional, and aided-directional conditions. Subjective performance and QOL measures were administered, including the Speech, Spatial and Qualities (SSQ) scale, Abbreviated Profile of Hearing Aid Benefit (APHAB), Hearing Handicap Inventory for the Elderly (HHIE), and Glasgow Benefit Inventory (GBI).

Results: Speech perception in quiet was not significantly different between devices. However, subjects demonstrated significantly better speech recognition in noise with the PPP in omnidirectional mode (p=.013). After 30 days of wearing the PPP, analysis of APHAB subscales showed significant benefits for "Ease of Communication" (p=0.002) and "Reverberation" (p=0.013) and SSQ "Quality" scores significantly increased from 4.5 to 7 (p=0.008). Self-reported hearing handicap was significantly reduced from 59 to 40 (p=0.029), and GBI subscale analysis showed positive scores for "Total", "General" and "Social" indicating enhanced QOL.

Conclusions: Patients with SSD and hearing loss in the better ear experienced significant hearing and QOL improvements after using the PPP.

Define Professional Practice Gap and Educational Needs: Lack of contemporary knowledge of bone anchored hearing system indications and benefits

Learning Objective: Improve knowledge of the benefits of bone anchored hearing systems with increased gain in patients with single-sided deafness and contralateral hearing loss

Desired Result: Expand use of powered bone-anchored hearing systems in patients with single-sided deafness and contralateral hearing loss

IRB or IACUC Approval: Approved

G034

Outpatient Management of Cholesteatoma with Canal Wall Reconstruction Tympanomastoidectomy

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Objective: The postoperative wound infection rate for Canal Wall Reconstruction (CWR) tympanomastoidectomy with mastoid obliteration in the treatment of chronic otitis media with cholesteatoma has been reported to be 3.6%. Inpatient administration of 24-48 hours of intravenous antibiotics has been recommended. We aim to determine the postoperative infection rate with outpatient oral antibiotics.

Study Design: Institutional review board—approved retrospective case review

Setting: Tertiary referral center

Patients: Retrospective review was performed on consecutive patients who underwent CWR tympanomastoidectomy with mastoid obliteration at a single institution from 2014 to 2016.

Main Outcome Measure: Patient characteristics (age, sex) were calculated. Rate of post-operative complications and infections within 1 month of surgery. Comparison to previous published infection rates with post-operative intravenous antibiotics.

Results: 42 patients underwent CWR followed by outpatient oral antibiotics with a mean age of 25.4 years (15 patients were less than 10 years old). There were no postoperative wound infections. Outpatient antibiotics showed noninferiority to IV antibiotic historic controls (0% vs. 3.6%; 95% confidence interval [CI], 0% – 6.09%; P = 0.03). One patient had small postoperative wound dehiscence with CSF leak that was managed conservatively. One patient developed Clostridium difficile colitis on postoperative day 2.

Conclusions: The infection rate after CWR tympanomastoidectomy with use of outpatient antibiotics is not significantly worse than with 24-48 hours of intravenous antibiotics. Thus, CWR can be safely performed as an outpatient procedure.

Define Professional Practice Gap and Educational Needs: 1. Lack of knowledge regarding post-operative antibiotics management in Tympanomastoidectomy with CWR for cholesteatoma. 2) Investigating whether intravenous versus oral antibiotics is required for this procedure

Learning Objective: 1. Determine whether post-operative oral antibiotics is an appropriate regimen for Tympanomastoidectomy with CWR in cholesteatoma. 2) Determine the complications and rate of complications after using post-operative oral antibiotics in this procedure.

Desired Result: 1. Practitioners would determine, given results, that outpatient oral antibiotics is a non-inferior post- operative regimen for tympanomastoidectomy with CWR for cholesteatoma.

IRB or IACUC Approval: Approved

G035

Validity of Predicting Ossiculoplasty Prosthesis Size from High-Resolution CT and Cone Beam CT

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Hypothesis: Computed tomography (CT) technologies available in the clinical setting may be used to identify key landmarks of the ossicular chain, facilitating production of ossiculoplasty prostheses adapted to individual patient's anatomy.

Background: Ossiculoplasty is a technically demanding procedure. One limiting step of this surgery is the intraoperative sizing of the prosthesis to the patient. Improper sizing of a prosthesis places patients at risk for poor sound conduction or prosthesis extrusion. High-resolution and cone beam CT technologies offer rich detail of a temporal bone anatomy, may diagnose the degree of ossicular chain necrosis and perhaps predict the proper sizing of prosthesis to be used in ossiculoplasty.

Methods: A total of 5 cadaveric temporal bones were used for this study. Each bone was imaged with micro-CT, high- resolution CT, and cone beam CT scanners. Three-dimensional models were generated using MeshLab 1.3. Validity of landmarks identified in high -resolution CT and cone beam CT was confirmed through comparison to micro-CT models.

Results: Using micro-CT as the gold standard, anatomical landmarks that could predict optimal prosthesis size could be reliably identified on high-resolution clinical CT and cone beam CT. Both types of temporal bone CT scans may be used to accurately predict prosthesis size for ossiculoplasty.

Conclusions: When correlated with micro-CT detail, both high-resolution and cone beam CT technologies offer foresight into the ideal prosthesis requirements for ossiculoplasty. By utilizing CT imaging technology, physicians may decrease intraoperative times and error in determination of ideal prosthesis requirements.

Define Professional Practice Gap and Educational Needs: Ossiculoplasty is a highly skilled procedure involving multiple critical steps. One of the key steps is selection of the appropriately sized prosthesis. Visualization of the size requirements can be difficult due to the available angles of visualization, whether through a binocular microscope or endoscope. Appropriate prosthesis size selection is made more difficult by intraoperative changes in the anatomy of the tympanomeatal flap or tympanoplasty grafting material. Use of contemporary imaging technology in this situation can potentially improve outcomes; however there is a lack of awareness of the utility of these imaging modalities

Learning Objective: To introduce the use of contemporary clinical imaging into the planning of ossiculoplasty.
To demonstrate consistent landmarks in clinical high-resolution CT and cone beam CT that have been cross correlated to microCT imaging and that can be utilized in the appropriate size selection for prostheses

Desired Result: Attendees will apply the knowledge they learned from the presentation to preoperative surgical planning and prosthesis selection for ossiculoplasty.

IRB or IACUC Approval: Exempt

G036

Resolution of Post-Stapedotomy Dizziness with Migraine Prophylactic Medication

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Objectives: To understand the occurrence of vestibular migraine as an etiologic factor in post-stapedotomy dizziness (PSD).

Study design: Retrospective case series.

Setting: Tertiary referral center

Patients: Patients presenting with PSD lasting more than 30 days over a 10-year period

Intervention(s): migraine treatment (i.e. nortriptyline, verapamil, and/ or Topamax).

Main outcome measure(s): treatment type, medical history, and time to dizziness resolution.

Results: Five patients with PSD were identified. The initial onset of the vertigo ranged from 2-days to 2-months post- operatively. Two of the patients had had their surgery performed by outside surgeons. Three patients (60%) reported sleep deprivation, stress, and certain foods as triggers for the dizziness, while two (40%) endorsed yawning and eructation as triggers. The latter two had CT imaging which failed to show a long prosthesis or superior canal dehiscence. Two patients (40%) received an autologous blood injection in the middle ear, and two (40%) received intratympanic steroid injections in the office, which all failed to resolve the dizziness. All five had complete resolution of dizziness symptoms within 2- months of receiving migraine treatment. Dosage was increased incrementally until symptomatic relief was achieved. Symptom recurrence occurred in one patient who decreased the medication and resolved with subsequent increase in the dosage.

Conclusions: PSD may result from perilymphatic fistula, aberrant prosthesis length, or benign positional-vertigo. However, in patients with a prior history of migraines, migraine-related vertigo should be considered in the differential. Symptomatic resolution with migraine medications suggests that migraines may contribute to the underlying etiology in a subset of patients.

Define Professional Practice Gap and Educational Needs: Lack of awareness regarding all etiologies of post- stapedotomy dizziness and appropriate treatment options for persist cases.

Learning Objective: (1) review various etiologies for post-stapedotomy dizziness review various treatment options for post-stapedotomy dizziness investigate role of vestibular migraine in etiology of post-stapedotomy dizziness

Desired Result: Vestibular migraine may have a role in patients with a history of migraines and post-stapedotomy dizziness. A more thorough history should be obtained. Treating persistent post-stapedotomy dizziness with migraine medications can be considered in these subset of patients.

IRB or IACUC Approval: Approved

G037

Results of Cochlear Implants for Acetaminophen Toxicity

Jeffrey T. Vrabec, MD; Alex Sweeney, MD
Shirin Jivani, AuD; Lauren Placke, AuD
Ross Tonini, AuD

Objective: To improve awareness of sensorineural hearing loss due to acetaminophen ototoxicity and discuss results of cochlear implants in these individuals.

Study design: retrospective case review

Setting: Tertiary referral center

Patients: Individuals with rapidly progressive hearing loss due to presumed acetaminophen ototoxicity Intervention(s): Cochlear implant

Main outcome measure(s): Measures of speech recognition using the implant are displayed over time.

Results: None of the individuals with acetaminophen ototoxicity had any measurable speech recognition pre-operatively. In our cohort of adult implant recipients, approximately 25 % of patients have no measurable pre-operative speech recognition in at least one ear. Sentence recognition scores at one year or less in patients with acetaminophen ototoxicity averaged 88% compared to 62% for other adult implant recipients.

Conclusions: Acetaminophen ototoxicity produces a rapidly progressive profound bilateral hearing loss limiting the patient's ability to develop compensatory strategies for speech recognition. Patients usually receive cochlear implants after a very short duration of deafness thus; adaptation to the device is more rapid than in most implant recipients.

Define Professional Practice Gap and Educational Needs: Lack of awareness of acetaminophen ototoxicity as a cause of bilateral profound sensorineural hearing loss.

Learning Objective: To improve recognition of acetaminophen ototoxicity

Desired Result: To improve counseling for patients with acetaminophen ototoxicity regarding expected results of cochlear implants

IRB or IACUC Approval: Approved

G038

Longitudinal Tracking and Prediction of Sound Exposure and Usage in Hearing Aid Wearers Using Objective Data Logs

John B. Doyle, BA; Rohit R. Raghunathan, BS
Ilana Cellum, AuD; Gen Li, PhD
Justin S. Golub, MD

Objective: Use data logging technology to: (1) objectively track hearing aid (HA) usage and aided sound exposure; (2) identify predictors of usage and aided sound exposure.

Study design: Retrospective cohort study of prospectively collected data

Setting: Tertiary care academic medical center

Patients: Individuals (mean 74.7 years, SD=19.3) with HAs between 2007-2016 (n=451)

Interventions: Data logging technology intrinsic to new-generation HAs was enabled to track usage and sound environment. Age, sex, number of audiology visits, pure-tone average, and HA side were assessed as predictors of usage and sound exposure using multivariable linear regression.

Main outcome measure(s): Usage (hours/day), aided sound exposure (dB-hours/day, i.e., "dose" of sound per day)

Results: Mean follow-up duration was 313 (SD=431) days. Mean HA usage was 8.4 (SD=4.8) hours/day. Mean aided sound exposure was 439 (SD=281) dB-hours/day. After a drop in usage over the first 250 days (β=-0.006, p=0.03), usage stabilized (β<0.0001, p=0.94). Aided sound exposure was also stable over time (β=0.003, p=0.94). Both HA usage and sound exposure were only associated with number of audiology visits (β=0.096, p=0.004 and β=10.5, p=0.007, respectively).

Conclusion: While measurement of HA use has traditionally relied on subjective reporting, data logging offers an objective tool to longitudinally track HA use and sound environment. Usage and sound exposure were stable among patients with continued audiology follow-up. Number of audiology visits was the only predictor for both usage and aided sound exposure. Maximizing HA usage and sound enrichment might be possible through regular audiology follow-up visits.

Define Professional Practice Gap and Educational Needs: There is a lack of knowledge about objective usage patterns and sound exposure for patients with hearing aids. There is a need for better understanding of data logs as a new technology to measure this, as well as the factors to predict increased usage and sound enrichment to improve patient care.

Learning Objective: To understand the longitudinal usage and sound exposure patterns of patients with hearing aids, and to understand the factors that might maximize a patient's usage and sound enrichment.

Desired Result: Attendees will better understand how patients use hearing aids (including the sound exposure), how to measure this, and how they could modify their clinical practice to maximize usage and sound exposure.

IRB or IACUC Approval: Approved

G039

Sequential Imaging in Patients with Suspected Meniere's Disease Demonstrates Endolymphatic Sac Tumors

Elliott D. Kozin, MD; William C. Faquin, MD, PhD
David A. Kieff, MD; Ronald DeVenecia, MD, PhD
Steven D. Rauch, MD; David H. Jung, MD, PhD

Objective: The standard evaluation of patients with suspected Meniere's disease includes temporal bone imaging. Few guidelines, however, advocate sequential imaging. Herein, we describe two patients with presumed Meniere's disease and initially unremarkable imaging. Repeat imaging after worsening symptoms demonstrated interval development of an endolymphatic sac tumor (ELST).

Study design: Case series.

Setting: Tertiary care referral center.

Patient: Case series of two patients with longstanding diagnosis of Meniere's disease.

Interventions: Resection of endolymphatic sac.

Main outcome measures: 1) Audiometry, 2) temporal bone imaging, and 3) otopathology.

Results: Patient 1: 45-year-old male with diagnosis of asymmetric sensorineural hearing loss and intermittent vertigo underwent temporal bone magnetic resonance imaging that did not demonstrate any causative lesion. After an episode of sudden sensorineural hearing loss four years after initial presentation, repeat imaging was obtained. Magnetic resonance imaging showed development of probable ELST. Patient subsequently underwent a retrolabyrinthine approach to resection of the ELST, confirming diagnosis. Patient 2: 43-year-old male with long standing diagnosis of Meniere's disease. Original imaging was negative for causative lesion. New onset facial nerve weakness prompted repeated imaging that showed probable ELST. Patient subsequently underwent resection, confirming diagnosis. Neither patient had history of von Hippel Lindau (VHL) disease.

Conclusions: Cases demonstrate interval development of ELSTs in patients with Meniere's-like symptoms without VHL. Patients with VHL commonly have routine imaging surveillance to detect development of ELST. While ELSTs are rare, the study raises the question as to whether interval imaging is indicated in patients with Meniere's disease.

Define Professional Practice Gap and Educational Needs: Lack of contemporary knowledge of need for repeat imaging in patients with Meniere's Disease.

Learning Objective: Understand potential role of sequential imaging in patients with Meniere's Disease.

Desired Result: Attendees may apply knowledge of presentation to patients with Meniere's Disease.

IRB or IACUC Approval: Exempt

G040

A Systematic Review of the Sequelae of Antibiotics with or without Myringotomy versus Antibiotics and Mastoidectomy as Initial Treatment for Acute Mastoiditis

Christian M. Eisert, MD, MPH

Objective: Historically, definitive treatment for acute mastoiditis (AM) has been mastoidectomy and parenteral antibiotics, however several authors have reported successful treatment of AM using antibiotics with or without myringotomy. The objective of this review is to determine which initial treatment is associated with a higher risk of sequelae.

Data Sources: A PubMed search using the term "acute mastoiditis" written in English since 1980 was performed.

Study Selection: Inclusion criteria were: diagnostic criteria for AM were provided, a group for whom either conservative treatment or mastoidectomy were initial treatment options, a description sequelae that occurred after presentation.

Data Extraction: Target population, diagnostic criteria, type of antibiotics, and type of sequelae were abstracted.

Data Synthesis: When similar patient populations were reported on, the number of sequelae was pooled.

Results: The search resulted in 481 articles, 39 were analyzed, and 4 were included. All were retrospective studies. 456 patients were reported on, of which 175 underwent a mastoidectomy. 19 complications were reported with conservative management, 2 with mastoidectomy. This yielded sequelae rate estimates of 4.17% (19/456) following medical management and 1.14% (2/175) following mastoidectomy. Results were skewed by the largest study, which had a disproportionately large number of sequelae following conservative management; however in this study, only 67.3% underwent myringotomy at presentation. Excluding this study yields comparable rates of sequelae.

Conclusion: Sequelae from treatment of acute mastoiditis are rare. Mastoidectomy appears to have lower sequelae rates than broadly defined conservative management. Narrowing the definition to include a myringotomy yields comparable rates of sequalae.

Define Professional Practice Gap and Educational Needs: 1. The rate of sequelae of mastoidectomy vs. conservative management (antibiotics with or without myringotomy) for treatment of acute mastoiditis is unknown.
2. There is little evidence base for which treatment to choose to address uncomplicated acute mastoiditis

Learning Objective: 1. To learn sequelae rates of mastoidectomy and conservative management in the treatment of acute mastoiditis. 2. To use the the knowledge of sequelae rates to guide treatment for uncomplicated acute mastoiditis.

Desired Result: Attendees will be able to apply the systemtic review data to make an evidence-based choice of initial treatment for cases of uncomplicated acute mastoiditis.

IRB or IACUC Approval: Exempt

AMERICAN OTOLOGICAL SOCIETY RESEARCH FUND
RESEARCH GRANT AWARDS
& TRAINING FELLOWSHIPS

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

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

SAVE THE DATE

2017

A letter of intent must be submitted by November 1st of the year *prior* to funding (next funding cycle begins July 1, 2018). The letter must state the grant mechanism for the proposal, the Principal Investigator and Institution(s) for the work, provide a working title, and abstract. This should contain the Specific Aims and summarize the proposal in no more than 2 pages.

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

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

Information may be obtained from:

Kristen Bordignon, Assistant to
John S. Oghalai, MD
Executive Secretary, Research Fund of the
American Otological Society, Inc.
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Project Title: Multi-Sensory Modulation of Tinnitus Correlates in Primary Auditory Cortex
Primary Investigator: Gregory J. Basura, MD, PhD
Mentor: Susan Shore, PhD

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

Specific Aim 1 is testing the hypothesis that STDP following bimodal (auditory-Sp5) stimulation modulates tinnitus correlates (spontaneous firing rates; SFRs and neural synchrony; NS) in A1. Using a behavioral test for tinnitus in noise-exposed guinea pigs, recording electrodes measure extracellular SFRs and NS across A1. To assess plasticity, SFRs and NS is measured before and after bimodal stimulation at varied pairing intervals and orders.

Scientific Progress: We have essentially completed all experiments for this aim. We published portions of Aim 1 in the Journal of Neurophysiology (see list below). This publication was integral in demonstrating that in A1 with and without tinnitus that plasticity following bimodal stimulation is pairing order and interval dependent. From these data, we determined optimal bimodal intervals (0ms and +10ms) for maximal neural suppression and enhancement, respectively. Subsequently, we completed separate experiments that showed 0ms and +10ms pairing led to long-term changes in tone-evoked, SFRs and in NS in A1 and in the rostral belt (RB); an associative adjacent auditory area that may modulate A1 firing. These changes were altered following noise exposure. Those data have been submitted and are under review at Hearing Research (see below). Prior to submission for publication these data were presented at two different meetings this past year: Association for Research in Otolaryngology (ARO); San Diego, CA, Feb 2016 (Basura GJ, Takacs J, Issa M and Shore SE. Bimodal Stimulation Leads to Long-Term Changes in Neural Firing Rates in Primary and Anterior Auditory Cortex After Noise Exposure); and at 10th annual International Tinnitus Research Initiative; Nottingham, UK; March 2016 (Basura GJ, Takacs J, Issa M and Shore SE. Noise Exposure Leads to Increased Synchrony Between Primary Auditory Cortex and Anterior Auditory Field Neurons). Since we have completed all experiments for aim 1, the remaining 6-months of the third/final year of funding, will be spent finalizing experiments for aim 2. The final data analysis for aim 1 are in process and it is anticipated that a fourth paper will be submitted in mid-late Spring 2017.

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

Scientific Progress: We have made excellent progress and will easily complete this aim within the remaining/final 6 months of the AOS award. The neuropharmacology studies have been completed for atropine and we are finalizing the mecamylamine studies now. For the remaining 6 months of AOS funding we will be completing the neuropharmacology studies in noise-exposed animals with and without tinnitus following gap detection.

A sub aim of Aim 2 is to map cholinergic receptor expression in A1 after noise with and without tinnitus. Utilizing radio-ligand binding with [3H]-scopolamine (mAChR) and [18F]-Flubatine (nAChR) to label these receptors in brain slices we recently showed a down-regulation in mAChRs in both A1 and RB and an increase in nAChRs only in RB. These data will be presented at ARO in February 2017 (Forrest TJ, Desmond TJ, Issa, M, Scott PJH, and Basura GJ. Cholinergic receptor expression in primary auditory and rostral belt cortices after noise damage) and have been recently submitted and are under review at JARO (Journal of the Association for Research in Otolaryngology; see below). 50

Budget: No new requests or changes.

Publications attributed to AOS funding:

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

2. Forrest TJ, Desmond TJ, Issa M, Scott PJH, and Basura GJ. Cholinergic receptor expression in primary auditory and rostral belt cortices after noise damage. JARO (under review; 2016).

3. Takacs J, Forrest T, Basura GJ. Noise exposure alters long-term neural firing rates and synchrony in primary auditory and rostral belt cortices following bimodal stimulation. Hearing Research (under review; 2017). 51

American Otological Society (AOS); Research Grants 2016; Progress Report
AOS Research Award Progress Report
Project Title: Zwitterionic coatings for reduction of fibrosis following cochlear implantation
Primary Investigator: Elise Cheng, MD
Mentor: Marlan R. Hansen, MD

Our central hypothesis is that zwitterionic coatings formulated for cochlear implant materials will resist fibrosis and cell adhesion, improving the biocompatibility of cochlear implants and therefore improving the interface between spiral ganglion neurons and implanted electrode arrays. To test this hypothesis, two aims were formulated for the AOS research grant.

Specific Aim 1 is to evaluate the ability of zwitterionic coatings of cochlear implant biomaterials to resist protein adsorption and cell adhesion and to guide cell growth. To this end we have evaluated fibroblast, platelet and bacterial adhesion to zwitterionic coated Silastic.

Scientific Progress: We find that zwitterionic coatings resist protein adsorption on glass and Silastic. To this end we have been able to optimize Silastic coating techniques using anactivation step. We have been able to successfully pattern the coating of glass and Silastic using a masked photoinitiation step. Zwitterionic coating of glass and Silastic essentially eliminates cell adhesion to these substrates This includes fibroblasts and glial cells that are important for fibrotic responses as well as platelets and bacteria (*Staphylcoccus aureus* and *Staphylcoccus epidermis*).

Further preliminary data indicate that zwitterionic coating of Silastic significantly reduces *Staphylcoccus aureus* biofilm formation in vitro. These results that zwitterionic coatings may resist fibrosis, thrombosis, and infection in response to implanted biomaterials.

Our next steps will be to optimize methods for coating metallic components such as nitinol and platinum-iridium with zwitterionic coatings. We will also proceed to test spiral ganglion neurite guidance and Schwann cell directionality on patterned Silastic as well as on these metallic substrates.

Specific Aim 2 is to evaluate the anti-fibrotic activity and zwitterionic coating durability *in vivo*. To this end we have proposed cochlear implantation of rats with coated vs uncoated cochlear implant biomaterials.

Scientific Progress: In preliminary experiments we have implanted coated and uncoated Silastic material in rat cochleae. We are in the process of measuring hearing outcomes with auditory brainstem responses and processing implanted cochleae for radiological and histological analysis. To this end, we have recently developed a new protocol that uses X-ray (the Zeiss XRadia) to assess intracochlear tissue responses. This avoids tissue destruction during sectioning and only requires osmication to achieve excellent tissue contrast. We have had high resolution results with rodent cochleae achieving near cell-level resolution. This should provide us with improved ability to evaluate the full extent of fibrosis throughout the turns of the cochlea in three dimensions.

Budget: No new requests or changes to existing budget.

PI: Judith Lieu, MD
Grant Title: Development of preschool hearing-related quality -of-life measure Reporting Project Period: 07/01/2016 – 06/30/2017
6-Month Progress Report Introduction: Health-related quality of life (QOL) has become a key outcome of interest for children with hearing loss (HL), after speech perception and speech-language development. Although hearing assistive devices may improve hearing, how these treatments influence the QOL of patients with HL is also important. Existing questionnaires for young children with HL evaluate or screen for hearing and communication function and educational performance. Generic QOL inventories are limited in probing how HL affects children in their lives. Currently, there are no inventories designed specifically to evaluate QOL in young children with HL or their perceptions of their environment. The long-term goal of this study is to provide clinicians with a quantitative measure of QOL in young children with HL, and thereby improve clinical decision-making for treatment of HL. The objective of this study is to develop a reliable, valid, and sensitive questionnaire to assess QOL in 2-6 year old children with HL using a parent/caregiver proxy measure. We propose to achieve our objectives by pursuing the following Specific Aims:

Aim 1: Grounded theory approach will be used to collect qualitative data from in-depth, semi structured interviews with 1) parents of children with permanent HL, and 2) professionals who interact with these children. Interview questions will be developed based on the literature, results of our recent focus groups, and prior work by our group and others regarding the effects of hearing loss on QOL in children. Interviews will be transcribed verbatim and analyzed for themes, domains, and specific behaviors and responses.

Aim 2: Develop a parent/caregiver proxy report questionnaire that can be used to assess the QOL of young children with hearing loss. The questionnaire will be developed through an iterative process with collaborators and consultants, and cognitive response testing with a target population of the caregivers.
Aim 3: Begin the iterative process of item reduction of the parent/ caregiver proxy report using principal components analysis of data from parents of young children. We will assess the reliability, construct and discriminant validity of the new parent-proxy hearing-related QOL measure for 2-6 year old children with HL.

Results: A total of 20 participants were interviewed using the semi-structured interview, including 10 parents of children with hearing loss and 10 professionals who interact with children with hearing loss. A parent-proxy hearing-related QOL measure with 71 total statements was created using the information gathered from the semi-structured interviews. Field-testing with 10 parents of young children and 3 professionals who interact with children further helped to narrow the questionnaire down to 65 statements.

Work currently underway: The parent-proxy hearing-related QOL measure is being sent to parent participants to assess its reliability, construct, and discriminant validity. Upon receipt of the validation surveys, we will proceed with factor analysis, item reduction, and data analysis for reliability and validity of the survey, and a final parent-proxy hearing-related QOL measure for 2-6 year old children with HL will be developed.

PI: Aaron C. Moberly, M.D.
Grant Title: Variability in Speech Recognition for Adults with Cochlear Implants Reporting Project Period: 07/01/2016 – 12/30/2016
Progress Report

Introduction: Enormous variability exists in speech recognition outcomes in adults with cochlear implants (CIs). For patients with postlingual deafness, factors that have been found to explain some of the variability are primarily "bottom-up" auditory sensitivity factors related to the surgery, the device, and the condition of the peripheral auditory system. However, with more than 50% of outcome variability still unexplained, three problems arise: (1) Clinicians cannot adequately counsel patients preoperatively regarding likely performance with a CI; (2) Clinicians cannot explain a poor outcome; and (3) Clinicians cannot tailor rehabilitation protocols to the needs of each individual patient.
In addition to bottom-up processes, "top-down" sources likely contribute to CI outcome variability. Broadly speaking, top-down factors include the cognitive functions and linguistic skills of the listener. For example, working memory, processing speed, and inhibitory control support speech recognition for hearing aid users. Two general categories of language knowledge underlie success in speech recognition: phonological knowledge – how the sounds of speech are organized in a given language – and lexical, semantic, and syntactic skills. The interactions of cognitive and linguistic abilities have been largely neglected in research studies of CI users. Furthermore, it is not clear whether auditory deprivation results in deficits in top-down cognitive and linguistic abilities in CI users. The objective of this project is to identify top-down factors that contribute strongly to speech recognition in CI users, and to examine the effects of auditory deprivation on these abilities. I propose two studies using a model-based approach. For study 1, sixty postlingually deafened adults who are experienced CI users and 60 age-matched adults with normal hearing (NH) will undergo testing of bottom-up auditory sensitivity and top-down phonological knowledge, examined as predictors of recognition of words in sentences. For study 2, the same CI users and NH listeners will undergo testing of additional top-down linguistic skills – lexical, semantic, and syntactic skills – along with cognitive functions – working memory, attention/inhibition, and processing speed, as predictors of sentence recognition. These studies will also investigate the effects of auditory deprivation on top-down cognitive and linguistic skills. Addressing these objectives will have a sustained research impact by informing the field regarding the relative importance of bottom-up and top-down domains during recognition of speech, as well as the effects of auditory deprivation. Results will also provide a sustained clinical impact by laying the groundwork for a CI clinical battery that can be used to obtain a profile of strengths and weaknesses for individual patients, as well as to direct future individualized aural rehabilitation efforts.

Results: During the first 6 months of this award, we have enrolled and collected data from 24 CI users and 30 NH controls for study 1 and study 2. Thus far, we are finding strong correlations between word/ sentence recognition and both spectral resolution and phonological skills. Moreover, sentence recognition scores are related to inhibitory control and speed of processing of verbal materials. Increasing our enrollment over the next year will allow us to perform larger-scale analyses to address our primary aims.

PI: Richard K. Gurgel, MD
Grant Title: Exploring the Impact of Hearing Loss on Impaired Cognition in Older Adults Reporting Project Period: 07/01/2016 – 06/30/2017
Progress Report

Introduction: Hearing loss is associated with the development of dementia in older adults. While multiple epidemiologic studies have established the association between hearing loss and dementia, the mechanistic underpinnings of the association require further elucidation. Our overall research goal is to determine if hearing loss is a remedial risk factor for dementia. To further understand the association between hearing loss and dementia, we are working to address the following hypotheses and aims:
Hypothesis: The auditory cortex is an area of selective vulnerability in AD.
AIM 1. Correlate the extent of auditory cortical damage as determined with FDG-PET imaging with the degree of hearing loss in patients with AD, controlling for severity of cognitive impairment.
Hypothesis: Music processed through the auditory cortex activates other cortical domains and the hippocampus in older adults with AD.
AIM 2. Characterize auditory cortical connectivity to brain networks activated during music-listening session in subjects with AD.
Hypothesis: Restoring hearing in profoundly deaf older adults by means of cochlear implantation will improve cognitive function.
AIM 3. Evaluate pre- and post-operative cognitive function in older cochlear implant patients and determine which measures are most sensitive to inform future clinical trials.
Results
Aim 1 Our target enrolment for this aim is 10 patients in this study. To date we have completed audiologic, cognitive, and PET imaging on 3 patients. We have identified another 14 patients who have completed PET imaging and who have been contacted to complete the test battery, so we anticipate completion of enrollment within the upcoming year. It is too early to draw any meaningful conclusions on the data we have obtained from the 3 patients who have completed testing, but we plan an interim analysis after 5 patients have completed the full test battery.
Aim 2
We planned to enroll 20 patients in this study. Thus far, we have consented 14 patients, and have completed audiologic, cognitive, and functional MRI imaging in 10 patients. When we look at brain responses to either music played forward or in reverse, we see expected areas of the brain more active, such as regions that process sound and language. These are well characterized areas, and not surprising. What is more interesting is comparing responses to meaningful music to comparable but not meaningful sounds. For the 10 subjects so far, we do not have any significant brain regions that are active, but are starting to see some regions get close to statistical significance. Three areas in particular are very intriguing to us that look activated by the favored music: one region that is an epicenter of memory storage, one that is involved in control of attention, and one that registers reward in the brain. We are optimistic that adding additional patients into the study may confirm that one or more of these regions are active beyond a conventional statistical threshold.
We have also seen that patients with Alzheimer's disease who have relatively good peripheral hearing show a significant decline in performance on tests of central auditory processing. The story is emerging that in Alzheimer's patients, there are some specific brain regions that may be activated by music that may lead to higher attention, engagement of memory networks, and reward, but these findings remain preliminary pending imaging more volunteers.
Aim 3
Our target enrollment is 45 subjects for this aim. We have currently enrolled 16 patients and are collecting 6 month and 12 month post-operative cognitive data. Once we have 6 month post-operative cognitive data on at least 15, we will do an interim analysis to

determine if we are detecting a statistically significant difference in cognitive test results in the first 6 months after surgery.

Career development The career development training portion of the grant is proceeding as scheduled with the awardee enrolled in formal coursework through a master of science in clinical investigation program and applying for NIH funding as well as working regularly with the study mentoring team. A K76 Paul A. Beeson Scholarship award was submitted to the National Institute of Aging in February, 2016, was scored, and resubmitted in October, 2016. Additionally, an R03 was submitted in September, 2016, under the Grants for Early Medical/Surgical Specialists' Transition to Aging Research (GEMSSTAR) mechanism. This proposal is focused on quality of life in cochlear implantation in elderly patients and their caregivers.

PI: Soroush Sadeghi, M.D., Ph.D.
Progress Report: In Vivo Optogenetic Stimulation of Vestibular Nerve Afferents and Efferents

Vestibular nerve afferents carry information from vestibular sensors in the inner ear to the brain stem and are divided into two groups: 'Regular' afferents have little variability in their resting discharges and have broadband, tonic response properties, whereas 'irregular' afferents have larger variability in their resting discharges and high pass, phasic response properties. On the other hand, an efferent vestibular pathway provides feedback from the brain stem to the vestibular periphery. Efferent neurons in the brain stem receive inputs from the vestibular nuclei and project bilaterally to all end organs. Stimulation of efferents result in an increase in the resting discharge of afferents and a decrease in their sensitivity, with larger effects on irregular fibers. Recent studies have suggested that efferents are required for normal development of high frequency responses by the vestibulo-ocular reflex (VOR) and normal compensation after unilateral lesion. Thus, it seems like efferents exert a role on high frequency functions of the vestibular system through their effects on irregular vestibular nerve afferents.

The ultimate goal of our proposal was to study the differential effect of different groups of efferent fibers on the activity of vestibular afferents. However, using optical stimulation in mice with channelrhodopsin 2 (ChR2) expression in their efferent fibers, in addition to the expected fast effects of optogenetic stimulation, we also observed a slower inhibitory effect on afferents that reached a maximum in seconds. On further investigation, this inhibitory effect was also observed in wild type control mice. To better understand this effect and to be able to parse it out from the effect of ChR2 stimulation, we focused our studies on wild type animals.

The activity of vestibular nerve fibers were monitored using in vivo extracellular recordings in one month old C57B mice. The vestibular nerve and ganglion were approached through a parietal bone craniotomy and suctioning of the lateral portion of the cerebellum overlaying the vestibular nerve. Single unit recordings were performed using 20-25 Mohm glass electrodes. Afferents showed spontaneous resting discharges (mean: 21 ± 2 spikes/s, range: 1 – 60 spikes/s, n = 163) and were divided into regular and irregular groups based on their discharge regularity, calculated by a normalized coefficient of variation (CV*). To deliver optical stimulation, a standard 460 nm LED coupled to a fiber optic was positioned over the nerve through the same craniotomy (stimulus: 3 – 10 s, 90% duty cycle). Such optical stimulation differentially affected the two types of afferents (n=60): while 97% of irregular afferents showed 40-100% decrease in resting rate, most regular afferents (85.7%) showed < 40% inhibition. This effect started at ~ 500 ms after stimulation onset and plateaued at ~5.5 s. The firing rate returned to baseline ~10 s after stimulus termination. Notably, all irregular afferents could be silenced with a strong enough stimulation and failed to respond to even a strong rotational stimulation (7 Hz, 100 deg/s). The temperature increase as a result of optical stimulation (3-7 deg Celsius in 3-10 s) was measured by a thermocouple sensor positioned near the nerve and showed a similar time course to that of the nerve inhibition. The temperature effect was confirmed (n=7) by applying warm (37 deg Celsius) or cold water (4 deg Celsius) during afferent recordings, which resulted in inhibitory and excitatory effects, respectively.

Together, our results show that optical stimulation can be used for exclusive inhibition or silencing of irregular afferents in the vestibular periphery in vivo. We believe that this is mediated through the inhibition of unmyelinated vestibular efferent pathway, suggesting a function for spontaneous efferent activity in normal conditions. Indeed, previous studies have shown an inhibition of activity in unmyelinated pain fibers in normal conditions as well as in poorly myelinated fibers in patients with multiple sclerosis (Uhthoff's phenomenon). This efferent-mediated activity is most likely exerted through modulation of the activity of potassium channels by metabotropic receptors activated by efferent inputs (e.g., muscarinic

AChR that control KCNQ channels). We propose that under normal conditions, spontaneous activity of
efferents is required for control of membrane properties of peripheral cells and terminals in order to have normal afferent resting discharge.
Our future goal is to study the effect of optical inhibition of irregular fibers on the VOR gain in order to better understand the differential roles of the peripheral phasic and tonic pathways in processing of vestibular information. We will also focus more on optogenetic stimulation of afferents and efferents to study the effect of different groups of efferents on regular and irregular afferents.

AWARD OF MERIT RECIPIENTS (1949 - 2016)

1949	George M. Coates, MD
1951	Barry J. Anson, PhD
	Theodore H. Bast, PhD
1952	Edmund P. Fowler, Sr., MD
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1966	Gordon D. Hoople, MD
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1968	Lawrence R. Boles, MD
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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

GUESTS OF HONOR (1974 - 2016)

1974	Harry Rosenwasser, MD
1975	John E. Bordley, MD
1976	Ben H. Senturia, MD
1977	Henry B. Perlman, MD
1978	Howard P. House, MD
1979	Hallowell Davis, MD
1980	Victor Goodhill, MD
1981	Harold Schuknecht, MD
1982	George E. Shambaugh, Jr., MD
1983	Wesley H. Bradley, MD
1984	Brown Farrior, MD
1985	Bruce Proctor, MD
1986	Merle Lawrence, PhD
1987	Robert M. Seyfarth, PhD
1988	G. Dekle Taylor, MD
1989	Eugene L. Derlacki, MD
1990	William F. House, MD
1991	Michael E. Glasscock III, MD
1992	William E. Hitselberger, MD
1992	D. Thane R. Cody, MD
1994	Cesar Fernandez, MD
1995	Richard R. Gacek, MD
1996	James L. Sheehy, MD
1997	Mansfield F.W. Smith, MD
1998	Robert A. Jahrsdoerfer, MD
1999	Barbara A. Bohne, Ph.D.
2000	Derald E. Brackmann, MD
2001	James B. Snow, Jr., MD
2002	David J. Lim, MD
2003	James F. Battey, Jr., MD, PhD
2004	Ugo Fisch, MD
2005	George A. Gates, MD
2006	Richard A. Chole, MD, PhD
2007	Fred H. Linthicum, Jr., MD
2008	H. Ric Harnsberger, MD
2009	Robert J. Ruben, MD
2010	Edwin Rubel, PhD
2011	Richard T. Miyamoto, MD
2012	Vicente Honrubia, MD
2013	Bruce J. Gantz, MD
2014	David A. Moffat, PhD
2015	Joseph B. Nadol Jr., MD
2016	Blake Wilson, PhD, DSc, DEng, Dr.med.hc (mult.)

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

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1868 - 69	E. Williams, MD
1870 - 73	H.D. Noyes, MD
1874 - 76	D.B. St.John Roosa, MD
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1879 - 80	A.H. Buck, MD
1881 - 83	J.O. Green, MD
1884 - 85	C.H. Burnett, MD
1886 - 89	J.S. Prout, MD
1890	O.D. Pomeroy, MD
1891 - 94	Gorham Bacon, MD
1895 - 99	Arthur Mathewson, MD
1900 - 02	H.G. Miller, MD
1903 - 05	B. Alex Randall, MD
1906 - 0 7	Emil Gruening, MD
1908	C.J. Kipp, MD
1909 - 10	Frederick L. Jack, MD
1911 - 12	Edward B. Dench, MD
1913 - 14	J.F.McKernon, MD
1915 - 16	C.W. Richardson, MD
1917	C.R. Holes, MD
1918	Norval H. Pierce, MD
1919	Ewing W. Day, MD
1920	Robert Lewis, MD
1921	W.P. Eagleton, MD
1922	H.S. Birket, MD
1923	G. Shambaugh, Sr., MD
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1927	Arthur B. Duel, MD
1928	M.A. Goldstein, MD
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1930	S. Mac C. Smith, MD
1931	D.H. Waler, MD
1932	L.W. Dean, MD
1933	G.I. Tobey, Jr., MD
1934	John R. Page, MD
1935	Samuel J. Crowe, MD
1936	F.R. Packard, MD
1937	E.P. Fowler, MD
1938	Harris P. Mosher, MD
1939	Isidore Friesner, MD
1940	Horace Newhart, MD
1941	George M. Coates, MD
1942	L. M. Seydell, MD
1943 - 44	W.C. Bowers, MD
1945 - 46	Gordon Berry, MD
1947	William E. Grove, MD
1948	B. J. McMahon, MD
1949	Marvin F. Jones, MD
1950	Philip E. Meltzer, MD
1951	Kenneth M. Day, MD
1952	Gordon D. Hoople, MD
1953	A.C. Furstenberg, MD
1954	Frederick T. Hill, MD
1955	D.E.S. Wishart, MD
1956	William. J McNally, MD
1957	John R. Lindsay, MD
1958	Dean M. Lierle, MD
1959	Moses H. Lurie, MD
1960	Robert C. Martin, MD
1961	Henry L. Williams, MD
1962	Lawrence R. Boies, MD
1963	Joseph A. Sullivan, MD
1964	Theodore E. Walsh, MD
1965	Harry Rosenwasser, MD
1966	Howard P. House, MD
1967	James A. Moore, MD
1968	G. Shambaugh, Jr., MD
1969	Frank D. Lathrop, MD
1970	Francis L. Lederer, MD
1971	John E. Bordley, MD
1972	Walter P. Work, MD
1973	Ben H. Senturia, MD
1974	Wesley H. Bradley, MD
1975	Lester A. Brown, MD
1976	Victor Goodhill, MD
1977	Harold Schuknecht, MD
1978	Clair M. Kos, MD
1979	G. Dekle Taylor, MD
1980	Eugene Derlacki, MD
1981	Richard J. Bellucci, MD
1982	J. Brown Farrior, MD
1983	Jack V. Hough, MD
1984	Cary N. Moon, Jr., MD
1985	Francis A. Sooy, MD
1986	Brian F. McCabe, MD
1987	Harold G. Tabb, MD
1988	Richard R. Gacek, MD
1989	D. Thane Cody, MD
1990	H.A. Ted Bailey, Jr., MD
1991	William F. House, MD
1992	Michael Glasscock, III, MD
1993	Mansfield F.W. Smith, MD
1994	Robert I. Kohut, MD
1995	Robert A. Jahrsdoerfer, MD
1996	Derald E. Brackmann, MD
1997	Joseph C. Farmer, Jr., MD
1998	Charles M. Luetje, MD
1999	Gregory J. Matz, MD
2000	C. Gary Jackson, MD
2001	A. Julianna Gulya, MD
2002	Richard A. Chole, MD PhD
2003	Horst R. Konrad, MD
2004	Jeffrey P. Harris, MD, PhD
2005	Sam E. Kinney, MD
2006	John K. Niparko, MD
2007	Antonio De La Cruz, MD
2008	Clough Shelton, MD
2009	Joseph B. Nadol, Jr., MD
2010	Bruce J. Gantz, MD
2011	C. Phillip Daspit, MD
2012	Herman A. Jenkins, MD
2013	Paul R. Lambert, MD
2014	John W. House, MD
2015	D. Bradley Welling, MD, PhD
2016	Debara L. Tucci, MD, MS, MBA
2017	Samuel H. Selesnick, MD

NOTES

AMERICAN OTOLOGICAL SOCIETY
2016 - 2017 Membership Roster
Includes the 2017 Candidates inducted at the AOS 2017 Spring Meeting

ACTIVE

Oliver F. Adunka, MD (Active 2016)
Columbus, OH

Ronald G. Amedee, MD (Active 1995)
New Orleans, LA

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Patrick J Antonelli, MD (Active 2001)
Gainesville, FL

Moises A Arriaga, MD (Active 2002)
Metairie, LA

H. Alexander Arts, MD (Active 2001)
Ann Arbor, MI

Douglas D Backous, MD (Active 2006)
Seattle, WA

Manohar Bance, MD (Active 2013)
Halifax, Nova Scotia Canada

Loren J Bartels, MD (Active 1992)
Tampa, FL

Carol A Bauer, MD (Active 2006)
Springfield, IL

Charles W Beatty, MD (Active 1995)
Rochester, MN

James E Benecke Jr., MD (Active 2006)
St. Louis, MO

Brian Blakley, MD (Active 1996)
Winnipeg, Manitoba Canada

Nikolas H Blevins, MD (Active 2009)
Stanford, CA

Hilary A Brodie, MD, PhD (Active 2001)
Sacramento, CA

Craig A Buchman, MD (Active 2005)
St. Louis, MO

John P Carey, MD (Active 2006)
Baltimore, MD

Stephen P Cass, MD (Active 2000)
Aurora, CO

Sujana S Chandrasekhar, MD (Active 2004)
New York, NY

Kay W Chang, MD (Active 2014)
Stanford, CA

Douglas A Chen, MD (Active 2008)
Pittsburgh, PA

Steven Wan Wan Cheung, MD (Active 2006)
San Francisco, CA

Richard A Chole, MD, PhD (Active 1984)
St. Louis, MO

Daniel Choo, MD (Active 2008)
Cincinnati, OH

Roberto A Cueva, MD (Active 2005)
San Diego, CA

Charles C Della Santina, MD (Active 2009)
Towson, MD

M. Jennifer Derebery, MD (Active 2002)
Los Angeles, CA

Hamid R Djalilian, MD (Active 2015)
Orange, CA

Joni K Doherty, MD, PhD (Active 2015)
Los Alamitos, CA

John L Dornhoffer, MD (Active 2004)
Little Rock, AR

Karen Jo Doyle-Enright, MD, PhD (Active 2002)
Fenton, MI

Colin LW Driscoll, MD (Active 2012)
Rochester, MN

Thomas L Eby, MD (Active 1995)
Jackson, MS

Hussam K El-Kashlan, MD (Active 2006)
Ann Arbor, MI

Adrien A Eshraghi, MD (Active 2013)
Weston, FL

Jose N Fayad, MD (Active 2007)
Dhahran, Saudi Arabia

Joseph G Feghali, MD (Active 2002)
Bronx, NY

Howard W Francis, MD (Active 2003)
Durham, NC

David R Friedland, MD, PhD (Active 2011)
Milwaukee, WI

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Michael H Fritsch, MD (Active 2003)
Indianapolis, IN

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Gerard J Gianoli, MD (Active 2007)
Covington, LA

Paul W Gidley, MD (Active 2015)
Houston, TX

Joel A Goebel, MD (Active 1995)
St. Louis, MO

J. Douglas Green Jr., MD (Active 2008)
Jacksonville, FL

John H Greinwald Jr., MD (Active 2013)
Cincinnati, OH

Samuel P Gubbels, MD (Active 2017)
Aurora, CO

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Iowa City, IA

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Nashville, TN

Keiko Hirose, MD (Active 2010)
St. Louis, MO

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Miami, FL

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Santa Fe, NM

Timothy E Hullar, MD (Active 2013)
Portland, OR

Akira Ishiyama, MD (Active 2009)
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Robert K Jackler, MD (Active 1992)
Stanford, CA

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Tucson, AZ

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Toronto, Canada

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Raleigh O Jones Jr., MD (Active 2017)
Lexington, KY

Timothy K Jung, MD (Active 1990)
Riverside, CA

David M Kaylie, MD (Active 2014)
Durham, NC

Bradley W Kesser, MD (Active 2008)
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Ana H Kim, MD (Active 2016)
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Hung Jeff Kim, MD (Active 2014)
Washington, DC

Harold H Kim, MD (Active 2010)
Portland, OR

Richard D Kopke, MD (Active 2005)
Oklahoma City, OK

Robert F Labadie, MD, PhD (Active 2009)
Nashville, TN

Anil K Lalwani, MD (Active 1999)
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Paul R Lambert, MD (Active 1995)
Charleston, SC

Daniel J Lee, MD (Active 2016)
Brookline, MA

Kenneth H Lee, MD, PhD (Active 2017)
Plano, TX

John P Leonetti, MD (Active 1995)
Maywood, IL

Samuel C Levine, MD (Active 1999)
Minneapolis, MN

Phillip D Littlefield, MD (Active 2013)
Kaneohe, HI

Larry B Lundy, MD (Active 2011)
Ponte Vedra Beach, FL

Lawrence R Lustig, MD (Active 2006)
New York, NY

John D Macias, MD (Active 2015)
Phoenix, AZ

Sam J Marzo, MD (Active 2011)
Maywood, IL

Douglas E Mattox, MD (Active 1992)
Atlanta, GA

John T McElveen Jr., MD (Active 1997)
Raleigh, NC

Michael McGee, MD (Active 2002)
Oklahoma City, OK

Michael J McKenna, MD (Active 1999)
Boston, MA

Brian J McKinnon, MD (Active 2015)
Philadelphia, PA

Sean O McMenomey, MD (Active 2009)
Seattle, WA

Cliff A Megerian, MD (Active 2006)
Cleveland, OH

Alan G. Micco, MD (Active 2007)
Chicago, IL

Lloyd B Minor, MD (Active 2001)
Stanford, CA

Gary F Moore, MD (Active 2003)
Omaha, NE

William H Moretz Jr., MD (Active 1999)
Augusta, GA

Terrence P Murphy, MD (Active 2002)
Atlanta, GA

Brian A Neff, MD (Active 2014)
Rochester, MN

Erik G. Nelson, MD (Active 2011)
Lake Forest, IL

John S Oghalai, MD (Active 2009)
Stanford, CA

Robert C O'Reilly, MD (Active 2009)
Philadelphia, PA

Dennis G. Pappas Jr., MD (Active 2004)
Birmingham, AL

Blake C Papsin, MD (Active 2005)
Toronto, Ontario, Canada

Steven M Parnes, MD (Active 2002)
Albany, NY

Lorne S Parnes, MD (Active 2000)
London, Ontario, Canada

Myles L Pensak, MD (Active 1992)
Cincinnati, OH

Brian P Perry, MD (Active 2015)
San Antonio, TX

Harold C Pillsbury, MD (Active 1988)
Chapel Hill, NC

Dennis S Poe, MD (Active 1995)
Boston, MA

G. Mark Pyle, MD (Active 2003)
Madison, WI

Steven D Rauch, MD (Active 2004)
Watertown, MA

Miriam I Redleaf, MD (Active 2013)
Chicago, IL

J. Thomas Roland Jr., MD (Active 2005)
New York, NY

Seth Rosenberg, MD (Active 2001)
Sarasota, FL

Jay T Rubinstein, MD, PhD (Active 2002)
Seattle, WA

Michael J Ruckenstein, MD (Active 2003)
Philadelphia, PA

Leonard P Rybak, MD, PhD (Active 1989)
Springfield, IL

Robert T Sataloff, MD (Active 1990)
Philadelphia, PA

James E Saunders, MD (Active 2008)
Lebanon, NH

Michael D Seidman, MD (Active 2001)
Celebration, FL

Samuel H Selesnick, MD (Active 1999)
New York, NY

William H Slattery III, MD (Active 2014)
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Eric E Smouha, MD (Active 2004)
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Hinrich Staecker, MD, PhD (Active 2013)
Kansas City, KS

Konstantina M Stankovic, MD, PhD (Active 2015)
Boston, MA

Steven A Telian, MD (Active 1997)
Ann Arbor, MI

Fred F Telischi, MD (Active 2002)
Miami, FL

Norman Wendell Todd Jr., MD (Active 1996)
Atlanta, GA

Debara L Tucci, MD (Active 2000)
Durham, NC

Jeffrey T Vrabec, MD (Active 2004)
Houston, TX

P. Ashley Wackym, MD (Active 1997)
New Brunswick, NJ

George B Wanna, MD (Active 2015)
New York, NY

Jack J Wazen, MD (Active 1993)
Sarasota, FL

Peter C Weber, MD, MBA (Active 2002)
Boston, MA

D. Bradley Welling, MD, PhD (Active 1998)
Boston, MA

Eric P Wilkinson, MD (Active 2014)
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SENIOR

Edward Applebaum, MD (Senior 1985)
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Miami, FL

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Margaretha L Casselbrant, MD, PhD (Senior 2001)
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Jack D Clemis, MD (Senior 1976)
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Joseph R DiBartolomeo, MD (Senior 2015)
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Robert A Dobie, MD (Senior 1985)
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Larry G Duckert, MD (Senior 1988)
Seattle, WA

John R Emmett, MD (Senior 1990)
Memphis, TN

George W Facer, MD (Senior 1994)
Bonita Springs, FL

Jay B Farrior, III, MD (Senior 1990)
Tampa, FL

L. Gale Gardner, Jr., MD (Senior 1983)
Shreveport, LA

Robert A Goldenberg, MD (Senior 1989)
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Paul E Hammerschlag, MD (Senior 2001)
New York, NY

Jeffrey P Harris, MD, PhD (Senior 1988)
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Barry E Hirsch, MD (Senior 1996)
Pittsburgh, PA

Ronald A Hoffman, MD (Senior 1992)
New York, NY

John W House, MD (Senior 1984)
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Athanasios Katsarkas, MD (Senior 1991)
Montreal, Quebec Canada

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Moreland Hills, OH

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Charles M Luetje, MD (Senior 1991)
Olathe, KS

Charles A Mangham Jr., MD (Senior 1987)
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Southfield, MI

Michael M Paparella, MD (Senior 1968)
Minneapolis, MN

Simon C Parisier, MD (Senior 1982)
New York, NY

Peter S Roland, MD (Senior 1992)
Eden, UT

Max L Ronis, MD (Senior 1972)
Philadelphia, PA

Robert J Ruben, MD (Senior 1974)
Bronx, NY

Allan M Rubin, MD, PhD (Senior 1997)
Perrysburg, OH

Clarence T Sasaki, MD (Senior 1992)
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Mitchell K Schwaber, MD (Senior 1993)
Nashville, TN

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Bobby R Alford, MD (Emeritus 1970)
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Little Rock, AR

Charles D Bluestone, MD (Emeritus 1977)
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B. Hill Britton, MD (Emeritus 1978)
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Rinaldo F Canalis, MD (Emeritus 1991)
Santa Monica, CA

Robert W Cantrell, MD (Emeritus 1979)
Charlottesville, VA

Noel L Cohen, MD (Emeritus 1985)
New York, NY

Newton J Coker, MD (Emeritus 1991)
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Charles Phillip Daspit, MD (Emeritus 1995)
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John M Fredrickson, MD (Emeritus 1978)
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Naoaki Yanagihara, MD (Honorary)
Matsyama, Japan

IN MEMORIUM
(in alphabetical order)

The AOS Administrative office was notified of the following members death since the last Spring meeting.

Please take a moment of silence to remember these outstanding colleagues & friends.

John K. Niparko, MD

Wallace Rubin, MD

Josef M. Miller, PhD

Beverly Armstrong, MD

Seymour J. Brockman, MD

Richard A. Buckingham, MD

James M. Cole, MD

James A. Donaldson, MD

Paul H. Ward, MD