

Genetic Mutations in Middle Ear Cholesteatoma

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Hypothesis: Mutation of a proto-oncogene may increase the pathology of a middle ear cholesteatoma.

Background: Many studies have suggested that chronic inflammation contributes greatly to the development of cholesteatoma. However, it remains unknown whether neoplastic-like features play any role.

Objective: To analyze genetic variants of middle ear cholesteatoma and address the question: Do the pathologies exhibit features of neoplasms?

Methods: DNA was extracted from cholesteatomas and blood samples of five patients, followed by exome sequencing. MuTect2 software was used to extract somatic variants present in cholesteatomas but not blood. All exons of the variant genes were analyzed using an additional 17 cholesteatoma/blood pairs. Capture baits for these genes were designed using the Sure Design system (Agilent Technology), and the genes were sequenced.

Results: Exome sequencing of five patients revealed 24 genes with somatic mutations. Sequencing of all exons of these genes in 17 additional cholesteatoma/blood pairs revealed variants in *Myc* in two samples and variants in *Notch1* in five; both genes are known proto-oncogenes.

Conclusion: Five of the 22 cholesteatoma samples exhibited variants in *Notch1* (a proto-oncogene), suggesting that *Notch1* signaling may be associated with the pathology of cholesteatoma. Further studies are necessary to explore the clinical significance of this observation.

Professional Practice Gap & Educational Need: There is limited knowledge about genetic mutations in cholesteatoma.

Learning Objective: To find out if cholesteatoma is close to a neoplasm in terms of genetic mutation.

Desired Result: There is a gene that is commonly mutated in cholesteatoma samples.

Level of Evidence - Does not apply

Indicate IRB or IACUC: This study protocol has been approved by the committee for Ethical Issues on Human Genome and Gene Analysis at Nagasaki University: 20150501-2

Bilateral Sensorineural Hearing Loss in a Patient Treated with Nivolumab and Ipilimumab for Metastatic Melanoma

*Nader Berry, BS; Karl W. Doerfer, MD; Jonathan Choi, MD
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Objective: To report a case and discuss existing literature related to diagnosis and management of sudden, bilateral, sensorineural hearing loss (SNHL) and uveitis following treatment for metastatic melanoma with immune checkpoint inhibitors Nivolumab and Ipilimumab.

Study Design: Case Report

Setting: Tertiary Neurotology Referral Center

Patients: A 77 year-old male who developed sudden, bilateral, SNHL and uveitis after starting immune checkpoint inhibitor therapy (ICIT) for metastatic melanoma.

Interventions: Treatment of SNHL using intratympanic steroid injections and systemic steroids. Treatment of uveitis with steroid eye drops.

Main Outcome Measures: Audiogram, ophthalmologic evaluation.

Results: During ICIT for metastatic melanoma, the patient developed acute, bilateral, hearing loss, auditory distortion, and vision changes. Leptomeningeal disease was ruled out. Audiogram demonstrated moderate sloping to severe high-frequency hearing loss, and poor word recognition. Ophthalmic evaluation confirmed uveitis. ICIT was held for two weeks during which he was treated with multiple intratympanic steroid injections, a high-dose, systemic steroid taper, and steroid eye drops. Following treatment, the patient's hearing and vision recovered, and ICIT was resumed.

Conclusions: This case report describes otologic side effects of ICIT with Nivolumab and Ipilimumab for metastatic melanoma. It highlights the potential efficacy of both topical and systemic steroids for SNHL and uveitis likely related to ICIT. It also shows the need for further investigation of potential otologic side effects of ICIT.

Define Professional Practice Gap & Educational Need: Sudden SNHL associated with ICIT is not well described in current otolaryngology literature. This possible adverse outcome will likely become more common as use of ICIT increases. Otolaryngologists should be aware of this disease entity, associated complications, prognosis, and management options.

Learning Objective: Increase awareness of ICIT related sudden SNHL, associated complications, prognosis, and management options.

Desired Result: To improve physicians' ability to understand, diagnose, and manage otologic complications related to ICIT.

Level of Evidence - Level V

Indicate IRB or IACUC : Exempt

**The Incremental Economic Burden of Concurrent Depression
in Hearing Loss Patients: A MEPS Study**

*Humzah A. Quereshy, MD, MBA; Noah Yaffe, BS; Brooke A. Quinton, BS
Sarah E. Mowry, MD*

Objective: To analyze the incremental economic burden of depression on adults with concurrent hearing loss in the United States

Study Design: Retrospective cross-sectional study

Methods: Using the Medical Expenditure Panel Survey (MEPS) from 2007 to 2015, patients with hearing loss with at least one outpatient visit were identified by ICD-10-CM codes and stratified based on the presence of concurrent depression. A multivariate two-part regression model was used to determine incremental economic burden, healthcare utilization, and expenditures. This form of analysis has been well-founded in other specialties and has not been replicated in otology.

Results: Of 3360 patients with hearing loss, 720 (21.43%) were diagnosed with depression (mean expenditures: \$14147.54±2101.17) and 2640 patients (78.57%) without depression (mean expenditures: \$10071.18±805.49). The prevalence of depression was higher in patients with hearing loss (21.4%) than in patients without hearing loss (13.4%) (p<0.001). Patients with hearing loss and concurrent depression were more likely to be female (p<0.001), white (p<0.001), poor (p=0.016), and have comorbidities (p<0.001). These patients faced an increased expenditure ratio compared to those without depression (expenditure ratio: 1.47 [1.22,1.77], p<0.001). These patients had higher utilization for emergency room visits and medication visits (p<0.001) and higher expenditures for emergency room visits (p=0.004) and prescription medications (p<0.001) when adjusted for sociodemographic factors and comorbidities.

Conclusions: Patients with hearing loss and concurrent depression face a significant incremental economic burden due to their diagnosis of depression, compared to those without hearing loss. Otolaryngologists need to be more cognizant of the burden of depression among this patient population.

***Professional Practice Gap & Educational Need:** Lack of awareness and treatment of multidisciplinary effects of hearing loss

***Learning Objective:** Increase awareness of the compounding effect of hearing loss and psychiatric illness on financial toxicity.

***Desired Result:** Improve comprehensive care provided by otologists and neurotologists to holistically support their hearing loss patient population.

***Level of Evidence - III**

***Indicate IRB or IACUC:** Exempt

Hearing Test History and Discordance between Audiometry-Measured and Self-Reported Hearing

*Janet S. Choi, MD MPH; Tyler J. Gathman, BS; Tina C. Huang, MD
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Objective: Discordance between objective and subjective measures of hearing is prevalent. However, the role of an audiogram on one's assessment of hearing has not been explored on a population-level. This study aims to investigate the association between hearing test history and discordance in audiometry-measured and self-reported hearing.

Study Design: National cross-sectional study.

Setting: 2005-2016 National Health and Nutrition Examination Survey

Patients: 13,832 participants (12-85+ years)

Intervention: Survey (self-reported hearing condition; time of last hearing test) and pure-tone audiometry.

Main outcome measure: Discordance between audiometry-measured hearing loss (defined as speech frequency pure-tone average ≥ 25 dB HL in better hearing ear) and self-reported hearing loss.

Results: Rates of discordance between audiometry-measured and self-reported hearing were 15.4% [95% CI: 14.4-16.6%] overall and significantly higher among older adults (≥ 60 years) at 25.7% [95% CI: 24.1-27.5%]. Discordance was most prevalent among older adults who have never had their hearing tested (27.9% [95% CI: 24.5-31.6%]) and those who had hearing tested within 5 years (22.8% [95% CI: 19.3-26.7%]). In multivariate analyses adjusting for demographics, audiometric hearing loss severity, and tinnitus, underreporting of hearing loss was significantly less likely among individuals who had hearing tested previously (OR: 0.52 [95% CI: 0.40-0.67]), especially if they were tested less than 1 year ago (OR: 0.17 [95% CI: 0.10-0.26]).

Conclusions: Rates of discordance between audiometry-measured and self-reported hearing were higher for older adults who experience greater health consequences of hearing loss and would benefit most from amplification. Routine audiometric testing accompanied by proper counseling and education may improve awareness of hearing loss and understanding of one's own hearing, particularly among older adults.

***Professional Practice Gap & Educational Need:** This study will improve the current gap in our knowledge on the impact of hearing test on one's assessment of hearing on a population level.

***Learning Objective:** At the conclusion of this presentation, the participants should be able to recognize the difference in rates and patterns of discordance between audiometry-measured and self-reported hearing by history of previous hearing test.

***Desired Result:** Findings from the study will inform physicians about the potential role of audiogram for improving the discordance in subjective and objective measures of hearing in the US population, especially in older adults who commonly underreport their hearing loss.

***Level of Evidence** – level III

***Indicate IRB or IACUC:** Exempt

Understanding the Impact of a Global Pandemic on Cochlear Implantation in the United States

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

Objective: Cochlear Americas and Advanced Bionics together supply approximately 85% of cochlear implants (CIs) in the United States. The objective of the current study was to characterize the impact of the COVID-19 pandemic on national cochlear implantation rates using Cochlear Americas and Advanced Bionics cochlear implantation data between 2015 and 2020 across all ages.

Study Design: Analysis of prospectively registered patient data from two major CI manufacturers in the United States.

Patients: Children or adults who received unilateral or bilateral CIs.

Interventions: Cochlear implantation.

Main Outcome Measures: Annual implantation rates by age.

Results: A total of 46,346 patients received CIs between 2015 and 2020. The annual number of implant recipients increased significantly during the first five years of the study period for both children and adults, from a total of 6,179 in 2015 to 9,226 in 2019 ($p < 0.001$). During 2020, national cochlear implantation rates witnessed a -13.1% drop across all ages compared to 2019, including a drop of -1.6% for those aged ≤ 3 years, -4.7% for those aged 4-17, -9.8% for those aged 18-64, -16.7% for those aged 65-79, and -22.6% for those aged ≥ 80 . In a multivariable linear regression model, the percent drop in CIs differed significantly by age group ($p = 0.004$) but not by miles traveled by the patient from home to the CI center ($p = 0.45$).

Conclusions: Children ≤ 3 years old were prioritized nationally with minimal interruption witnessed during 2020. Increasing age was associated with experiencing significantly greater decreases in cochlear implantation rates, with those aged ≥ 80 years old experiencing more than a 3-year setback in total annual CIs.

Professional Practice Gap & Educational Need: The COVID-19 pandemic introduced multiple barriers to cochlear implantation, and thus far the magnitude of the pandemic's impact on cochlear implant hearing healthcare in the United States is unknown. The current study reports national cochlear implantation rates directly from two of the major cochlear implant manufacturers in the United States inclusive of the year 2020. Identifying uniquely disadvantaged subgroups of the population affected by the pandemic may facilitate development of widespread efforts to correct the backlog in cochlear implant hearing healthcare.

Learning Objectives:

- (1) Describe the rising annual rates of cochlear implantation for two of the major cochlear implant manufacturers in the United States between 2015 and 2019.
- (2) Understand the unique impact of the COVID-19 pandemic on national trends in cochlear implantation, particularly surrounding the differences between children with congenital deafness and adults of advanced age.
- (3) Describe the month-to-month variation in cochlear implantation rates across the United States as it relates to national COVID-19 numbers during the year 2020.
- (4) Understand the influence of patients' location of geographic residence on likelihood of receiving a cochlear implant during the COVID-19 pandemic.

Desired Result: Physicians and researchers would be able to better understand the impact of the COVID-19 pandemic on patient access to cochlear implants across the United States.

Level of Evidence: III

Indicate IRB or IACUC: Exempt.

Migraine Features in Patients with Fluctuating Hearing Loss

*Mehdi Abouzari, MD, PhD; Shahrnaz Jamshidi, MD; Alizah S. Gomez, BS
Negaar Aryan, MD; Ariel Lee, BS; Hamid R. Djalilian, MD*

Objective: To evaluate the presence of migraine features in patients with fluctuating hearing loss.

Study Design: Retrospective cohort.

Setting: Tertiary-care neurotology clinic.

Patients: Fifty-nine patients diagnosed with fluctuating hearing loss (other etiologies ruled out with exam, audiometry, CT scan, and MRI) between 2013-2021, with a mean age of 56 ± 16 years.

Interventions: Patients were evaluated for meeting the International Classification of Headache Disorders (ICHD) 3rd edition criteria for migraine headache without aura.

Main Outcome Measures: We compared the prevalence of migraine features in patients who met the majority of ICHD 3rd edition criteria (3 or more out of 5) for migraine headache to those who did not (less than 3 out of 5).

Results: There were 32 females (54%) and 27 male (46%) patients. Forty-two patients (71%) fulfilled 3 or more ICHD criteria for migraine headache without aura (migraine group). Of the patients who met less than 3 criteria (non-migraine group), 1 (2%) met 2/5 criteria, and 16 (27%) met 1/5 criteria, for a total of 17 (29%) patients. Migraine features were not significantly different between the migraine and non-migraine groups.

Conclusions: A large proportion of fluctuating hearing loss patients with migrainous features do not meet the ICHD criteria for migraine headache. The lack of meaningful differences in migraine features between patients in our cohort who fulfilled the majority of ICHD migraine criteria and those who do not represent selection bias rather than meaningful features unique to the cohorts. The diagnostic criteria for migraine may be too strict and unnecessarily exclude many patients from receiving migraine treatment.

Define Professional Practice Gap & Educational Need: Many patients with migraine-related fluctuating hearing loss do not meet the ICHD criteria for migraine and thus may not be treated as migraine patients by clinicians. In order to account for these patients, it will be important to re-examine the ICHD migraine criteria and to determine whether there exist meaningful differences in the prevalence of migraine features and symptomatology in these patients compared to those who meet the ICHD migraine criteria. Our study further supports the need to evaluate patients presenting with fluctuating hearing loss for possible migraine disorder when other causes have been ruled out.

Learning Objective: To educate ANS members on a series of patients with fluctuating hearing loss and identify limitations in the diagnostic criteria for migraine that may prevent patients from receiving appropriate treatment.

Desired Result: Increased awareness and consideration of migraine-related fluctuating hearing loss in the differential diagnosis by clinicians and expansion of the ICHD criteria for migraine headache may help expand the pool of patients who benefit from migraine therapy.

Level of Evidence - IV

Indicate IRB or IACUC: The study has IRB approval from the UC Irvine review board under the PI name of Hamid R. Djalilian.

Hearing Aids Enhance Active Music Enjoyment among Individuals with Hearing Loss

*Alexander Chern, MD; Michael W. Denham, BA, BS, MPhil; Alexis S. Leiderman, BS
Rahul K. Sharma, MD; Anil K. Lalwani, MD*

Objective: The impact of hearing aids (HAs) on music enjoyment is poorly studied. We examine the effect of HAs on active music enjoyment in individuals with varying levels of hearing loss (HL).

Study Design: Cross-sectional, within-subjects design

Setting: Tertiary medical center, community

Patients: Adult (≥ 18 years) bilateral HA users

Interventions: HA usage

Main Outcome Measures: The main outcome was music enjoyment. Subjects actively listened to musical stimuli and rated their enjoyment across three validated measures (pleasantness, musicality, and naturalness) with and without their HAs (order of conditions randomly assigned) using a visual analog scale. The main exposures were HA usage and HL (measured by pure tone average [PTA] and word recognition score [WRS] of the better ear).

Results:

One hundred bilateral HA users (mean age 66.0 years, 52% female, 44% with music experience, better ear mean PTA 50.2 dB, mean WRS 84.5) completed the study. Multivariable linear regression demonstrated increasing severity of HL was associated with decreased music enjoyment (pleasantness, musicality, naturalness) with and without HAs ($p < 0.05$), adjusting for age, sex, education, race, HA type, age HL diagnosis, duration HL, duration HA use, musical preference, musical experience, and music discrimination. The use of hearing aids increased music enjoyment (musicality) across all subjects and subjects with moderate to moderately-severe HL (paired t-test).

Conclusions: Increased severity of HL is associated with decreased music enjoyment that can be enhanced with the use of HAs. Thus, the use of hearing aids can positively enhance both speech and music appreciation.

Define Professional Practice Gap & Educational Need: Hearing aids were designed for speech, not music listening. The impact of hearing aids on music enjoyment is poorly studied. Understanding this association will help inform healthcare personnel of the effect of hearing aids on music enjoyment across a range of hearing loss.

Learning Objective: After this presentation, the learner will be able to describe the relationship between hearing loss and music enjoyment, as well as the potential effect of hearing aids on music enjoyment.

Desired Result: Otolaryngologists will better understand the relationship between hearing loss and music enjoyment.

Level of Evidence – Level III

Indicate IRB or IACUC: Columbia Irving University Medical Center IRB-AAAR3559

Cochlear Implantation Outcomes in the Older Adult: A Scoping Review

Emily Kay-Rivest, MD, MSc; Jamie Schlacter, BSc; Susan Waltzman, PhD

Objective: To summarize available literature on cochlear implantation outcomes in older adults.

Data sources: MEDLINE, Embase and Web of Science were searched through July 2021.

Study selection: A scoping review was performed in accordance with the Preferred Reporting Items of Systematic Reviews and Meta-analysis extension for scoping review (PRISMA-ScR) guidelines. Studies reporting outcomes of CI recipients over age 60 were reviewed.

Data extraction: Extracted data was divided into five categories: open-set speech perception scores, perioperative complications and type of anesthesia, neurocognitive outcomes, quality of life assessments and vestibular outcomes/falls.

Data synthesis: Over 3000 abstracts were screened, and 107 studies were included from 21 countries, encompassing 5704 patients. 79 studies reported speech perception outcomes. Elderly patients achieved scores similar to younger patients, which were stable over time (over 10 years). Perioperative complications were discussed in 38 studies, with minor complications occurring in 0 to 23.5% of patient. 105 patients underwent CI under local anesthetic. Neurocognitive outcomes were assessed in 13 studies (10 prospective). Over a 7-year period, patients with mild cognitive impairment who underwent CI had lower rates of progression to dementia. Quality of life was assessed in 44, demonstrating improvements on various depression, anxiety and loneliness scales. Eight studies reported vestibular outcomes, and although changes in vestibular function were noted objectively, there was no increased incidence of postoperative falls.

Conclusions: Age should not be a limiting factor in cochlear implant candidacy, as older patients can achieve comparable performance with low rates of adverse events. Longitudinal studies will help assess long-term changes in cognition, and whether CI truly prevents cognitive decline.

***Professional Practice Gap & Educational Need:** 1) There is no comprehensive review of current literature which encompasses multiple important outcomes in older adults undergoing CI. 2) Research gaps are identified and can guide future studies towards areas that are less well described, such as neurocognitive outcomes, vestibular function changes, and the role of frailty.

***Learning Objective:** To review open-set speech perception scores, perioperative complications and type of anesthesia, neurocognitive outcomes, quality of life assessments and vestibular outcomes/falls in older adults undergoing CI.

***Desired Result:** Our goal is to provide attendees with a concise roadmap when faced with an older adult undergoing a CI, allowing them to better counsel patients and their families using the available outcomes literature.

***Level of Evidence - NA**

***Indicate IRB or IACUC:** Exempt.

Defining the Learning Curve for Endoscopic Ear Surgery: A Multi-Institutional Study

*Kevin Wong, MD; Scott Gorthey, MD; Annie E. Arrighi-Allisan, BA; Caleb J. Fan, MD
Zachary G. Schwam, MD; George B. Wanna, MD; Maura K. Cosetti, MD*

Objectives: 1) Quantify the learning curve for transcanal endoscopic ear surgery (TEES) and 2) determine if demographic factors or previous experiences influence skill development.

Study Design: Prospective, multi-center study.

Setting: Two academic teaching hospitals.

Subjects: 38 otolaryngology residents from two residency programs in the United States, 26 from program A and 12 from program B.

Interventions: Each participant completed a demographics survey and questions regarding previous otoendoscopy, sinus endoscopy, and video game experience. Residents then completed 10 amassed trials of a “precision stacking” task using a validated endoscopic ear simulator.

Main Outcome Measures: Trial completion times; rate of improvement over time; inverse regression learning curves.

Results: Mean age was 30 years old (range 26-34 years). Fifteen participants were female and 23 were male. Combined task completion times were analyzed over 10 trials to create inverse learning curves using non-linear regressions. The greatest improvements occurred over the first 3 trials and plateau reached before the 10th trial. Prior experience with otoendoscopy (B=-16.7, p=0.005) and sinus endoscopy (B=-23.4, p=0.001) independently correlated with lower overall trial times. However, on multivariate logistic regression, residents *without* prior endoscopic experience improved at a faster rate than those with experience (p<0.001). Age, gender, postgraduate year, handedness, interest in otology, and video game experience did not correlate with trial times.

Conclusions: Novice surgeons can acquire endoscopic ear experience with simulation training. Specific task competencies can be achieved within 10 trials, suggesting that prior experiences, or lack thereof, may not dictate the ability to acquire new skills. There may be a translational value to previous endoscopic sinus experience on learning TEES.

Define Professional Practice Gap & Educational Need: As the prevalence of endoscopic ear surgery grows, uncertainties remain in regards to many aspects of its teaching and training. Defining the learning curve is one crucial step with implications for both patient safety and residency education.

Learning Objective: 1) Understand the learning curve for novice surgeons learning endoscopic ear surgery; 2) recognize the benefit of previous endoscopic experience –ear and sinus alike – for skills development.

Desired Result: 1) Increased incorporation of simulation into otology training; 2) recognition of learning curves as an important metric to optimize teaching, improve surgical outcomes, and minimize patient risk.

Level of Evidence: III - Cohort

Indicate IRB or IACUC: Mount Sinai Institutional Review Board (IRB- 20-01637)

**Severe Hearing Loss is Associated with Poor Dynamic Balance
Regardless of Vestibular Status and Age**

*Maria A. Mavrommatis, MD; Anat Lubetzky, PT, PhD, CSCS; Jennifer Kelly, DPT, NCS
Brittani Morris, DPT; Sarah Mischianti, SPT; Andrew Medlin, SPT; Maura Cosetti, MD*

Objective: To identify the relationship between Hearing Class and dynamic balance

Study design: Cross-sectional

Setting: Tertiary academic practice

Patients: 86 patients (mean age 56.5 ± 17.7 years) who underwent behavioral audiometry and assessments of dynamic balance; 46 (53.5%) had hearing loss alone, 17 (19.8%) had vestibular dysfunction alone, and 23 (26.7%) had both

Intervention(s): Timed Up-and-Go (TUG) and Four-Square Step Test (FSST)

Main outcome measure(s): TUG and FSST are timed tests of dynamic balance where slower performance is associated with an increased risk for falls; Hearing Class as defined by the AAO-HNS guidelines, increasing in severity from Class A to D.

Results: 60 patients were classified as Hearing Class A (including all 17 patients with vestibular dysfunction alone and 15/23 (65.2%) patients with both vestibular dysfunction and hearing loss.) 12 were Hearing Class B, 9 were Class C, and 5 Class D. Overall, progressively slower TUG and FSST scores were noted with increasing Hearing Class. Class D was significantly slower than Class A in the FSST and TUG tests ($p = 0.025$ and 0.002 , respectively) and Class B in FSST alone ($p = 0.018$). Age could not exclusively explain poorer TUG and FSST scores in patients with a higher Hearing Class, as Class D was not significantly older than Class B despite significant differences in FSST scores between the two groups ($p = 0.013$).

Conclusions: Severe hearing loss may independently contribute to balance dysfunction and risk of falls. Given the small number of patients in Class D, these results should be interpreted with caution and suggest further investigation into hearing loss and dynamic balance is warranted.

Define Professional Practice Gap & Educational Need: While it is widely accepted that vestibular dysfunction contributes to difficulties with dynamic balance, it appears that hearing loss may also have a significant impact.

Learning Objective: Severe hearing loss may contribute to balance dysfunction and risk of falls, independent from vestibular dysfunction and age.

Desired Result: Improved understanding of the relationship between hearing loss and dynamic balance may guide fall-risk intervention and therapy for patients with advanced hearing loss.

Level of Evidence – Level IV

Indicate IRB or IACUC: Mount Sinai 18-00431

Comparison of CT Incidence of SSWA and SCD in a Cohort of Patients with Idiopathic Pulsatile Tinnitus Compared with Control

*Nathan D. Cass, MD; Nathan R. Lindquist, MD; Miriam R. Smetak, MD
Ankita Patro, MD; Kareem O. Tawfik, MD*

Objective: Determine incidence of SSWA and SCD in pulsatile tinnitus patients compared with a control group.

Background: Patients with idiopathic pulsatile tinnitus (PT) who undergo workup with high resolution CT scan are occasionally found to have sigmoid sinus wall abnormalities (SSWA) or superior semicircular canal dehiscence (SCD), and may be offered surgery. We sought to confirm the incidence of these radiographic diagnoses in a representative group of patients with otherwise idiopathic PT, and compare it with a control group without idiopathic PT.

Study Design: Retrospective.

Setting: Tertiary care center.

Subjects: Patients with pulsatile tinnitus (n=46) or cochlear implant candidates (n=29) serving as controls who underwent high resolution CT scan (slice thickness 0.5 to 0.67mm) at our institution.

Main Outcome Measures: Incidence of SSWA and SCD, compared via unpaired T-test.

Results: Incidence of SCD is similar ($p=0.81$) between controls (13.8%) and PT subjects (13.0%), whereas SSWA is more common ($p=0.0015$) in PT subjects (17.4%) than controls (6.9%).

Conclusions: SSWA is likely causing PT in patients who exhibit this radiographic finding, without another obvious cause for PT. SCD is found at similar rates in our control group, leading us to believe SCD is less likely to be the causative agent in idiopathic PT. Further investigation is necessary to explain the high incidence of SCD in cochlear implant candidates.

Define Professional Practice Gap & Educational Need: We aim to compare incidence of SSWA in patients with PT, using a control group comparator, to give a better understanding of the incidence in the population to ensure neurotologists are treating the true underlying pathology in those who suffer from this condition.

Learning Objective: Understand the incidence of SSWA in a control group, compared to those with pulsatile tinnitus.

Desired Result: Apply the incidence of these conditions to practice, to offer surgical therapy to those with the best chance of experiencing symptom resolution.

Level of Evidence: III

Indicate IRB or IACUC: Vanderbilt University Medical Center IRB #210996

**Automated Whole Cochlear T2 Signal Changes Do Not Correlate
with Hearing Loss in Observed Acoustic Neuroma**

*Nathan D. Cass MD; Yubo Fan, MS; Nathan R. Lindquist, MD
Benoit M Dawant, PhD; Kareem O. Tawfik. MD*

Objective: To evaluate the correlation between whole cochlear T2 signal changes obtained with a novel automated segmentation method and hearing levels, both at diagnosis and over time, in patients with observed acoustic neuroma.

Study Design: Retrospective evaluation at a tertiary neurotology practice.

Setting: Academic medical center neurotology practice and associated collaborative engineering program.

Patients: 127 patients with acoustic neuroma observed over time, each with ≥ 2 MRI scans (367 total) and ≥ 2 audiograms (472 total) over that time period.

Main Outcome Measures: Correlation of the ipsilateral-to-contralateral ratio of whole cochlea T2 signal with hearing outcomes as measured by pure tone average (PTA) and word recognition score (WRS).

Results: The ratio of cochlear T2 signal, as determined by a novel automated method, did not show a correlation with hearing levels at diagnosis. Change in signal ratio over time did also not correlate with changes in hearing over time. Cochlear signal ratio change did not precede, nor follow, changes in hearing.

Conclusions: Whole cochlear T2 signal ratio does not correlate with hearing levels in patients with observed acoustic neuroma. Nevertheless, the technology of automated segmentation and signal processing holds great promise for future evaluation of other clinical entities that may be associated with cochlear signal changes.

Define Professional Practice Gap & Educational Need: When counseling patients with small to medium sized acoustic neuroma, surgeons desire better markers for identifying the rates at which hearing will be lost in different patients, as it may clarify treatment recommendations. This study sought to evaluate one such marker via an innovative machine learning algorithm measuring cochlear T2 signal.

Learning Objective: To understand the correlation, or lack thereof, between T2 cochlear signal and hearing levels in patients with observed acoustic neuroma.

Desired Result: We hope that neurotologists will continue to search for better markers of impending hearing loss in observed acoustic neuroma.

Level of Evidence: V

Indicate IRB or IACUC: IRB Approved (#210996, Vanderbilt University Medical Center)

**Stapedotomy Outcomes of Retrofenestral Otosclerosis:
Association of the Halo Sign with Surgical Outcomes**

*Robert M. Conway, DO; Pedrom C. Sioshansi, MD; Amy Schettino, MD; Dennis I. Bojrab, MD
Christopher A. Schutt, MD; Seilesh C. Babu, MD*

Objective: To examine the association of the “halo sign” on computed tomography (CT) with pre- and postoperative audiologic outcomes

Study Design: Retrospective chart review

Setting: Single tertiary care center

Patients: Adult patients undergoing primary stapedotomy with perioperative CT scan

Interventions: Stapedotomy

Main Outcome Measures: Patients were grouped based on the presence or absence of a halo sign on perioperative CT. Audiologic outcomes compared were pre- and postoperative word recognition score (WRS) and pure tone averages (PTA), bone conduction thresholds, and air-bone gap (ABG) in decibels (dB). Complications examined included postoperative profound hearing loss, facial paralysis, BPPV, or third window symptoms.

Results: Two hundred twenty-nine consecutive patients undergoing stapedotomy with perioperative CTs were included, 30 in the halo sign group and 199 in the non-halo sign group. Both preoperative PTA and ABG were significantly worse in the halo group. Preoperative ABG was 29.3 dB and 24.8 dB for the halo and non-halo groups, respectively ($p=0.01$). Similarly, preoperative PTA was 61.9 and 53.4 dB for halo and non-halo groups, respectively ($p<0.05$). There was no difference in preoperative mean bone conduction thresholds or WRS. Postoperative PTA, ABG, mean bone conduction thresholds did not differ significantly between the two groups. There was no difference in the complication profile between the two groups.

Conclusions: Patients with a halo sign on CT had significantly worse preoperative PTA and ABG compared to those without a halo sign. Both groups improved significantly following stapedotomy with similar postoperative audiologic outcomes.

***Professional Practice Gap & Educational Need:** There is limited evidence available on how halo sign on CT affects audiologic outcomes of patients undergoing stapedotomy.

***Learning Objective:** To increase the evidence of how CT image findings may affect stapedotomy outcomes.

***Desired Result:** To demonstrate that patients with halo sign on CT scan have similar outcomes after stapedotomy.

***Level of Evidence - IV**

***Indicate IRB or IACUC :** 1130957-4

**Evaluation of Psoriatic Disease on the Audio-Vestibular System:
Systematic Review & Meta-Analysis**

Seth S. Jeong, BA; Michael C. Shih, BS; Paul R. Lambert, MD

Objective: To explore the association between psoriasis and the audio-vestibular system.

Data sources: Following PRISMA guidelines, the English-language literature from Pubmed, Scopus, CINAHL, and Cochrane databases were searched from inception to October 7, 2021.

Study selection: Included studies described audiometric or vestibular findings for subjects with psoriasis.

Data extraction: Risk of bias was assessed using Cochrane Handbook for Systematic Reviews of Interventions. Primary outcomes were audiometric and vestibular assessments.

Data synthesis: Continuous variables were summarized as pooled means (standard deviation). Meta-analysis was represented as odds ratios (OR) or mean difference (MD) with 95% confidence intervals.

Results: A total of 11 studies with 528 psoriasis and 558 controls were included. Age did not significantly differ between psoriasis (46.0[11.7]) and controls (46.7[13.0]) (MD 0.42[-1.33, 2.18], $p=0.64$). PASI score was 7.8 (7.8). Psoriatic manifestations included 94 plaque psoriasis, 21 guttate, 20 palmoplantar, 6 inverse, and 2 erythromatous. Audiometry analysis showed that speech reception threshold was worse with psoriasis (MD 3.48[1.88, 5.08] dB, $p<0.0001$). Greater hearing loss was present in psoriasis patients compared to healthy controls (MD 4.06[2.89, 5.22] dB, $p<0.00001$). Abnormal stapedial reflex was more common in psoriasis (OR 5.24[1.70,16.13], $p=0.004$). Abnormal vestibular testing was more common in psoriasis for caloric testing (OR 17.66[4.25, 73.29], $p<0.0001$) and saccade test (OR 5.07[1.64,15.65], $p=0.005$). Two additional studies of 41681 psoriasis and 80273 controls found that psoriasis patients were at higher risk for sudden sensorineural hearing loss (OR 1.50[1.25,1.80], $p<0.0001$)

Conclusions: Psoriasis is associated with hearing loss and vestibular dysfunction. The mechanisms of otologic manifestations remain unclear, and more basic science and translational research is needed.

***Professional Practice Gap & Educational Need:** Need for increased understanding regarding interplay of psoriasis with the audio-vestibular system.

***Learning Objective:** To understand the extent psoriasis can impact a patient's audio-vestibular system

***Desired Result:** Considerations for improvement of patients' quality of life, and call for basic science and translational research.

***Level of Evidence - III**

***Indicate IRB or IACUC : N/A**

**Video Education Before Cochlear Implantation Enhances Patient Knowledge and Confidence:
A Randomized-Controlled Study**

*Ankita Patro, MD, MS; David S. Haynes, MD; Kareem O. Tawfik, MD
Matthew R. O'Malley, MD; Marc L. Bennett, MD
Robert F. Labadie, MD, PhD; Elizabeth Perkins, MD*

Objective: Evaluate video education's effects on patient knowledge and attitudes related to cochlear implantation (CI).

Study Design: Prospective, provider-blinded, randomized-controlled trial.

Setting: Tertiary referral center.

Patients: 56 adult CI candidates (28 video, 28 control) between 2020 and 2021.

Interventions: Following initial consultation with the surgeon and audiologist, patients were randomized into either the video or control group. Both groups completed five surveys: (1) prior to arrival; (2) after initial consultation; (3) on the day of surgery; (4) at the 1-month postoperative visit; and (5) at the 3-month postoperative visit. Video group participants viewed a 15-minute video on the CI process prior to completing the second survey.

Main Outcome Measures: Demographics, 17-question knowledge quiz, patient attitudes.

Results: There were no differences in age ($p=0.83$), gender ($p=0.79$), race ($p=0.33$), education level ($p=0.58$), income ($p=0.17$), time to surgery ($p=0.88$), or baseline knowledge ($p=0.08$) between the video and control groups. Video group participants had significantly higher knowledge scores after initial consultation (83% vs. 67%, $p<0.001$) and at 1 month post-op (80% vs. 70%, $p=0.02$). On the day of surgery, a higher percentage of the video group (87%) felt fully confident in pursuing implantation compared to the control group (58%) ($p=0.02$). Nearly half of the video group reported that the videos directly influenced their decision to proceed with CI surgery. Average rating for the videos was 9.2 out of 10.

Conclusions: Video supplementation to the traditional CI process improved patient understanding at multiple timepoints and significantly increased confidence in pursuing surgery.

Define Professional Practice Gap & Educational Need: While video education has been used in other specialties to decrease patient anxiety and increase knowledge, the role of videos for CI patients, who already struggle with social deprivation and communication during traditional office visits, has yet to be explored.

Learning Objective: To highlight the utility of video education in the CI process and demonstrate its benefits in patient understanding and confidence.

Desired Result: To report patient knowledge and attitude gains with educational videos and, in turn, encourage their adoption as a standard part of the CI process.

Level of Evidence: Level II.

Indicate IRB or IACUC: IRB Exempt (201932, Vanderbilt University).

Extensive Cervicofacial Emphysema Post Eustachian Tube Balloon Tuboplasty

Isabelle JH Jang, MD, MMed (ORL)
Hengwai Yuen, MMed (ORL), FAMS (ORL)

Objectives:

1. To report the rare complication of cervicofacial subcutaneous emphysema post eustachian tube balloon dilation.
2. To discuss factors that could predispose patients to this complication, and preventive measures.

Study Design: Retrospective case review.

Setting: Tertiary hospital.

Case summary: 50-year-old male presented with recurrent right eustachian tube dysfunction causing ear blockage and intermittent middle ear effusion. He underwent two previous right Eustachian tube balloon tuboplasty under general anesthesia. Both procedures were uneventful, done at one-year intervals, with resolution of symptoms between procedures. One year after the last procedure, he presented with similar signs and symptoms. Clinical examination showed right tympanic membrane retraction, with poor mobility on Valsalva maneuver. Audiometry showed right mixed hearing loss with type C tympanogram. He underwent right Eustachian tube balloon tuboplasty again under general anesthesia. On the first post-operative day, patient developed palpable subcutaneous emphysema over bilateral parotid, neck, and suprasternal region. The postoperative computed tomography (CT) images with contrast showed extensive emphysema in subcutaneous and deep spaces of bilateral face and neck, extending to the mediastinum. Complete resolution was seen with conservative treatment.

Conclusions: This case highlights the rare complication of subcutaneous emphysema and pneumomediastinum post eustachian tube balloon tuboplasty. Clinicians must employ meticulous techniques to ensure minimal trauma, and be watchful for such complications post-procedure, even if the procedure was uneventful. Post-procedure advice to avoid Valsalva maneuvers, effortful coughing, sneezing, blowing of nose and heavy weightlifting should be advised. Furthermore, clinicians should take care to choose appropriate patients for this procedure and consider pre-operative imaging if deemed necessary.

***Professional Practice Gap & Educational Need:** To report the rare complication of cervicofacial subcutaneous emphysema post eustachian tube balloon dilation, including images showing the extent of extensive subcutaneous emphysema. This case also allows discussion of factors that could predispose patients to this complication, and how it can be avoided.

***Learning Objective:** For clinicians to learn about the possible complication of subcutaneous emphysema and pneumomediastinum post eustachian tube balloon tuboplasty; and to discuss predisposing factors, preventive measures, and management of the complication.

***Desired Result:** For clinicians to be aware of the rare complication of subcutaneous emphysema and pneumomediastinum post eustachian tube balloon tuboplasty, and to adapt measures for prevention when performing the procedure.

***Level of Evidence** – Level V.

***Indicate IRB or IACUC:** Exempt.

Cochlear Implant Hearing Outcomes vary by Implant Type in the Presence of Congenital Inner Ear Malformations

*Jake Langlie, BS; Ariel Finberg, BS; Chrisanda Sanchez, AuD, Molly R. Smeal, AuD
Meredith Holcomb, AuD; Rahul Mittal, PhD; Adrien A. Eshraghi, MD, MSc*

Objective: Cochlear implant (CI) indications have expanded to include patients with severe to profound sensorineural hearing loss due to inner ear malformations (IEM). In this study, we determined CI outcomes and surgical complications in children with IEM.

Study Design: Retrospective chart review.

Setting: Tertiary care hospital.

Patients: Children under 18 years old with congenital IEM (n=32), implanted between 2011-2021.

Intervention: CI surgery in patients with IEM.

Main Outcome Measures: Electrode design type (perimodiolar vs lateral wall), complication rate, speech recognition threshold (SRT), and speech awareness threshold (SAT) were compared pre-operatively and post-operatively.

Results: For children receiving CI for IEM, the mean age was 4 years old (SD: 2.3), 69% were male, and 57% reported English as their primary language. SRT and SAT scores were compared with mean improvements of 58 dB and 54 dB following surgery. The most common IEM was enlarged vestibular aqueducts (EVA). In implanted patients with EVA, rate of complication (gusher, electrode extrusion, reimplantation) varied by implant type with 63% of perimodiolar implants and 33% of lateral wall implants having surgical complications. Among these patients, those receiving a perimodiolar implant had less average improvement of hearing 8-12 months postoperatively (SRT = 42 dB; SAT = 47 dB) compared to those receiving a lateral wall implant (SRT = 70 dB; SAT = 80 dB)

Conclusions: Individuals with IEM can benefit from CI as indicated by improvement in SRT and SAT post-operative scores. Perimodiolar electrodes, designed to accommodate normal inner ear anatomy, appear to have higher rates of complications and less gain of function post-implantation compared to lateral wall electrodes in patients with EVA.

***Professional Practice Gap & Educational Need:** Limited cohort studies have been performed regarding outcomes of CI implantation in patients with congenital inner ear malformations, especially in the US population. Previous case studies have shown greater complication rates during cochlear implantation of patients with inner ear malformations.

***Learning Objective:** Recognize that cochlear implant patients with inner ear malformations suffer from greater surgical complications, and therefore, should have better consultation about alternative options and greater surgical planning prior to implantation.

***Desired Result:** Physicians will gain knowledge about the benefits and risks of cochlear implant surgery in patients with specific congenital inner ear malformations. This study will aid in electrode selection, gusher management, prevention of electrode extrusion, and guide the need for immediate post-operative radiology exams.

***Level of Evidence – Level IV**

***Indicate IRB or IACUC:** University of Miami IRB #20141009, approved 1/19/2021

Surgical Outcomes of Hearing Rehabilitation After Transcutaneous Bone-Conduction Implantation in a Large Adult and Pediatric Case Series

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Ursula M. Findlen, PhD; Yin Ren, MD, PhD; Oliver F. Adunka, MD*

Objective: To assess surgical outcomes following implantation of the active transcutaneous bone conduction implant Bonebridge®.

Study Design: Retrospective review of all Bonebridge® implants.

Setting: Tertiary referral center.

Patients: Bonebridge® recipients from January 2017 to August 2021.

Interventions: Active transcutaneous bone conduction implantation.

Main Outcome Measures: Age, sex, surgical indication, prior hearing aid use, operative time, post-operative complications, follow-up time and further treatments.

Results: There were 42 adults (mean age 45 years; 67% female; average follow-up 21 months \pm 20.6 months) and 20 children (mean age 13.1 years; 60% female; average follow-up 41 months \pm 20.4 months) who received a Bonebridge® implant. Indications for implantation included conductive hearing loss (adults 40%, children 75%), mixed hearing loss (adults 27%, children 5%) and single-sided deafness (adults 33%, children 20%). Most common etiologies of hearing loss included cholesteatoma (adults 24%, children 20%), aural atresia (adults 14%, children 20%), chronic otitis media (adults 14%, children 20%), sudden sensorineural hearing loss (adults 17%), tympanic membrane perforation (adults 12%) and sensorineural hearing loss status-post vestibular schwannoma resection (adults 7%). Average operative time was 100 \pm 41 minutes. Bilateral implantation was performed in one adult and one child. Six adults (14%) experienced complications requiring explantation, with two electing to not undergo reimplantation. Two children experienced overlying skin infection and one developed wound dehiscence, with none requiring explantation.

Conclusions: In the largest North American series to date consisting of both adult and pediatric patients, Bonebridge® implantation was a safe aural rehabilitation option for a variety of etiologies.

***Professional Practice Gap & Educational Need:** There is a lack of data regarding large dataset outcomes in both adult and pediatric patients in North America following implantation of the active transcutaneous bone conduction implant Bonebridge®.

***Learning Objective:** To discuss and elucidate long-term surgical outcomes following Bonebridge® implantation in adult and pediatric patients.

***Desired Result:** To provide evidence regarding the safety of the Bonebridge® bone conduction implant for adults and children in North America.

***Level of Evidence – Level V**

***Indicate IRB or IACUC :** Approved Adult IRB Number: 2019H0366 and Pediatric IRB Number: STUDY00001609

Intraoperative Electrocochleography with Active Insertion Monitoring to Assist in Preserving Residual Hearing during Cochlear Implantation: A Single Center's Experience

*Michael J. Eliason, MD; Kanthaiah Koka, PhD; Luke Edelmayer, MD
Michael D. Seidman, MD*

Objective: To provide the initial data and lessons learned on sixteen patients at a single center by a single surgeon whose cochlear implant (CI) was performed using real-time Electrocochleography (ECochG) assessment during array insertion.

Study Design: retrospective case series

Setting: Tertiary Care Otolaryngology/Neurotology Practice

Patients: Sixteen patients was performed on consecutive patients who underwent CI by the senior author using real-time ECochG monitoring with AIM system from January, 2019 to November, 2020.

Interventions: Patients were prospectively identified and ultimately underwent implantation at a single tertiary care institution using Advanced Bionics cochlear implants. There were 6 Ultra HiRes implants and 10 Ultra HiRes 3D implants. There were 3 patients with HFMS (HiFocus MidScala) electrode vs 13 SlimJ (HiFocus SlimJ) electrode types. ECochG recordings were made from the apical electrode of the CI array as it was advanced into the cochlea.

Main Outcome Measures: Active insertion monitoring of the ECochG responses during insertion of the CI electrode to assess for changes in residual acoustic hearing intraoperatively. Pre- and post-operative audiometric assessments.

Results: There are three distinctive patterns observed in this group regarding ECochG responses during insertion that are characterized to describe concomitant changes in residual hearing during CI insertion.

Conclusions: Active insertion monitoring of acoustic hearing using ECochG in real time is a tool the CI surgeon can use to calibrate insertion techniques and may serve as a prognostic indicator of post-operative acoustic hearing.

***Professional Practice Gap & Educational Need:** Active insertion monitoring during CI electrode insertion is a tool for the surgeon to optimize post-operative acoustic hearing preservation.

***Learning Objective:** To provide initial data and lessons learned from a robust CI practice utilizing active monitoring during electrode insertion for purposes of maximizing post-operative hearing outcomes.

***Desired Result:** Successful monitoring of electrocochleographic signal regarding the patient's native acoustic hearing.

***Level of Evidence – Level IV**

***Indicate IRB or IACUC :** IRB approved research study.

**A Novel Anterior Transcanal Surgical Approach for Treating
Patulous Eustachian Tube Dysfunction**

*Michael J. Eliason, MD; Sankalp Goberdhan, BS; Luke Edelmayer, MD
Michael D. Seidman, MD*

Objective: To describe a unique modification of a traditional tympanoplasty to facilitate better access to the anterior mesotympanum and tubotympanic region of the middle ear to treat troublesome patulous eustachian tube dysfunction.

Study Design: Retrospective Review with Surgical Technique Description

Setting: Tertiary Care Otolaryngology/Neurotology Practice

Patients: A total of five ears underwent the anterior transcanal tympanoplasty technique

Interventions: Treatment of bothersome patulous eustachian tube dysfunction with a novel surgical approach/technique

Main Outcome Measures: Clinical resolution of symptomatic patulous dysfunction and audiometric assessment before and after surgical intervention.

Results: All patients reported resolution of patulous dysfunction. Audiologic assessment before and after surgery showed no changes in speech reception threshold as measured in decibels.

Conclusions: This presentation describes a novel and simple technique to surgically correct the very bothersome symptoms resulting from patulous eustachian tube dysfunction. The anterior transcanal tympanoplasty approach maximizes visualization and instrumentation of the middle ear orifice to the Eustachian tube to safely provide occlusion that effectively resolves these symptoms.

***Professional Practice Gap & Educational Need:** While the incidence of patulous eustachian tube dysfunction is low, the increased use of eustachian tube dilation has resulted in an increase in these patients seen in our Otolaryngology clinics. Patulous eustachian tube dysfunction remains a bothersome condition for afflicted patients and one that is difficult for the Otolaryngologist to adequately treat. The novel approach using an anterior transcanal tympanoplasty provides the ear surgeon a unique means of correcting the dysfunction.

***Learning Objective:** To describe a novel surgical approach to treat bothersome patulous eustachian tube dysfunction.

***Desired Result:** Successful novel approach to treat a rare, but bothersome Otolaryngologic condition.

***Level of Evidence – Level IV (Case Series)**

***Indicate IRB or IACUC :** Exempt.

Socioeconomic Disparities in Adult Cochlear Implantation

*Rachel Greiner, BS; Jay T. Rubinstein, MD, PhD
Gavriel D. Kohlberg, MD*

Objective: To explore socioeconomic disparities in adult cochlear implant evaluation (CIE) referrals and cochlear implantation.

Study Design: Retrospective chart review.

Setting: Tertiary referral academic center.

Patients: Adults (n=271) with an audiogram performed between 2015-2019 with a pure-tone average (PTA) \geq 60 dB and word recognition score (WRS) \leq 60% in the better hearing ear or no WRS performed.

Intervention: Cochlear Implantation

Main Outcome Measures: Rate of referral to CIE and cochlear implantation.

Results: There were 122 insured patients referred to CIE of which 84 were considered cochlear implant (CI) candidates and 73 were implanted. In multivariate regression analysis, non-English-speaking patients were referred to CIE at lower rates (P =.011) than English-speaking patients. In addition, when patients were evaluated by otolaryngology nurse practitioners (P<.001) or solely audiologists (P <.001) they were referred at lower rates to CIE compared to when they were evaluated by otolaryngologist physicians. Patients who met CI candidacy criteria with private insurance (P=.03) or Medicare with private insurance supplement (P=.03) had higher rates of cochlear implantation than those with Medicare or Medicaid. Of the uninsured patients (n=22) 3 were referred to CIE and 2 were considered CI candidates. No uninsured patients received a CI.

Conclusions: Language and the type of provider patients were evaluated by were associated with a disparity in rates of CIE referral. Insurance type did influence rate of cochlear implantation once patients completed CIE and were considered CI candidates. Additional research is needed to implement strategies for more inclusive treatment.

***Professional Practice Gap & Educational Need:** Most patients who would qualify for CI are not implanted. Receiving a CIE referral is a critical step in obtaining a CI. Providers would benefit from a greater understanding of the impact socioeconomic disparities have on rate of implantation to ensure appropriate referral to CIE.

***Learning Objective:** Identify socioeconomic disparities within cochlear implantation and explain barriers to CIE referral.

***Desired Result:** 1. Gain knowledge to provide more equitable access to cochlear implantation. 2. Considerations for CIE referral in non-English-speaking patients.

***Level of Evidence - V**

***Indicate IRB or IACUC :** University of Washington IRB No. 00012875.

**Azimuthal Sound Source Localization in Patients with Congenital Aural Atresia:
Performance with Bone Conduction Implants vs. Cartilage Conduction Hearing Aids**

*Renee M. Banakis Hartl, MD, AuD; Emily Nairn, AuD
Tadashi Nishimura, MD, PhD; Emily Z. Stucken, MD*

Objective: Compare localization performance who use both osseointegrated bone conduction implants (BCI) and cartilage conduction hearing aids (CCHA) to the unaided condition in patients with conductive hearing loss due to congenital aural atresia.

Study Design: Prospective cohort study.

Setting: Academic tertiary care referral center.

Patients: Adults with congenital aural atresia previously implanted with an osseointegrated BCI participating in a separate clinical study testing the efficacy of CCHA.

Main Outcome Measures:

1. Localization accuracy (quantified in degrees of error) for presentation of sounds from an azimuthal array of 24 loudspeakers spaced at 15° intervals in an anechoic chamber with BCI, CCHA, and in the unaided condition.
2. Subjective measure of perceived localization benefit quantified with responses to the Speech, Spatial and Qualities of Hearing Scale (SSQ).

Results: Localization performance was compared between devices for individuals, across individuals, and with performance from listeners with normal hearing. No large differences in performance were noted between devices for individual subjects. Subjective results were mixed, without significant differences in SSQ scores between devices.

Conclusions: Patients with conductive hearing loss due to congenital aural atresia demonstrate comparable objective localization performance and subjective spatial benefit with BCI and CCHA. Continued investigation in additional patients is needed to quantify potential significant benefits in this unique population.

***Professional Practice Gap & Educational Need:** Studies of localization performance and subjective spatial hearing benefit for patients with congenital aural atresia have shown promise for both BCI and CCHA, suggesting the potential for improvements to patient quality of life with these interventions; however, large studies with carefully designed psychoacoustic stimulation paradigms may illustrate some benefits that clinical studies are unable to capture with standard audiometry alone.

***Learning Objectives:**

1. Characterize differences in objective localization performance between BCI and CCHA devices for patients with conductive hearing loss due to atresia.
2. Characterize differences in subjective spatial hearing benefit between BCI and CCHA devices for patients with conductive hearing loss due to atresia.

***Desired Result:** Attendees will demonstrate an improved understanding of the limitations of localization performance from unilateral rehabilitation devices in patients with bilateral conductive hearing loss.

***Level of Evidence:** Level III - Cohort and case-control studies

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

**Access to Ear and Hearing Care Globally:
Findings from the Lancet Commission on Global Hearing Loss**

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Alyssa Platt, MA; Shelly Chadha, MBBS, MS, PhD
Catherine M. McMahon, MAud, PhD; Susan D. Emmett, MD, MPH*

Objective: Characterize global access to ear and hearing care (EHC) to inform future policy recommendations

Study Design: Cross-sectional survey

Setting: Subjects were surveyed via contact lists of the World Health Organization, Global Otolaryngology-Head and Neck Surgery Initiative, and Global HEAR Collaborative.

Subjects: Otolaryngologists, audiologists, and other health professionals

Interventions: None

Main Outcome Measures: Workforce, training programs, affordability, government funding, and incorporation of EHC into national health strategy by World Bank income group

Results: There were 124 survey responses representing 58 countries: 76% from low- and middle-income countries (LMICs) and 24% from high-income countries (HICs). Regarding workforce, 38% of respondents (31% in LMICs, 60% in HICs) agreed there is an adequate supply of ENT surgeons, 23% (12% in LMICs, 57% in HICs) for audiologists, 21% (10% in LMICs, 57% in HICs) for speech-language pathologists, and 14% (12% in LICs, 20% in HICs) for EHC community health workers. Only 13% (7% in LMICs, 30% in HICs) agreed there are adequate training programs for EHC workforce. On affordability of care, 28% respondents (21% in LMICs, 50% in HICs) agreed that hearing aids are affordable and 23% that cochlear implants are affordable (14% in LMICs, 53% in HICs). Finally, 20% of participants agreed that government funding or investment is sufficient (13% in LMICs, 43% in HICs) and 44% that EHC care is included in national health strategy (37% in LMICs, 67% in HICs).

Conclusions: Globally, EHC may be limited by systems-level barriers that disproportionately affect LMICs. Future policy recommendations should advance EHC in national health strategies and funding priorities to address workforce and cost barriers.

Professional Practice Gap & Educational Need: Despite global efforts to strengthen EHC, barriers to EHC remain ill-defined.

Learning Objective: Learners will gain an understanding of barriers to EHC across countries by World Bank income group.

Desired Result: Learners will use this knowledge to improve understanding of EHC barriers and develop appropriate policy- and program-level interventions.

Level of Evidence – Level V

Indicate IRB or IACUC: Exempt

Prospective, Single-Blinded Study on the Use of Medical Grade Honey in the Prevention of Bone Anchored Hearing Aid Associated Skin Breakdown

*Anya Costeloe, DO; Robert Conway, DO; Kylie Smith, DO; Bo Pang, DO
Robert T. Standring, MD; Seilesh Babu, MD*

Objective: To demonstrate that postoperative use of medicinal grade honey compared to current post-operative care decreases bone anchored hearing aid (BAHA) associated skin reactions and breakdown and promotes faster healing.

Study Design: Prospective, single blinded, randomized study

Setting: Tertiary referral center

Patients: Adults >18 years old undergoing bone-anchored hearing aid implantation (BAHA) surgery. Patients undergoing revision surgery or with history of radiation to the site were excluded.

Interventions: Participants were randomized to postoperative medical honey (MediHoney) or standard care. The experimental group applied MediHoney to the abutment site daily for 2 weeks post-op. The control group applied bacitracin ointment. Photos were taken of the site for the first 7 days post-operatively, then at 2 weeks, 1 month, 3 months and 6 months. The de-identified photos were sent to 4 blinded otolaryngologists, who graded the abutment site using the Holgers skin classification. Patient's subjective level of pain and discomfort were assessed.

Main Outcome Measures: The key outcome variables were the differences in the Holgers values, levels of pain at abutment site and infection rates between the 2 groups, which were analyzed using t-test, ANOVA and Post-Hoc tests. A p-value < 0.05 is considered significant.

Results: With n = 17, there were no statistically significant differences in the Holgers scale ratings detected between the two groups at any of the time points. The average level of pain (scale 0-10, 0 no pain) at 6 months was significantly lower in the MediHoney group (0.583 ± 1.021) compared to the control (5.833 ± 4.119 , $p = 0.013$). The overall infection rate was 16.7% (n = 1) and this patient was in the control group.

Conclusions: Skin reactions are the most common complication after BAHA Connect implant surgery. Post-operative use of MediHoney may decrease long term discomfort associated with BAHAs.

***Professional Practice Gap & Educational Need:** None

***Learning Objective:** To learn about a unique preventative therapy for BAHA associated cutaneous reactions and infections.

***Desired Result:** Consider use of MediHoney in addition to standard care post-operatively in patient's undergoing BAHA implantation.

***Level of Evidence - II**

***Indicate IRB or IACUC :** IRB# 1325595-3

Variability of Cholesteatoma Operative Notes: Need for Standardization?

*Matthew J. Wu, BS; Renata M. Knoll, MD; Aaron K. Remenschneider, MD, MPH
Adrian L. James, DM; Elliott D. Kozin, MD*

Objective: Characterize the variability and “completeness” (i.e. presence of essential items) of dictated cholesteatoma operative notes (ON).

Study design: Retrospective chart review.

Setting: Tertiary referral center.

Patients: Dictated ON by three otologists/neurotologists of primary cholesteatoma surgery were included. ON of revision cholesteatoma surgery or created with templates were excluded.

Intervention(s): European Academy of Otolology and Neurotology and Japanese Otological Society Middle Ear (ME) Cholesteatoma Joint Consensus Statement used to create list of 32 assessable ON items including peri-operative findings (e.g. ossicle mobility) and surgical steps (e.g. ossicular chain reconstruction [OCR]).

Main outcome measure(s): ON completeness scores (%) were calculated by dividing the sum of present items by the maximum possible score.

Results: A total of 50 ON were assessed. The overall completeness score was 68.7±9.8%. Perioperative findings were documented less than surgical procedure items (53.3% vs 75.6%; $p<.001$). Peri-operatively, the etiology of cholesteatomas in 52.0%, status of ME mucosa in 29.2%, chorda tympani in 52.1%, tensor tympani in 4.2%, and presence of ME effusion was documented in 8.3% of ON. Ossicular erosion was documented more than ossicular mobility (70.2% vs 38.9%; $p<.001$). Erosion of the malleus was documented less than the incus (46.0% vs 84.0%; $p<.001$) and stapes (46.0% vs 82.0%; $p<.001$). Mobility of the malleus was documented less than the stapes (19.5% vs 64.0%; $p<.001$), but similar to the incus (19.5% vs 22.7%; $p=.755$). The extent of OCR (97.9%) and ossiculoplasty material (100%) were frequently described.

Conclusions: In this quality initiative study, our findings show variability in cholesteatoma ON documentation. Perioperative findings such as ossicular mobility are underreported.

***Professional Practice Gap & Educational Need:** Operative notes (ON) are utilized to document procedural details and used in medical quality assurance and outcomes research, but few studies have examined the variability in documentation, especially in the otolaryngology literature.

***Learning Objective:** Understand and identify commonly missed areas in cholesteatoma ON documentation.

***Desired Result:** The development of a standardized OR may improve the “completeness” of documentation and potentially improve patient care.

***Level of Evidence:** IV

***Indicate IRB or IACUC:** Exempt

Three-dimensional Printing for Preoperative Planning of Complex Otologic Procedures

*Oshri Wasserzug, MD; Ophir Handzel, MD; Solomon Dadia, MD; Gadi Fishman, MD
Omer Ungar, MD; Efrat Reindorf-Kfir, MD; Ari DeRowe, MD*

Objective: Surgery in complex otologic cases is often challenging since the temporal bone anatomy can be considerably distorted. Preoperative planning in these cases is currently based on physical examination and CT/MRI findings. Our objective was to evaluate whether tailored 3D printed models of the involved temporal bone have any advantage over standard imaging studies for preoperative planning.

Methods: Life-sized 3D printed models of the temporal bone were created based on CT and MRI images in three patients. One patient had recurrent cholesteatoma involving the TMJ and the temporal fossa, another patient had a huge congenital cholesteatoma, and the third had an extensive glomus tympanicum. The added value of the 3D printed models was assessed for each of 11 domains by 7 otologic surgeons who were asked to rate to what extent the 3D model was advantageous over the imaging studies according to a validated Likert scale for importance.

Results: The mean rating for all domains was 3.6 ± 0.63 , ("moderately important" to "very important", tending towards "very important") and the median was 4 ("very important"). There was complete agreement between raters for domains 3 and 4, while it was 0.608 (good) for domain 1, 0.585 (moderate) for domain 2 and 0.429 (moderate) for domain 5.

Conclusions: Patient-specific 3D printed models of the temporal bone were rated by 7 otologic surgeons to range from moderately important to very important for preoperative planning of complex otologic procedures. Outcome studies are warranted to establish their usefulness in reducing recurrence rates.

***Professional Practice Gap & Educational Need:** Temporal bone 3D models are currently not considered standard of care nor are they mentioned in any of the guidelines. However, as technology improves and data on their usefulness accumulate, 3D models may become a valuable part of the preoperative evaluation and preoperative surgical planning.

***Learning Objectives:** To raise awareness among otologic surgeons of the advantages in using 3D models for preoperative planning in complex cases.

***Desired Result:** Tailored temporal bone 3D models will find widespread use among otologic surgeons.

***Level of Evidence – Level V.**

***Indicate IRB or IACUC:** Institutional Review Board approval was acquired before the data was collected. Approval N. 0174-18 TLV.

Accessibility to University Tinnitus Program during COVID-19 Pandemic

*Rachel Fryatt, AuD; Susan Ellsperman, MD; Allie Heckman, AuD
Emily Bellile, MS; Emily Stucken, MD*

Objective: To evaluate the accessibility of the University of Michigan Tinnitus program as it transitioned from in-person to virtual format in response to the global pandemic.

Study Design: Retrospective review

Setting: Tertiary academic center

Patients: 324 subjects who participated in the Michigan Tinnitus group information class from 4/5/2019 to 3/5/2021.

Interventions: Attendance of group tinnitus class, tinnitus and social/emotional questionnaires

Main Outcome Measures: Demographics and ADI (Deprivation index from University of Wisconsin resource), Tinnitus surveys (THI/TRQ), Social/emotional surveys

Results: Of the 324 patients analyzed, 168 participated in the in-person tinnitus class, while 156 participated in the virtual course over Zoom. A one-way ANOVA revealed that the mean age of the virtual participants ($\mu=56$ years) was significantly younger than in-person ($\mu=61$ years) participants ($p=0.02$). There was no statistical difference between gender and smoking history. Of the total subjects, 222 subjects were able to have their home addresses linked with ADI rankings. In these rankings, a subject is given a score from 1-100, which is used to describe the level of neighborhood disadvantage they might experience based on their address. Higher scores indicate more disadvantage. Current data suggests a trend of larger percentage of participants with higher ADI rankings participating in the virtual format compared to in-person participants. In questionnaire scores, there is no significant difference between two participation groups for Tinnitus Handicap Inventory (THI) ($p=0.09$) and Tinnitus Reaction Questionnaire (TRQ) scores ($p=0.09$).

Conclusions: Preliminary data suggests expanding tinnitus management and educational appointments to a virtual format increases accessibility for lower SES populations in the state of Michigan.

***Professional Practice Gap & Educational Need:** Few studies have identified the accessibility of services during the pandemic, especially in audiological management. There is a lack of understanding potential benefits to offering virtual audiological appointments, though virtual care is explored in other medical professions.

***Learning Objective:** To identify group differences in tinnitus education participants between in-person and virtual settings.

***Desired Result:** Patients from lower SES populations had a greater participation in a virtual format for tinnitus education, following a clinical reorganization in response to COVID-19 pandemic. This knowledge allows audiologists and medical professionals to consider offering more virtual services to address accessibility gaps.

***Level of Evidence - Level V**

***Indicate IRB or IACUC :** HUM00203064

**Electrode-to-Modiolus Distance in Round Window versus Cochleostomy Surgical Approaches:
A Meta-Analysis**

*Sanjay Jinka, BS; Vardhan Avasarala, BS
Anita Jeyakumar, MD, MS*

Objective: Contrast electrode-to-modiolus distances achieved from round window (RW) and cochleostomy (C) approaches.

Data Sources: Peer-reviewed articles were identified from PubMed and Google Scholar utilizing the search methodology of a MeSH searching for studies comparing RW and C surgical approaches. Only articles with an English version were considered, and date of publication was not considered.

Study Selection: Studies included for detailed review had to meet the search criteria of including human subjects, including data about straight 12-electrode contact arrays specifically, and determining electrode-to-modiolus distance for all 12 electrode positions with combined flat-panel computed tomography and curved multiplanar reconstruction. Only studies published after 2000 were considered.

Data Extraction: Quality and validity was determined by PRISMA guidelines. Extracted data was made comparable by analyzing RW and C electrode-to-modiolus distances for only the 12 electrode positions common to all studies.

Data Synthesis: Two-sample independent t-testing was used to compare the two surgical approaches at each electrode site.

Conclusions: 37 papers were reviewed. 48 electrode arrays were analyzed with a mean patient age of 26. The RW approach allows for electrode insertion to be significantly ($p < 0.05$) closer to the cochlear modiolus than the C approach across pediatric and adult populations. Decreased distance correlates with increased probability of perimodiolar placement and minimized electrical impedance.

***Professional Practice Gap & Educational Need:** Understanding the differences between the RW and C surgical approaches in peri-modiolar cochlear electrode array placement.

***Learning Objective:** Understand differences between RW and C surgical approaches. Understand benefits of decreased electrode-to-modiolus distances. Learn how to use surgical approach as an avenue to improve electrode-to-modiolus distances.

***Desired Result:** Consideration of electrode-to-modiolus distance when selecting between RW and C approaches. Additionally, inspiring further study looking at trauma and hearing preservation is necessary to delineate potential adverse effects with decreased electrode-to-modiolus distance.

***Level of Evidence - IV**

***Indicate IRB or IACUC:** Exempt

**Transcanal Endoscopic Versus Microscopic Tympanoplasty:
Is There a Difference in Perforation Closure Rates?**

*Tanner J. Mitton, BS; Jenny Kim, BA; Daniel E. Killeen, MD; Jacob B. Hunter, MD
Brandon Isaacson, MD, FACS; J. Walter Kutz Jr., MD*

Objective: To compare closure rates of endoscopic and microscopic tympanoplasty as influenced by perforation size, perforation location, and graft position.

Study Design: Retrospective chart review.

Setting: Tertiary university medical center.

Patients: Adult patients who underwent tympanoplasty by a fellowship-trained neurotologist from January 2010 to December 2019, had at least two months of follow-up, and had a tympanic perforation with no cholesteatoma prior to surgery.

Interventions: Transcanal endoscopic tympanoplasty or microscopic tympanoplasty.

Main Outcome Measures: The primary outcome is post-operative closure of the tympanic membrane perforation as assessed using otomicroscopy at the last follow-up appointment.

Results: Two-hundred and eleven patients - 98 in the transcanal endoscopic tympanoplasty (ET) group and 113 in the microscopic tympanoplasty (MT) group - were identified. Tympanic membrane closure rates were not significantly different between the ET and MT groups (79.6% and 84.1% respectively; $p = 0.473$), and further multivariable analysis revealed that closure rates for ET relative to MT had an insignificant odds ratio (0.56; $p = 0.144$). Similar analyses found no significant difference between the two methods in subsets of perforation size (small, large, subtotal/total), perforation location (anterior, posterior, inferior), and graft position (underlay, overlay). The MT group was more likely to have a postauricular incision (94.7% vs 0.0%; $p < 0.001$). Men were more likely to see their perforations closed than women on multivariable analysis (OR 2.46; $p = 0.035$).

Conclusions: Endoscopic tympanoplasty resulted in similar rates of post-operative closure rates compared to the microscopic technique with less need for postauricular incision.

***Professional Practice Gap & Educational Need:** Although microscopic and transcanal endoscopic tympanoplasties have similar outcomes generally, it is not clear if certain characteristics of the tympanic membrane perforation, such as size and location, cause one technique to be more successful than the other. A better understanding of how perforation characteristics may affect the efficacy of the two techniques differently is needed.

***Learning Objective:** Recognize that the endoscopic and microscopic tympanoplasty techniques result in similar perforation healing outcomes, regardless of perforation size, perforation location, or overlay or underlay graft placement.

***Desired Result:** Attendees will be able to apply this knowledge when evaluating which technique to use for tympanic membrane perforation repair, based on the characteristics of each patient's perforation.

***Level of Evidence:** Level IV—Historical cohort or case-control study

***Indicate IRB or IACUC:** UT Southwestern Medical Center (STU 012013-017, approved 9/17/19)

Assessing the Differences in Hearing and Healing in Pediatric Microscopic and Transcanal Endoscopic Tympanoplasty Procedures

Tanner J. Mitton, BS; Daniel E. Killeen, MD; Zoha K. Momin, BS; J. Walter Kutz Jr., MD

Objective: To compare closure rates and hearing outcomes of microscopic and endoscopic tympanoplasty in pediatric patients.

Study Design: Retrospective chart review.

Setting: Tertiary university medical center.

Patients: Pediatric patients who underwent tympanoplasty surgery by a fellowship-trained neurotologist between 2010-2019 with at least two months of follow-up, a tympanic membrane perforation, and no preoperative cholesteatoma.

Interventions: Transcanal endoscopic tympanoplasty surgery or microscopic tympanoplasty surgery.

Main Outcome Measures: The primary outcome is postoperative closure of the tympanic membrane perforation, assessed using otomicroscopy at the last follow-up appointment. Secondary outcomes include operative time and changes in the air-bone gap (ABG) and pure tone average (PTA).

Results: Two hundred and eleven tympanoplasty surgeries were analyzed—121 in the transcanal endoscopic tympanoplasty (TEES) group and 90 in the microscopic tympanoplasty (MT) group. Tympanic membrane closure rates were no different between the two groups (TEES = 82.6%, MT = 88.9%; $p = 0.24$), and no significant association was found on multivariable analysis (TEES OR = 0.8; $p = 0.61$). Both groups showed improvements in the 4-month PTA and ABG and the 12-month PTA, but the 12-month ABG only improved in the TEES group ($p < 0.01$). The TEES group had a shorter average operative time (109.8 vs 123.5 minutes; $p = 0.03$) and less need for post-auricular incision (0% vs 93.3%; $p < 0.01$).

Conclusions: In pediatric tympanoplasty, TEES gives similar membrane closure and hearing outcomes as the microscopic technique, with less operative time and need for post-auricular incision.

***Professional Practice Gap & Educational Need:** Current analyses of pediatric TEES and microscopic tympanoplasty healing and hearing outcomes are often limited by small sample size, absence of hearing outcome analysis, or the inclusion of patients with significant confounding factors, like cholesteatoma. Robust analysis of a large sample controlling for confounding variables and examining hearing outcomes is needed to confirm that the outcomes of the two tympanoplasty techniques are comparable in children, and that either technique can be used effectively.

***Learning Objective:** Recognize that pediatric patients have similar healing and hearing outcomes following either TEES or microscopic tympanoplasty surgery, but the operative time and post-auricular incision rates for the TEES approach are lower than those of the microscopic approach.

***Desired Result:** Physicians will gain understanding of the comparability of the TEES and microscopic approaches in pediatric tympanoplasty and effectively apply this knowledge to pediatric otologic care.

***Level of Evidence:** Level IV

***Indicate IRB or IACUC:** UT Southwestern Medical Center (STU 012013-017, approved 9/17/19)

**Hearing Preservation in Round Window versus Cochleostomy Surgical Approaches:
A Meta-Analysis**

*Vardhan Avasarala, BS; Sanjay Jinka, BS
Anita Jeyakumar, MD MS*

Objective: Contrast the Hearing Preservation achieved from round window (RW) and cochleostomy (C) surgical approaches.

Data Sources: Peer-reviewed articles were selected from PubMed and Google Scholar using the MeSH search terms Round window AND Cochleostomy. Only English and non-animal studies were selected, and date of publication was not considered.

Study Selection: Studies included for detailed review collected data analyzing hearing preservation under 3 categories: complete hearing loss, partial hearing preservation (>10 dB), and complete hearing preservation (<10dB loss) following either a cochleostomy or round window surgical method.

Data Extraction: Quality and validity was determined by PRISMA guidelines. Extracted data was made comparable by analyzing RW and C hearing preservation data that was homogenous across included studies.

Data Synthesis: A chi-squared test was used to compare the distribution between hearing preservation categories between the two surgical approaches.

Conclusions: 18 papers were reviewed. The distribution between the round window and cochleostomy groups were found to be significant ($p < 0.05$) with the percentages indicating that the round window surgical approach is better at preserving hearing than the standard cochleostomy method. RW procedures yielded complete hearing preservation in 42.6% of cases compared to only 31.3% in C.

***Professional Practice Gap & Educational Need:** Understanding the differences between the RW and C surgical approaches maintaining residual hearing preservation following the procedure.

***Learning Objective:** Understand differences between RW and C surgical approaches. Learn how to use surgical approach as an avenue to improve residual hearing preservation.

***Desired Result:** Consideration of hearing preservation when selecting between RW and C approaches. Additionally, inspiring further research with a greater sample size collecting homogenous data to increase strength of the results.

***Level of Evidence - IV**

***Indicate IRB or IACUC:** Exempt

The Efficacy of Intratympanic Injections in Sudden Sensorineural Hearing Loss

*A. Celeste Gibson, M.D.; Jennifer R. Silva-Nash, M.Sc.; Andrew R. Mangan, B.S.
Deanne King, M.D. Ph.D.; John L. Dornhoffer, M.D., FACS*

Objective: To evaluate the efficacy of intratympanic (IT) dexamethasone injections for sudden sensorineural hearing loss (SSNHL) with regard to subjective and objective audiometric data.

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

Patients: 56 patients (27-85 years of age) who received an IT dexamethasone injection for SSNHL from 2014-2020.

Main Outcome Measures: Patient demographics, indication and medication used for IT perfusion, complication rate, and patient's sense of subjective improvement were collected. Pre- and post-injection audiometric data were compared.

Results: Fifty-six patients received a total of 79 injections, with 18 patients receiving more than one injection. Dexamethasone 10mg/ml was the most common medication utilized (84%), followed by dexamethasone 12mg/ml. Nineteen injections resulted in a complication, 13 of which were tympanic membrane perforation and 3 were acute otitis media. Subjective relief was reported by 38% of patients. There was not a significant difference between pre- and post-injection air conduction pure tone average (AC PTA) (62.5 vs 60.1, $p=0.213$). However, the difference was larger among patients who received oral and injected steroids (57.8 vs 51.7, $p=0.059$).

Conclusions: Our data suggest that in our clinic, intratympanic injections did not result in a significant improvement in subjective or objective hearing recovery in patients suffering from SSNHL. In addition, complications followed 24% of injections.

Professional Practice Gap & Educational Need: Although the use of IT injections for SSNHL have increased, research regarding efficacy remains inconclusive. Our review adds to the literature by providing subjective and objective data, and complication rates to help guide current clinical practice.

Learning Objective: Our data suggest that in our clinic, intratympanic injections did not result in a significant improvement in subjective or objective hearing recovery in patients suffering from SSNHL. In addition, complications followed 24% of injections.

Desired Result: To analyze the efficacy of intratympanic injections for SSNHL from our institution's database.

Level of Evidence: Level IV

Indicate IRB or IACUC: Exempt

Treatment Options in Mal de Debarquement Syndrome: A Scoping Review

Corin M. Kinkhabwala, MD; Angel Cadena, MD; Habib G. Rizk, MD

Objective: The purpose of this study was to present a scoping review of mal de débarquement syndrome, a cause of chronic rocking dizziness of unclear etiology and unpredictable prognosis (MDDS), with the following question: “What are the current treatment options available for MDDS?”

Data sources: Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Review (PRISMA-ScR) guidelines, we performed systematic search queries in PubMed (NLM, NIH), Scopus (Elsevier), CINAHL (EBSCOhost), and PsycINFO (EBSCOhost) for MDDS-related texts. Documents must have been in the English language, and the time frame was all documents up until March 2021.

Study selection: Studies were selected for detailed review if they were published in a journal, if one of the primary objectives was the assessment of at least one treatment option for MDDS, or if the study was a systematic or scoping review with information on management of MDDS. 169 unique references were identified and underwent review. 40 were selected for full-text review and 37 for data extraction.

Data extraction: In determining which studies were ultimately extracted, the quality and validity of all documents were assessed by two independent reviewers. Conflicts resolved by a third reviewer.

Data synthesis: Data were stratified by treatment methodology for MDDS. The categories used were pharmacologic, vestibulo-ocular reflex (VOR) rehabilitation, and neuromodulating stimulation.

Conclusions: Improvement in patient-reported outcomes is reported with several treatment modalities including specific protocols of vestibular rehabilitation, repetitive transcranial magnetic stimulation (rTMS) protocols, and pharmacologic management with several types of neurotropic drugs.

Define Professional Practice Gap & Educational Need: MDDS is a challenging diagnostic and therapeutic problem. Practicing otolaryngologists who evaluate patients with dizziness will be exposed to this condition. Diagnostic criteria were established in 2020 by the Barany Society. There have been recent advances in treatment options available but not set gold standard for treatment yet

Learning Objective: To educate otolaryngologists on the current treatment options available to them for MDDS patients

Desired Result: More widespread awareness of the management for MDDS

Level of Evidence - Level V

Indicate IRB or IACUC : Medical University of South Carolina Pro00050097

**Multimodality and Multidisciplinary Treatment of Chronic Rocking Dizziness/Non-Otologic Vertigo:
Single Institution Case Series**

*Corin M. Kinkhabwala, MD; Angel Cadena, MD; Seth Jeong, MD
Shaun A. Nguyen, MD; Habib G. Rizk, MD*

Objective: To review the characteristics of patients with symptoms of chronic rocking dizziness (CRD) and assess the efficacy of medical treatment involving SNRI and benzodiazepines with or without vestibular rehabilitation in this population

Study Design: Retrospective case review

Setting: The study was performed at a university-based tertiary medical center

Patients: Adult patients with CRD seen in vestibular clinic between 10/2015 and 7/2021. Subsets were created for Mal de debarquement (MDDS) fulfilling the Barany Society criteria, persistent postural-perceptual dizziness (PPPD), CRD with associated vestibular migraine, unclassified CRD and spontaneous MDDS.

Interventions: Vestibular rehabilitation (VR) and/or pharmacologic treatment with the goal of treating symptoms of CRD

Main Outcome Measures: Quantitative assessment of dizziness handicap inventory (DHI) with change of score before and after intervention.

Results: Preliminary results thus far demonstrate 106 CRD patients, 23 MDDS, 23 spontaneous MDDS, 86 PPPD, 16 CRD with vestibular migraine, and 26 unclassified CRD. For pure MDDS patients, mean total change in DHI for pharmacologic-only therapy was -15.0 (SD 4.24), and change in DHI for combined therapy was -10.89 (SD 20.98). Venlafaxine had a DHI change of -17 (SD 20) and benzodiazepines had a DHI change of -22 (SD 13).

Conclusions: There is no significant statistical difference in the different treatment methodologies for MDDS, however, there is a significant clinical difference in reduction of DHI for each modality and pharmacologic therapy.

Define Professional Practice Gap & Educational Need: Pharmacologic advances in the management of MDDS have been limited, and assessment of migraine prophylaxis in its treatment is yet to be validated.

Learning Objective: To provide otolaryngologists with additional information in the management of MDDS to assist with pharmacologic and VR management strategies.

Desired Result: Improved MDDS patient outcomes

Level of Evidence - Level IV

Indicate IRB or IACUC : Medical University of South Carolina Pro00050097

**Subjective and Objective Taste Change Following Stapes Surgery:
Meta-Analysis and Systematic Review of the Literature**

Daniel H. Coelho, MD; Seong M. Lee, BA (presenter); Edward Yang, BA

Introduction: Iatrogenic injury to the chorda tympani (CT) is a well-recognized, though potential underestimated consequence of stapes surgery. This study aims to review the currently available literature to determine the incidence and prognosis of taste disturbances in these patients.

Data Sources: PubMed, Embase, and Cochrane Library databases

Methods: Databases were searched according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Search terms included (chorda tympani OR gustatory OR taste OR chemosensory OR dysgeusia OR nervus intermedius) AND (ear surgery OR middle ear OR stapes OR stapedectomy OR stapedotomy). Papers were further divided by methodology into “objective” and “subjective” assessments of taste dysfunction. Rates of taste disturbance between the two groups were compared using a chi-squared test.

Results: Initial search yielded 7217 papers. Once inclusion/exclusion criteria were applied and duplicates were removed, 7 papers were identified, representing 293 patients (119 with objective testing, 174 subjective testing). For all patients, an incidence of taste change was noted in 165 (56%). Post-operative objective taste change was noted in 82/119 (69%) of patients, whereas subjective taste change was noted in 83/174 (48%). The difference between the two groups was significant ($p = .0003$). The overall rate of recovery was 79/121 (65%). 32/82 (39%) and 10/39 (26%) patients demonstrated long-term objective and subjective taste loss respectively ($p = .148$).

Conclusion: Changes in taste occur relatively frequently following stapedectomy. Surgeons should continue to counsel prospective patients as to the risks of both short- and long-term taste disturbance.

***Professional Practice Gap & Educational Need:** Improved understanding of stapedectomy complications through the power of systematic review, pooled data, and meta-analysis.

***Learning Objective:** To review currently available literature to determine the incidence and prognosis of taste disturbances in these patients.

***Desired Result:** Surgeons must highlight the relatively common occurrence of post-stapes surgery taste disturbance when counseling prospective patients.

***Level of Evidence** – N/A (though some rubrics would say Level IV)

***Indicate IRB or IACUC :** Exempt

Lateral Graft Tympanoplasty Outcomes in Patients with Comorbidities

Zoha K. Momin, BS; Kristen L. Yancey, MD; Tanner J. Mitton, BS
J. Walter Kutz Jr., MD

Objective: To compare the effects of preoperative comorbidities, such as smoking, diabetes mellitus, and age, on the success of lateral graft tympanoplasty.

Study Design: Retrospective chart review

Setting: Tertiary medical center

Patients: Ninety-six patients undergoing lateral graft tympanoplasty from December 2008 to November 2020 with at least two months follow-up. Patient demographics, diabetes mellitus and smoking status, perforation closure rates, healing complications and hearing outcomes were recorded. Simultaneous ossiculoplasty was not excluded from the hearing analysis.

Interventions: Lateral graft tympanoplasty.

Main Outcome Measures: The primary outcome was perforation closure. Secondary outcomes were need for revision surgery, postoperative complications, and change in air-bone gap.

Results: Ninety-nine ears (mean age 40.94 ± 18.44 years) were included. Tympanic membrane perforation closure was achieved in 86 (87%) ears. Tympanic membrane closure rate was not associated with diabetes ($p = 0.42$), smoking (OR = 1.58, $p = 0.68$), or increasing age (OR = 1.00, $p = 0.85$). The presence of cholesteatoma (OR = 1.44, $p = 0.60$) and prior tympanoplasty (OR = 0.47, $p = 0.22$) were not associated with tympanic membrane closure rates. The air-bone gap (ABG) improved from a mean of 27.55 ± 11.88 dB to a mean of 23.54 ± 11.73 dB postoperatively ($p < 0.01$). History of prior tympanoplasty was associated with smaller ABG improvement following surgery ($\beta = 5.403$, $R^2 = 0.215$, $p = 0.03$).

Conclusions: Diabetes, active smoking and advanced age were not associated with adverse healing in patients undergoing lateral graft tympanoplasty. Further investigation with a larger, prospectively enrolled sample is warranted.

***Professional Practice Gap & Educational Need:** Patients with a history of diabetes, active smoking or advanced age may constitute a high-risk patient population with respect to wound healing. Evaluation of these patient-specific factors on healing following lateral graft tympanoplasty have yet to be fully explored in the literature.

***Learning Objective:** To understand patient-specific factors (diabetes, active smoking, advanced age) do not affect lateral graft tympanoplasty outcomes.

***Desired Result:** To demonstrate diabetes, smoking, and advanced age did not compromise healing or hearing outcomes following lateral graft tympanoplasty.

***Level of Evidence:** IV

***Indicate IRB or IACUC:** IRB UT Southwestern Medical Center (STU 012013-017)

**Expanding Understanding of Electrocochleography in Cochlear Implantation:
Auditory Neuropathy Spectrum Disorder with Normal Pure Tone Average**

*Hilary C. McCrary, MD, MPH; Steve Gordon, MD; Eric Babajanian, MD
Kathryn M. Johnson, AuD; Neil S. Patel, MD*

Objective: Describe the preoperative decision making, intraoperative electrocochleographic (ECoG) findings, and outcome of cochlear implantation (CI) in a patient with auditory neuropathy spectrum disorder (ANSD) and normal pure tone thresholds.

Study Design: Case report.

Setting: Tertiary care academic center.

Patients: A 19-year-old with a history of hypoxic ischemic encephalopathy and seizures was referred for hearing rehabilitation in the setting of typical hearing by pure tone audiometry, but poor speech understanding. A diagnosis of ANSD was made based on ABR, DPOAE, and acoustic reflex testing. Imaging revealed no central cause of hearing impairment.

Interventions: Right-sided cochlear implantation.

Main Outcome Measures: Pre- and postoperative audiometric data. Intraoperative electrocochleography (ECoG).

Results: Preoperative audiologic and cochlear implant assessment for the right and left ear, respectively: PTA 15 dB, 8dB; Word Recognition Score (WRS) 36%, 56%; CNC Words: 8%, 28%; and AzBio Quiet: 0%, 36%. Intraoperative ECoG amplitudes and audiometry showed responses in the 100 uV range and estimated PTA of 42 dB HL. Postoperative testing at 1 month post-initial activation revealed PTA of 45 dB HL and unchanged word and sentence scores. However, the patient cites an improved ability to communicate, increased confidence, and averages over 14 hours of device use daily. Further follow up data will be available at the time of presentation.

Conclusions: To our knowledge this is the first reported case of CI in an ear with normal PTA. Intraoperative and postoperative audiometric findings add to the understanding of ECoG and CI in ANSD.

***Professional Practice Gap & Educational Need:** To discuss the decision-making and workup, operative technique and intraoperative testing, and postoperative results with CI for ANSD.

***Learning Objective:** To describe the application of cochlear implantation in ANSD patients with normal PTA.

***Desired Result:** Improved knowledge about the applications of cochlear implantation in ANSD patients and the role of ECoG.

***Level of Evidence – Level V**

***Indicate IRB or IACUC:** Exempt

**Tympanoplasty with and without Mastoidectomy for Chronic Otitis Media without Cholesteatoma:
A Systematic Review and Meta-analysis**

*Nicolas S. Poupore, BS; Tamar M. Gordis, BA; Shaun A. Nguyen, MD, MA
Ted A. Meyer, MD, PhD; William W. Carroll, MD; Paul R. Lambert, MD*

Objective: To compare surgical and audiometric outcomes of tympanoplasty alone to tympanoplasty with mastoidectomy.

Data sources: According to PRISMA guidelines, English articles in PubMed, Scopus, CINAHL, and Cochrane Library databases from inception to 7/29/2021 were searched.

Study selection: Studies including a comparison of patients who underwent tympanoplasty (T) to patients who underwent tympanoplasty with mastoidectomy (T&M) were included. Patients with cholesteatoma were excluded.

Data extraction: Patient demographics, complications, and postoperative audiological findings were collected.

Data synthesis: Mean differences (MD) and Risk difference (RD) were calculated using RevMan 5.4. Heterogeneity was assessed using Q test and I^2 statistic. Risk of bias was assessed using ROBINS-I tool.

Results: A total of 27 studies fulfilled eligibility with tympanoplasty (n = 1711) and tympanoplasty with mastoidectomy (n = 1186). When pooling the data, comparing mean differences between T vs. T&M for ABG (-0.3 dB: 95%CI -1.9 to 1.3, p = 0.73) and PTA (1.9 dB: 95%CI -0.3 to 4.2, p=0.09) were not statistically significant. Graft failure was higher with T only (16.4% vs. 14.2%) than T&M [RD: -0.04 (95% CI: -0.07 to -0.00), p=0.03; I^2 : 35%].

Conclusions: This study endorses clinically similar audiological outcomes and a reduced risk difference of graft failure with mastoidectomy. While these data suggest that adding a mastoidectomy could decrease the risk of graft failure, the risk reduction is minimal. More research on the cost-effectiveness of adding a mastoidectomy to gain a small, reduced risk difference of graft failure is warranted.

***Professional Practice Gap & Educational Need:** Tympanoplasty alone and with mastoidectomy have been extensively debated in terms of safety, efficacy, and cost-effectiveness.

***Learning Objective:** To compare surgical and audiometric outcomes of tympanoplasty alone to tympanoplasty with mastoidectomy.

***Desired Result:** Graft failure rates and postoperative PTA and ABG changes

***Level of Evidence:** Level III

***Indicate IRB or IACUC:** Exempt.

Epitympanum and Mastoid Obliteration Reduces Recidivism in Acquired Cholesteatoma Surgery: Technique and Results

*Stefania Goncalves, MD; Brandon Kamrava, MD; Torin Thielhelm, MS; Courtney Dable, MS
Jorge L Hernandez-Rojas MD; Simon I. Angeli, MD*

Background: Cholesteatomas are a locally aggressive and leads to a significant impact on the patients' quality of life. Rate of recidivistic disease after traditional tympanomastoidectomy techniques have ranged 10%-60%. A recent meta-analysis reported that adding mastoid obliteration resulted in less than 3% risk of recidivistic disease in canal wall up and canal wall down mastoidectomy by eliminating the possibility of tympanum retractions into air containing spaces creating an environment that prevents the growth of potential residual keratin tissue.

Objective: To determine the rate of recurrent and/or residual cholesteatoma in acquired retraction cholesteatoma (AC) cases undergoing tympanomastoidectomy plus a refined technique of epitympanum and mastoid obliteration using a combination of autografts between 2015-2020.

Study Design: Retrospective case-control series of patients who underwent canal-wall-up and canal-wall-down tympanomastoidectomy with epitympanum and mastoid obliteration for AC with a minimum of one year follow up.

Main Outcome Measures: Rate of recidivism (i.e., residual and recurrent cholesteatoma) in cases of AC after tympanomastoidectomy with epitympanum and mastoid obliteration compared to historical control cases of tympanomastoidectomy without obliteration. Recidivism identified by otoscopy, imaging, or intraoperative findings during a second-look procedure.

Results: Thirty-five patients with a diagnosis of AC underwent primary and/or revision surgery with epitympanum and mastoid obliteration. Two of them were lost to follow-up and ten underwent a second look procedure. None of the cases developed recidivistic disease after at least 1 year of follow up, while recidivism was noted in 9% of 157 cases of tympanomastoidectomy without obliteration.

Conclusions: Epitympanum and mastoid obliteration with tympanomastoidectomy shows promise in reducing the rate of recurrence of AC. Refinements of the surgical technique have led to improve survival of the autografts used for obliteration.

Define Professional Practice Gap & Educational Need: Addressing cholesteatoma recurrence.

Learning Objective: Mastoid obliteration can decrease the rate of recurrence of cholesteatoma surgery.

Desired Result: Reduction of the rate of recurrence of cholesteatoma. Learn tips and pitfalls in mastoid obliteration surgery

Level of Evidence – Level III

Indicate IRB or IACUC: IRB # 20200699 (Approved 10/6/22020).

Factors Associated with Prognosis of Idiopathic Sudden Sensorineural Hearing Loss

*Victoria J. Cress, BA; Chloe E. Dominguez, BS; Kari D. Roberts, BS
Hector A. Perez, MD; Yuan F. Liu, MD*

Hypothesis: To characterize the disease progression of patients presenting with idiopathic sudden sensorineural hearing loss and identify potential positive and negative prognostic factors.

Background: Many potential risk factors for idiopathic sudden sensorineural hearing loss (ISSNHL) have been described. However, the impact of these risk factors on ISSNHL prognosis remains unclear.

Methods: We retrospectively assessed outcomes in 66 patients having idiopathic sudden sensorineural hearing loss from January 2012 to January 2021. Medical histories, audiometric data, and treatment modalities were collected and compared.

Results: Patients with higher initial word recognition scores (WRS) on the affected side were less likely to have positive change in pure tone average (PTA) (p-value 0.043). Patients with more severe PTA changes on the affected side had a greater likelihood for improvement in PTA with time and treatment (p-value 0.017). No significance in improvement of PTA or WRS on the affected side was noted in patients treated with oral (p-value 0.93) or intratympanic steroids (p-value 0.82) nor in correlation with patient age (p-value 0.93), sex (p-value 0.69), or BMI (p-value 0.15). Comorbidities analysis is ongoing.

Conclusions: Prognosis for ISSNHL may be independent from treatment with steroids, regardless of route of administration. Our study suggests that the most predictive prognostic factors for ISSNHL can be found on an initial audiogram. Patients with high WRS scores may have a less favorable outcome in PTA recovery, while those with significant losses in PTA may have a higher likelihood for hearing improvement.

***Professional Practice Gap & Educational Need:** Expand understanding of prognostic factors in patients treated for idiopathic sudden sensorineural hearing loss.

***Learning Objective:** Identification of positive and negative prognostic factors in patients treated for idiopathic sudden sensorineural hearing loss; Encourage discussion of observed trends at other institutions.

***Desired Result:** Increased provider awareness of prognostic factors involved in the treatment of idiopathic sudden sensorineural hearing loss.

***Level of Evidence - IV**

***Indicate IRB or IACUC :** Loma Linda University Institutional Review Board - #5210056