SELECTED ABSTRACTS

POSTER
PRESENTATIONS

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

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

Yin Ren, MD PhD; Jessica E. Sagers, BA
Lukas Landegger, MD; Sangeeta N. Bhatia, MD, PhD
Konstantina M. Stankovic, MD, PhD

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 (TNFα), 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 TNFα 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
2) Describe one pathway by which VS-secreted molecules can mediate hearing loss
3) Discuss therapeutic potential of short interfering RNA in VS
4) 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

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

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

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

*Mathieu Trudel, MD; Mathieu Côté, MD
Nicolas Rouleau, MOA; Carole Losier, MOA
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

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

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

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

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

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

Stephanie Y. Chen, BM; Brianna M. Griffin, MD
Dean M. Mancuso, AuD; Ilana Cellum, AuD
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

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

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

M. Geraldine Zuniga, MD; Kyle Kesler, BS
Neal Dillon, MS; Loris Fichera, PhD
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

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

Nauman Manzoor, MD; Kathryn Hoppe, MD
Mustafa Ascha, MS; Sarah Mowry, MD
Cliff Megerian, MD; Todd Otteson, MD, MPH
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

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

C. Scott Brown, MD; David M. Kaylie, MD, MS

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

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

Katrice E S Kazmerik, BScEng, BScMed; Bertram Unger MD PhD
Justyn Pisa, AuD; Jordan Hochman, MD

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.
2. Lack of knowledge in describing potential (dis)advantages to using 3D and Haptic temporal bone models.
3. 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.
2. Explain the advantages and disadvantages of using 3D versus Haptic temporal bone models.
3. 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

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

Steven A. Zuniga, MD; Brandon Kamrava, BS
Haeju Son; Nahyun Son; Devin P. Pittman
Ruth Ochia, PhD; Pamela C. Roehm, MD, PhD

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

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

Sean S. Evans, MD; Harishanker Jeyarajan, MBBS
Rupert J. Obholzer, MA, MBBS
Parag M. Patel, MSc, MBBS, BSc, DO-HNS
Elizabeth A. Grunfeld, BSc, MSc, PhD
M. Sherriff, PhD, BSc; Michael J. Gleeson, MD

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

High-Fidelity Surgical Middle Ear Simulator: A Pilot Study

Joshua P. Wiedermann, MD; Gabriela DeVries, MS
Ashkan Monfared, MD

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

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

Mohamed A. Alhussaini MD; Jameson K. Mattingly MD
Stephen P. Cass MD, MPH

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

Electrode Length and Long Term Hearing Preservation in Cochlear Implantation

Joshua M. Sappington, MD; Moises A. Arriaga, MD MBA
Rahul Mehta, MD

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

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

Matthew M. Dedmon, MD, PhD; Brendan P. O'Connell, MD
Elliott D. Kozin, MD; Aaron K. Remenschneider, MD, MPH
Daniel J. Lee, MD; Alejandro Rivas, MD
Robert F. Labadie, MD, PhD

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

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

Tirth Patel, BS; Irina Castellanos, PhD
Aaron C. Moberly, MD

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.

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.

IRB or IACUC Approval: Approved

How Often Do Cochlear Implants Move After Implantation?

Yiyuan Zhao, MS; Jack H. Noble, PhD
Benoit M. Dawant, PhD; Robert F. Labadie, MD, PhD

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

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

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

Audiologic Findings in Patients with CT Evidence
of Cavitary Cochlear Otosclerosis

Thomas J. Muelleman, MD; Kaley Pippin, MD
Alicia M. Quesnel MD; Luke Ledbetter, MD
Michael J. McKenna, MD; Hinrich Staecker MD, PhD

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

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

Justin S. Golub, MD; John B. Doyle, BA
Rohit Raghunathan, BS, Yi Cai, AB
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

Characterization of Patients Participating in a Staged Tinnitus Habituation Therapy Protocol

Saikrishna C. Gourishetti, BS; Chelsea Carter, AuD
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

The Genetic Basis of Deafness in Populations of African Descent

Jason R. Rudman, MD; Rosemary Kabahuma, MD, PhD
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

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

Brendan P. O'Connell, MD; Jourdan Holder, AuD
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

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

Robert F. Labadie, MD. PhD; Benoit M. Dawant, PhD
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

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

MRI stability of the Vibrant Soundbridge System (VSB)

Arne Ernst, MD, PhD

The VSB system can be coupled in different ways to the ossicular chain and/or the inner ear ("vibroplasty"). MRI stability of the FMT plays an essential role in the follow-up of the patients.

In a model (in-vitro experiments), 15 temporal bones with the FMT coupled to the long process of the incus, the stapes head and the round window (RW) niche, respectively, were examined by MRI scanning (1.5 – 3 T, Gyroscan, Philips, The Netherlands). In addition (in-vivo), we retrospectively analysed the data of 8 patients (out of a series of 72 with vibroplasty) who had undergone 12 MRI scanning procedures (at 3 T) for different medical indications.

The position of the FMT was determined by light microscopy (in-vitro) pre- and post-scanning (3 scans/each TB/magnetic field strength) or by micro-endoscopy, respectively, the pictures were digitally captured and photographed. Laser-Doppler vibrometry measurements were performed pre/post scan to examine the transfer function.

Positional changes of the FMT were observed in the incus coupling mode (n=2), but no dislocation was found at 3 T. The coupling to the round window was stable at 3 T when packed with cartilage/fascia/fibrin glue). LDV measurements showed no (incus coupling) or a moderate change (RW coupling) and a loss of transfer function (stapes coupling).

Although these in-vitro experiments confirmed the potential risk of dislocation of the FMT, the few patients who underwent MRI scanning accidentally (reported earlier: Ernst et al. 2002) demonstrate a remarkable mechanical stability of the VSB system.

Define Professional Practice Gap and Educational Needs: MRI scanning procedures are common use in clinical practice, but the special requirements for patients after VSB implantation have not yet been well defined. There is an educational need therefore to define the ability to scan and to consider special precautions in different coupling modes of vibroplasty patients with a VSB.

Learning Objective: Different vibroplasty techniques require different precautions before MRI scanning to make this medical need a safe procedure for the implantees. The otologist in charge should learn how to deal with those patients and how to counsel them that MRI scanning is a safe procedure for the implantee and the VSB itself.

Desired Result: The take-home-message should be that MRI scanning can be done safely when a tight circular bandage covering the implant bed is applied before the MRI scan is started (up to 3 T).

IRB or IACUC Approval: Exempt (author indicated n/a)

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

Matthew M. Dedmon, MD PhD; Jill M. Gruenwald, PhD
Ravi Sockalingham, PhD; Marc L. Bennett, MD
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

Outpatient Management of Cholesteatoma with Canal Wall Reconstruction Tympanomastoidectomy

Richard Kao, MD; Todd J. Wannemuehler, MD
Charles W. Yates, MD; Rick F. Nelson, MD, PhD

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

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

Brandon Kamrava, BS; Jonathan Gerstenhaber, PhD
Steven A Zuniga, MD; Pallav Shah, MD
Mamta Amin, PhD; Jie Yang, DDS
Yah-el Har-el, PhD; Pamela C. Roehm, MD, PhD

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

Resolution of Post-Stapedotomy Dizziness
with Migraine Prophylactic Medication

Hossein Mahboubi, MD; Omid Moshtaghi, BS
Ronald Sahyouni, BA; Yaser Ghavami, MD
Yarah M. Haidar, MD; Harrison W. Lin, MD
Hamid R. Djalilian, MD

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
(2) review various treatment options for post-stapedotomy dizziness
(3) 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

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

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

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

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