SELECTED ABSTRACTS

POSTER
PRESENTATIONS

154th Annual Meeting
AMERICAN OTOLOGICAL SOCIETY

Cochlear Nerve Deficiency in Pediatric Single-Sided Deafness and Asymmetric Hearing Loss

Teresa G. Vos, MD; Lisa R. Park, AuD; Amy S. Noxon, BS; Kevin D. Brown, MD, PhD

Objective: To investigate the incidence of cochlear nerve deficiency (CND) in pediatric patients with single-sided deafness (SSD) or asymmetric hearing loss (AHL).

Study Design: Retrospective chart review

Setting: Tertiary referral center

Patients: Pediatric patients <18 years of age evaluated for SSD or AHL with magnetic resonance imaging (MRI) between January 2014 and October 2019 (n=309).

Methods: MRI brain and computed tomography (CT) temporal bone were reviewed.

Main Outcome Measures: Status of cochlear nerve and cochlea were evaluated.

Results: Preliminary data analysis demonstrated concern for cochlear nerve deficiency (aplasia, hypoplasia or cochlear aperture stenosis) in approximately a quarter of pediatric patients with SSD or AHL. Ipsilateral cochlear malformations were noted in over 10% of the cohort and an enlarged vestibular aqueduct was found in approximately 10% of ipsilateral ears.

Conclusions: Imaging demonstrated a high incidence of inner-ear malformations, particularly CND, in pediatric patients with unilateral hearing loss. Radiologic evaluation should be performed in all patients within this population to guide counseling and management of hearing loss based on etiology, with implications on candidacy for cochlear implantation.

Professional Practice Gap & Educational Need: There is conflicting literature on the rates of cochlear nerve abnormalities and cochlear malformations in pediatric unilateral hearing loss, with important implications on management.

Learning Objective: To understand the incidence of cochlear abnormalities in pediatric SSD/AHL and the importance of imaging to recommended management.

Desired Result: Improved understanding of cochlear nerve deficiency in pediatric unilateral hearing loss.

Level of Evidence - Level IV

Indicate IRB or IACUC: Approved by the University of North Carolina at Chapel Hill**,** IRB#19-2622.

Prognostic Factors for Tympanoplasty: A Systematic Review

Jorge A. Gutierrez III, BA; Claudia Cabrera-Aviles, MD; Sarah E. Mowry, MD

Objective: To assess the prognostic factors for anatomic and hearing success after tympanoplasty.

Data Sources: PubMed, Cochrane Library, MEDLINE, and manual search of bibliographies.

Study Selection: A systematic review was performed in May 2020. English-language articles describing outcome data for tympanoplasty repair variables including underlying pathology, perforation location, smoking status, graft material, graft technique, reconstruction material, anatomic success, and hearing success were extracted. Articles were excluded when tympanosclerosis, retraction pockets, adhesions, cholesteatoma, chronic suppurative otitis media (CSOM), anterior perforations, and smoking were excluded.

Data Extraction: Underlying pathology, perforation location, smoking status, graft material, graft technique, reconstruction material, anatomic success, and hearing success were extracted. Any factors analyzed as potential indicators of success were sought out.

Data Synthesis: Systematic Review.

Conclusions: 60 articles met final criteria, which accounted for 3,831 patients. 32 articles presented data on both anatomic and hearing outcomes, 20 articles presented data on anatomic outcomes only, and 8 articles presented data on hearing outcomes only. This systematic review found that adhesions and tympanosclerosis were prognostic factors for poorer hearing. Cholesteatoma, smoking, retraction pockets, and anterior perforations did not significantly impact hearing outcomes. None of the assessed variables were predictive of anatomic tympanoplasty success. However, this analysis is significantly limited by both the heterogeneity within the patients and the lack of controls. This study illustrates the myriad of potential opportunities for future studies, which could further define prognostic factors involved in these tympanoplasty procedures.

Define Professional Practice Gap & Educational Need: Medical knowledge – lack of clear understanding regarding which surgical approach or grafting material should be used in patients with complex tympanic membrane perforations.

Learning Objective: Recognize the need for additional research into prognostic factors affecting tympanoplasty outcomes.

Desired Result: Spur research in prospective evaluations of both grafting material and surgical approach for complex tympanoplasty surgery. Recognize that the underlying pathology of chronic ear disease may play a role in the success or failure of a tympanic membrane repair. Encourage systematic reporting standards.

Level of Evidence – N/A

Indicate IRB or IACUC: Exempt

Review of Speech Outcomes in Cochlear Implant Recipients at an Evolving Cochlear Implant Program

Nathan Aminpour, MS, Laura Levin, AuD, Mary Finkbone, AuD, Michael Morikawa, AuD, Melissa Blumgart, AuD, H. Jeffrey Kim, MD, Michael Hoa, MD

Objective: To examine the percentage of adult patients in a heterogeneous group of cochlear implant (CI) recipients at an evolving CI program who demonstrate improvements in speech outcomes.

Study Design: Retrospective chart review

Setting: Tertiary academic center

Patients: Adult cochlear implant recipients from 9/2014 – 12/2019 with at least 3 months of audiologic follow up post-activation.

Interventions: Cochlear Implantation

Main Outcome Measures: Speech outcome scores were assessed preoperatively and postoperatively at 3, 6 and 12 month intervals using Consonant-Nucleus-Consonant words (CNC) and AzBio sentences in quiet (AzBio). Mean speech outcome scores at each time point and binomial distribution tables with 95% confidence intervals were used to assess individual improvement in speech understanding.

Results: 45 patients underwent a total of 49 cochlear implantation surgeries. Mean age at surgery was 62. Mean preoperative CNC score in the ear to be implanted was 18%±18%, while the mean postoperative CNC score at 3, 6 and 12 months was 35%±21%, 44%±23% and 45%±25%, respectively. Mean preoperative AzBio score in the ear to be implanted was 22%±26% while the mean postoperative AzBio score at 3, 6 and 12 months was 50%±29%, 56%±27% and 63%±26%, respectively. 74% (32 of 43) and 69% (22 of 32) of recipients showed significant improvement at 6 months or 1 year in the implanted ear using AzBio and CNC binomial distribution tables, respectively.

Conclusions: Findings demonstrate significant improvement in speech perception following cochlear implantation for patients not benefiting from hearing aid aural rehabilitation. The study provides realistic expectations for new cochlear implant programs hoping to demonstrate their utility in improving patient speech outcomes.

Define Professional Practice Gap & Educational Need: Expectations regarding likelihood and predicted improvement in speech understanding after cochlear implantation in adults remains poorly defined outside of data from large, established CI centers. This data provides reasonable expectations for CI outcomes at small to medium sized growing CI centers.

Learning Objective: To understand the likelihood and expected improvements in speech understanding after cochlear implantation in adults.

Desired Result: To provide physicians, audiologists, and patients realistic expectations for speech performance outcomes post-cochlear implantation.

Level of Evidence - IV

Indicate IRB or IACUC: This project was approved on 1/14/2020 and is in compliance with Medstar-Georgetown University Hospital IRB (STUDY00001609).

A Web-Based Deep Learning Model for Automated Diagnosis of Otoscopic Images

Kotaro Tsutsumi, BA; Khodayar Goshtasbi, MS; Pooya Khosravi, BS; Adwight Risbud, BS
Harrison W. Lin, MD; Hamid R. Djalilian, MD; Mehdi Abouzari, MD, PhD

Objective: To develop a multiclass-classifier deep learning (DL) model and website for distinguishing tympanic membrane (TM) pathologies based on otoscopic images.

Study Design: Development of DL multiclass-classifier models for TM images.

Setting: Tertiary academic center.

Patients: Patients who underwent TM image acquisition.

Interventions: Creation of an otoscopic image database using the Van Akdamar Hospital eardrum database and google search and its assessment by convolutional neural network (CNN) models developed by modifying publicly available models: ResNet-50, Inception-V3, Inception-Resnet-V2, MobileNetV2. Training and testing were conducted with a 75:25 breakdown.

Main Outcome Measure(s): Area under the curve of receiver operating characteristics (AUC-ROC), accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CNN for classifying TM images.

Results: Our database included 400 images, organized into normal (n=196) and abnormal classes (n=204), including acute otitis media (n=116), otitis externa (n=44), chronic suppurative otitis media (n=23), and cerumen (n=21). For binary classification between normal versus abnormal TM, the best performing model had average AUC-ROC of 0.902 (MobileNetV2), followed by 0.745 (Inception-Resnet-V2), 0.731 (ResNet-50), and 0.636 (Inception-V3). Accuracy ranged between 0.73-0.77, sensitivity 0.72-0.88, specificity 0.58-0.84, PPV 0.68-0.81, and NPV 0.73-0.83. Macro-AUC-ROC for MobileNetV2 based multiclass-classifier was 0.91, with accuracy of 66%. Binary and multiclass-classifier models based on MobileNetV2 were loaded onto a publicly accessible and user-friendly website (https://headneckml.com/tympanic). This allows the readership to upload TM images for real-time predictions with the associated probability.

Conclusions: Novel CNN algorithms were developed with high AUC-ROCs for differentiating between various TM pathologies. This was further deployed as a proof-of-concept publicly accessible website for real-time predictions.

REQUIRED:
Define Professional Practice Gap & Educational Need: Many otologic diseases have been shown to be more prevalent among the low and middle-income countries. This situation is further complicated by the severe limitations in the number of otolaryngologists available in these countries. Consequently, there is a great need to develop automated diagnostic technologies that allow for early and effective diagnosis of such diseases among these underserved regions.

Learning Objective: To explain the ability of a DL model and its web-based interface to classify TM images based on various pathologies.

Desired Result: Informing otologists of a novel web platform for classifying TM images.

Level of Evidence – IV

Indicate IRB or IACUC: Exempt

Single-stage Conversion of Bone-Anchored Hearing Implant to Cochlear Implant:
Surgical Technique and Literature Review

Sina Koochakzadeh, MD; Dustin M. Lang, MD
Patrick J. Antonelli, MD;Si Chen, MD

Objective: Describe surgical technique for single-stage conversion of bone-anchored hearing implant (BAHI) to cochlear implant (CI) and evaluate post-operative wound complications.

Study Design: Retrospective case series

Setting: Tertiary academic center

Patients: Patients with BAHI who underwent single-stage conversion to CI

Interventions: Removal of BAHI and placement of CI by utilizing landmarks of posterior insertion of temporalis muscle or lambdoid suture for separation of CI receiver-stimulator (RS) from BAHI site

Main Outcome Measures: Post-operative wound complications

Results: Four patients underwent single-stage conversion from BAHI to CI. The average duration of BAHI use was 5.75 years (range 2 – 13 years). There were 3 percutaneous BAHIs and one transcutaneous device. All 3 percutaneous BAHI patients had chronic abutment site issues. Two had extensive scalp thinning and hair removal at the time of BAHI placement. All except one had CI RS placed posterior to the BAHI site. One patient required scalp advancement flap for closure at BAHI site. Follow up ranged from 3 – 87 months (mean 26.3 months) after CI placement. One patient with scalp thinning, 13 years of BAHI use, and closure with an advancement flap experienced wound infection and BAHI closure breakdown. This resolved with oral antibiotics. CI RS site and performance were not affected.

Conclusions: Single-stage conversion of BAHI to CI can be performed safely. The CI RS can be preserved in the event of BAHI site wound breakdown. Scalp wound tension, inflammation around the abutment, and longer BAHI use may contribute to wound issues after BAHI removal.

*Define Professional Practice Gap & Educational Need:
Cochlear implant candidacy has expanded to include patients with single-sided deafness and residual sensorineural hearing. A growing number of BAHI recipients may now meet criteria for CI placement. Due to chronic skin inflammation and/or infection, the BAHI site poses risks of infection and poor wound healing for CI surgery. The safety and efficacy of single-stage versus two-stage removal of BAHI and placement of the CI is a serious concern. The literature includes 7 reports with 17 patients that received CIs after BAHI, and 17% experienced postoperative infections. Only 1 study with 3 patients reported single-stage removal of BAHI and placement of CI, however there was no description of how to keep the contaminated BAHI site separate from CI RS. Three studies described leaving the BAHI in place. Our study is the first to describe using temporalis pocket landmarks to ensure that the CI RS is anatomically separate from the BAHI, which is important for safe single-stage conversion of BAHI to CI.

*Learning Objective: To gain surgical technique for single-stage conversion of BAHI to ipsilateral CI.

*Desired Result: To be able to identify landmarks that separate BAHI site from CI RS during single-stage surgery.

Level of Evidence - V

Indicate IRB or IACUC : University of Florida Institutional Review Board, IRB201903352

Iatrogenic Seeding of Cholesteatoma in Rare Planes

Enter up to 7 author names (in 2 lines) as follows:
Cameron Todd, MD; Michele Gandolfi, MD

Objective: Discuss the risk of seeding cholesteatoma during surgery, and the growth rate of recurrent disease

Study Design: Retrospective Case Report

Setting: Academic Tertiary Care Hospital

Patients: A 29 year old male who had a left tympanomastoidectomy and then staged second look with ossicular chain reconstruction for cholesteatoma 6 years prior to presenting with a left pre and post-auricular mass measuring 8.2 x 2.9 x 6cm. He was found to have cholesteatoma extending from a defect in the mastoid cavity into the pre-auricular and post-auricular soft tissue, which was felt to be recurrent disease seeded from his initial surgery.

Interventions: Combined surgical excision of the mass with facial plastic surgery and neuro-otology.

Results: To our knowledge, we present the largest iatrogenic cholesteatoma reported in the literature, and one that had explosive growth in a relatively short time period with extension into an unusual location due to presumed iatrogenic causes.

Conclusions: Our case highlights the potential to seed cholesteatoma in previously disease free areas when performing cholesteatoma surgery. It also demonstrates the aggressive nature of pediatric cholesteatomas, and is in line with the literature in that regard. The case enforces the extreme care that needs to be taken when performing cholesteatoma surgery to ensure that disease is not introduced in areas of the head and neck. It also stresses the importance of close, long term follow up for pediatric cholesteatoma given the potential for aggressive reoccurrence and growth.

*Define Professional Practice Gap & Educational Need: To highlight key points in cholesteatoma surgery to avoid reoccurrence and discuss recommended follow up course in acquired pediatric cholesteatomas.

*Learning Objective: 1. To emphasize techniques in cholesteatoma surgery to improve recidivism rates in cholesteatoma surgery. 2. Help broaden differentials for superficial masses in patient who have undergone cholesteatoma surgery.

*Desired Result: Physicians should take extreme care to avoid iatrogenically seeding cholesteatoma in adjacent areas during removal of cholesteatomas and taking care to avoid placing disease in the soft tissue. Physicians should consider recurrent disease and then early intervention when masses appear near the middle ear after surgery.

Level of Evidence - V

Indicate IRB or IACUC : Exempt

**Subtotal Petrosectomy with Cochlear Implantation or Osseointegrated Hearing Rehabilitation:
A Single Institutional Study**

Kathy Zhang, BS; Flora Yan, BA; Shaun A. Nguyen, MD
Ted A. Meyer, MD, PhD

Objective: To examine audiologic outcomes and operative considerations for patients undergoing subtotal petrosectomy followed by implantable hearing restoration.

Study Design: Retrospective review

Setting: Tertiary academic referral hospital

Patients: All patients who underwent subtotal petrosectomy and implantable hearing restoration from 2014-2020.

Interventions: Subtotal petrosectomy (STP) in a single or staged procedure with cochlear implantation (CI) or placement of a bone-anchored hearing aid (BAHA).

Main Outcome Measures: Indications for subtotal petrosectomy and staged CI or BAHA in this cohort; post-operative complication and re-operation rates; audiologic outcomes through speech recognition thresholds (SRT) and AzBio sentence scores.

Results: Twenty-six adults (age range 33-85) and six children (age range 1-17) underwent 37 STP procedures with placement of 33 CI and 4 BAHA. Twenty-five cases were single-procedure and 12 were staged, mean interval of 7 months. Indications for staged procedures included extensive cholesteatoma (n=5, 42%), chronic middle ear inflammation (n=5, 42%), and osteoradionecrosis (n=2, 17%). Six cases (16%) required revision surgery due to refractory post-auricular infection and breakdown of wound closure; Out of six revision surgeries, five were initially single-procedure and four identified intra-operative inflammation. No patients with BAHA required revision surgery. The mean SRT decreased from 79±18 dB to 31±8 dB (p<0.001). For patients undergoing CI, mean AzBio scores improved from 11% to 43% (p=0.002).

Conclusions: Subtotal petrosectomy is effective for creating a safe, dry ear in chronic inflammation or anatomically challenging cases. Rehabilitative hearing options following STP can be achieved safely, restoring hearing to an acceptable level with CI or BAHA. Careful consideration should be undertaken to approach as a single or staged procedure.

*Define Professional Practice Gap & Educational Need: Subtotal petrosectomy has been detailed as a safe and effective procedure to obtain a dry ear for patients with chronic otitis media or anatomically unfavorable ear, however not many studies report on audiologic outcomes for these patients or technique involving STP and BAHA.

*Learning Objective: To describe indications for staged procedure. To identify audiologic outcomes of cochlear implantation or BAHA for patients after STP; To identify factors that may lead to increased risk of post-operative complications and ex-plantation or re-implantation.

*Desired Result: To characterize and identify operative technique, timing for staged procedures, and audiologic outcome results for patients requiring STP with CI or BAHA.

Level of Evidence - IV

Indicate IRB or IACUC: Approved by the Medical University of South Carolina Institutional Review Board. IRB Approval Pro#00098273.

Audiologic Evaluation in Patients with External Ear Abnormalities

Jennifer N. Shehan, MD; Asel Mustafa, BS
Akhil V. Uppalapati, BA; *Jessica R. Levi, MD*

Hypothesis: Children diagnosed with external ear abnormalities (EEA) do not routinely undergo recommended audiologic evaluation.

Background: Current guidelines by the American Academy of Audiology recommend that patients with EEA undergo audiologic evaluation. This study aims to determine the prevalence and demographic features of children with EEA who were referred for audiologic evaluation as well as their hearing status to better understand current and possible future guidelines.

Methods: A retrospective review at a tertiary academic medical center was performed of 723 patients ≤18 years old with EEAs (2012 -2020). Internal Classification of Diseases-9 and 10 codes were used for EEAs. Demographic factors (age, sex, race/ethnicity, language) and clinical findings (diagnoses, relevant exam, newborn hearing test results, hearing abnormalities, audiology results, surgical plan) were evaluated. Odds ratios and binary logistic regression methods were used to compare demographic factors and audiologic evaluation with a significant p value<0.05.

Results: Most patients were not evaluated by audiology (54.8%, n=396) or otolaryngology (54.8%, n=396). Patients with microtia were more likely (OR=5.025, 95% CI 2.035-17.840, p=.001) to undergo audiologic evaluation. Race/ethnicity and sex were not significant factors. Of those who had obtained audiograms, 17% (n=63) had hearing abnormalities, and conductive hearing loss was the most common hearing abnormality (n=41, 11%).

Conclusions: Most patients with EEAs do not undergo recommended evaluation. A majority of the patients evaluated do not have hearing abnormalities. Consideration should be taken to adjust evaluation guidelines for patients with EEAs.

*Define Professional Practice Gap & Educational Need: American Academy of Audiology recommends patients with EEA for audiologic evaluation, and this guideline has not been thoroughly assessed or supported in the literature.

*Learning Objective: To understand how to should counsel patients with EEAs in regards to audiologic and otolaryngologic evaluation.

*Desired Result: To support or reject the American Academy of Audiology's guidelines for evaluation in patients with EEAs.

Level of Evidence – Level IV

Indicate IRB or IACUC: Exempt

Reconstruction of the Anterior External Auditory Canal
with Mastoid Cortex Autologous Bone Graft

Braeden L. Lovett, BA; Sarah C. Shearer, MD; H. Jeffrey Kim, MD

Objective: To describe the surgical management of temporomandibular joint (TMJ) herniation with external auditory canal (EAC) reconstruction using autologous bone grafting from the mastoid cortex.

Study Design: Retrospective case series

Setting: A tertiary university medical center

Patients: Three patients who presented to our Otolaryngology clinic with evidence of TMJ herniation through an anterior EAC defect, both on otoscopy and computed tomography (CT) imaging.

Interventions: Reconstruction of the anterior EAC with mastoid cortex bone grafting using an endaural approach.

Main Outcome Measures: Successful reconstruction of anterior EAC bony defect without recurrence of herniation.

Results: All three patients presented with otalgia, hearing loss, and either tinnitus or a clicking sensation with jaw movement. Etiologies for TMJ herniation included osteoradionecrosis following extended beam radiation therapy (EBRT) for head and neck carcinoma and iatrogenic following multiple tympanoplasties and canalplasties. A mastoid cortex bone graft was placed and secured anterior to the bony EAC defect through an endaural approach. Two patients wore a dental retainer postoperatively to keep the condyle in an open position. After reconstruction, patients reported an improvement in their presenting symptoms. There was no recurrence of TMJ herniation in all cases after 1, 4, and 7 years, respectively.

Conclusions: Anterior EAC reconstruction with autologous bone grafting can be an effective definitive treatment in TMJ herniation. To our knowledge, this is the first report of the use of bone grafting to reconstruct the canal defect in TMJ herniation.

*Define Professional Practice Gap & Educational Need: TMJ herniation to the anterior EAC is a rare otologic problem. Once it is properly diagnosed, the defect can be successfully reconstructed.

*Learning Objective: Reconstruction of the anterior EAC with mastoid cortex autologous grafting

*Desired Result: Diagnose and repair anterior EAC defects

Level of Evidence: V

Indicate IRB or IACUC: Exempt per Georgetown University Institutional Review Board

Human Otopathology in Scleroderma

Melissa Castillo-Bustamante, MD; Prithwijit Roychowdhury,BS, Dhrumi Gandhi, MS
Elliott Kozin, MD; Aaron Remenschneider, MD, MPH

Objective: Scleroderma is a chronic progressive multisystem disease that results in vascular insufficiency, collagen deposition and fibrosis. Hearing loss and vestibular dysfunction have been clinically reported in scleroderma, but evidence of systemic sclerosis within the temporal bone has not been well described. Herein, we review two cases of scleroderma from a temporal bone repository.

Study Design: Clinical case review and correlative otopathologic analysis

Methods: The national temporal bone database was reviewed for cases with scleroderma. Middle and inner ear otopathologic analysis was performed following hematoxylin and eosin staining under light microscopy. Findings were compared to age-matched controls.

Results: Two patients (three ears) with a history of serologically confirmed scleroderma were identified. Both individuals reported tinnitus and demonstrated bilateral moderate to severe down-sloping sensorineural hearing loss on audiometry. Histologically, the incudomallear joint space was diminished and ossicles appeared demineralized. A loss of hyaline and calcified cartilage, and obliteration of the incudomallear and incudostapedial joint synovial spaces was observed. Decreased caliber and intimal hyperplasia of arteries adjacent to ossicles was also identified. Mild diffuse atrophy of stria vascularis in the middle and apical turns of cochlea were found. Hair cell populations were normal. Total spiral ganglion neurons were lower in cases of scleroderma (range 29%-51%) compared to age-matched controls. Atrophic changes on the sensory epithelium of the saccule was also found.

Conclusions: Fibrosis, inflammation, and vascular changes were observed in the middle and inner ear in patients with scleroderma. Findings have implications for understanding hearing and vestibular dysfunction in this patient population.

*Define Professional Practice Gap & Educational Need: Scleroderma (systemic sclerosis) is a multi-systemic disease characterized by small vessel vasculopathy and diffuse fibrosis. Clinical studies have reported hearing loss as an uncommon manifestation of scleroderma. The pathogenesis of hearing loss in scleroderma is poorly understood.

*Learning Objective: Participants will gain an understanding of systemic, audiologic and vestibular symptoms in scleroderma (systemic sclerosis) with correlation to human temporal bone histopathology.

*Desired Result: Following this presentation, participants will be better able to identify relevant audiovestibular symptoms in patients with scleroderma with histopathologic correlations; such an understanding has implications for management of patients with scleroderma.

Level of Evidence: Level IV

Indicate IRB or IACUC: MEE IRB: 2019P003755

Audiometric Outcomes of Endoscopic and Microscopic Ossiculoplasty

Mark Sakai, MD; Daniel E. Killeen, MD; Jonathon Korpon, MD; Connie Ma
Jacob B. Hunter, MD; Brandon Isaacson, MD; Joe Walter Kutz, MD

Objective: To assess endoscopic and microscopic ossiculoplasty audiometric outcomes

Study Design: Retrospective Review

Setting: Tertiary Academic Center

Patients: Adult patients who underwent ossiculoplasty with either partial ossicular replacement prosthesis (PORP) or total ossicular replacement prosthesis (TORP) from 2010 to 2019 with at least one year of audiometric follow-up

Interventions: Endoscopic or microscopic ossiculoplasty

Main Outcome Measures: Post-operative Air-Bone Gap (ABG) after at least 1 year.

Results: A total of 198 patients, 53.5% female, and a median age of 47.5 years (18-88), met inclusion criteria. Overall, 64.1% of patients were reconstructed with a PORP, and 65.2% of all patients underwent microscopic ossiculoplasty, compared with endoscopic ossiculoplasty in 34.8%. The median audiometric follow-up was 27 months (12-122). The median post-operative ABG was 16.9 dB (-0.6-66.9) overall, 15.6 dB (-0.6-65.6) for PORP reconstruction and 19.4 db (2.5-66.9) for TORP reconstruction (PORP vs. TORP, $p=0.002$). For TORP reconstructions, the median ABG for endoscopic TORP was 19.4 dB (6.9-59.4) compared to 19.4 dB (2.5-66.9) for microscopic TORP ($p=0.92$). For PORP reconstructions, the median ABG for endoscopic PORP was 13.1 dB (1.3-37.5) compared to 16.3 dB (-0.6-65.6) for microscopic PORP ($p=0.03$). Using multivariate linear regression to predict post-operative PORP ABG, and controlling for ipsilateral middle ear atelectasis, ipsilateral myringitis, any previous contralateral middle ear disease, and a diagnosis of diabetes, endoscopic PORP was associated with improvement in ABG by 4.8 dB ($p=0.02$), while prior ipsilateral ossiculoplasty was associated with worsening of ABG by 5.5 dB ($p=0.03$).

Conclusions: Endoscopic ossiculoplasty is associated with improved ABG, while previous ipsilateral ossiculoplasty was associated with worse ABG for PORP reconstruction.

*Define Professional Practice Gap & Educational Need: There is limited data on audiometric outcomes following endoscopic ossiculoplasty, as well as comparing them to microscopic ossiculoplasty outcomes, which will allow evaluation of potential factors that could influence outcomes.

*Learning Objective: Identify factors that may influence ossiculoplasty outcomes, specifically looking at endoscopic compared to microscopic approaches.

*Desired Result: To better elucidate factors that may influence ossiculoplasty outcomes in order to improve future ossiculoplasty outcomes.

Level of Evidence – Level IV

Indicate IRB or IACUC: IRB #STU- 2019-1673, UT Southwestern.

The Effect of Cochlear Implantation on Tinnitus and Quality of Life:
A Systematic Review and Meta-analysis

Cheng Ma, BS; Erick Yuen, BA; Shaun A. Nguyen, MD
Ted A. Meyer MD, PhD; Paul R. Lambert MD

Objective: To explore the effect of cochlear implantation (CI) on tinnitus and quality of life.

Data Sources: Pubmed, SCOPUS, Web of Science, and Cochrane Library were searched through August 21, 2020 using a combination of subject headings and keywords related to cochlear implantation (CI) and tinnitus.

Study Selection: English articles reporting on pre-intervention tinnitus-related patient-reported outcome measures (e.g. Tinnitus Handicap Inventory [THI], Tinnitus Questionnaire [TQ], Visual Analogue Scale [VAS] for loudness, etc) and quality of life measures (e.g. Nijmegen Cochlear Implantation Questionnaire [NCIQ] and Hospital Anxiety and Depression Scale [HADS]) for CI recipients were included.

Data Extraction: Demographics, baseline, and follow-up outcomes data.

Data Synthesis: Meta-analysis of continuous variables and proportions were performed for the included studies. A total of 27 articles reporting on 1,285 patients (mean age 54.5 years, range 14-81) were included. Meta-analysis of all tinnitus-related measures demonstrated improvement following implantation, with a mean difference of -23.2 [95% CI: -28.8 to -17.7], -12.6 [95% CI: -17.5 to -7.8], and -4.5 [95% CI: -5.5 to -3.4], ($p < 0.05$ for all) for THI, TQ, and VAS, respectively. NCIQ increased 12.2 points [95% CI: 8.2 to 16.2], ($p < 0.05$), indicating improved quality of life among CI recipients. Psychological comorbidities were also ameliorated, as evidenced by reductions in HADS depression (-1.7 [95% CI: -2.4 to -0.9]) and anxiety (-1.3 [95% CI: -2.1 to -0.5]), ($p < 0.05$ for both) scores.

Conclusions: Following CI, patients reported significant improvement in tinnitus via several validated questionnaires. Additional benefits include improved quality of life and reduction in psychological comorbidities.

Define Professional Practice Gap & Educational Need: Lack of understanding of the secondary benefits of cochlear implantation on patients with hearing loss with concurrent tinnitus and its effect on quality of life.

Learning Objective: To understand how cochlear implantation improves tinnitus-related symptoms and quality of life in patients with hearing loss requiring CI and compare pre-operative and post-operative tinnitus outcome measures.

Desired Result: Attendees will: (1) understand how cochlear implantation improves tinnitus in patients with concurrent hearing loss; 2) understand how a reduction in tinnitus symptoms relates to improved quality of life as reported by patients

Level of Evidence – Level II

Indicate IRB or IACUC: Exempt

Characterization of Vestibular Test Results in Patients with Horizontal Canal Benign Paroxysmal Positional Vertigo (BPPV)

Eric K. Kim, BA; Lauren Pasquesi, AuD; Kristen Steenerson, MD; Jeffrey D. Sharon, MD

Objective: Analyze vestibular test results of patients with horizontal canal BPPV with ageotropic nystagmus (AHC) and geotropic nystagmus (GHC) in comparison to patients with posterior canal BPPV (PC).

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

Patients: Adults with BPPV from 1/1/2015 to 6/30/20.

Interventions: We reviewed patient questionnaires, notes, and testing results of patients with BPPV.

Main Outcome Measures: We compared caloric tests, subjective visual vertical (SVV)/ Subjective visual horizontal (SVH), and vestibular evoked myogenic potential (VEMP) results between groups.

Results: We included 11 AHC and seven GHC patients and randomly selected 20 PC patients as the comparison group. All groups had a high rate of migraines but no difference between groups (3/10 AHC, 5/7 GHC, 10/20 PC). Ipsilateral caloric weakness was more prevalent in AHC and GHC groups compared to the PC group (p=0.01). One of two AHC patients and both GHC patients who had SVV/SVH testing had abnormal findings. The only AHC patient who had ocular VEMP testing had abnormal results. Additionally, we observed significant downbeating nystagmus (4 deg/sec or greater) exclusively in the AHC group (5/10 patients).

Conclusions: We demonstrated that patients with AHC and GHC have unique vestibular testing results, including ipsilateral caloric weakness and abnormal SVV/SVH results. Furthermore, only AHC patients showed downbeating nystagmus.

*Define Professional Practice Gap & Educational Need: Insufficient literature examining the vestibular testing results in patients with horizontal canal BPPV.

*Learning Objective: Describe the vestibular test patterns of AHC and GHC patients.

*Desired Result: Identify patterns of clinical factors and vestibular test results that can help providers better identify and gain a deeper understanding of the pathogenesis of horizontal canal BPPV.

Level of Evidence - III

IRB: Approved 2/12/19, UCSF IRB 18-25365

Middle Ear Adenoma: A Systematic Review

Peter E. Ashman, MD; Andrew R. Magdich, BS; Zachary T. Grace, BS
Guy Talmor, MD; Brian Benson, MD; Dennis I. Bojrab II, MD; Peter F. Svider, MD

Objective: To perform a systematic review of the diagnosis, treatment, and prognosis of patients with a middle ear adenoma (MEA).

Data Sources: PRISMA guidelines were followed and the PubMed, Embase, Cochrane databases were searched from January 1, 1960 to July 1, 2020 with the following terms: [(middle ear) OR (adenoma) OR (otology) OR (neuroendocrine adenoma)].

Study Selection: Studies reporting on patients diagnosed with MEA detailing patient characteristics, diagnosis, management, and prognosis were included. Excluded studies were either non-English, not relevant to search terms or examined irrelevant parameters, or reported on non-human populations.

Data Extraction: All studies were assessed for quality and risk of bias either via the Modified Newcastle-Ottowa Scale for non-comparative studies or the Methodological Index for Non-Randomized Studies (MINORS) criteria for non-randomized studies. Data were collected on patient demographics, presenting signs and symptoms, diagnosis, treatment and management, as well as prognosis and recurrence.

Data Synthesis: Seventy-seven articles encompassing 250 patients met inclusion criteria including sixty-four case reports, seven case series, and seven retrospective reviews. Descriptive statistics were used to organize the data for further analysis.

Conclusions: Hearing loss and a middle ear mass are the most common presenting manifestations of MEA. Facial nerve involvement is rare but can occur more than expected. Primary treatment consists of surgical resection. Radiation and chemotherapy have little role in this disease. Recurrence is uncommon but can occur with incomplete resection.

*Define Professional Practice Gap & Educational Need: 1) Need for systematic literature review of this rare tumor 2) Lack of awareness of this rare tumor when formulating a differential of a middle ear/mastoid mass. 3) Lack of awareness of diverse nomenclature regarding middle ear adenomas 4) Unclear long-term prognosis of this rare tumor

*Learning Objective: 1) To learn about an uncommon disease entity and its presentation, diagnosis, treatment, and management. 2) To learn to differentiate neuroendocrine tumors 3) To learn history of nomenclature regarding middle ear adenomas 4) To understand further the prognosis of this rare tumor

*Desired Result: Attendees will use the information obtained from this presentation to help diagnose and manage this uncommon tumor. They will also be able to differentiate neuroendocrine tumors of the middle ear based on staining and pathologic examination. They will learn about the prognosis and recurrence of MEA.

Level of Evidence – N/A

Indicate IRB or IACUC: Exempt

The Top 100 Cited Articles in Otology and Neurotology

Omid S. Dehghan; Kotaro Tsutsumi, BA; Khodayar Goshtasbi, MS
Elaine Martin, MD; Ethan Muhonen, MD; Mehdi Abouzari, MD, PhD; Hamid R. Djalilian, MD

Objective: To perform a bibliometric analysis of top 100 cited *Otology and Neurotology* (*O&N*) articles and elucidate important research topics and trends over the past 40 years.

Data sources: Articles published in the *O&N* Journal (previously American Journal of Otology) from 1980-2020 were identified through the Scopus database and evaluated.

Study selection: Top 100 articles ranked by citation rate were selected. All types of articles were included.

Data extraction: Articles were assessed for year of publication, subjects and types of study, country of origin, and affiliated institutions.

Data Synthesis: A total of 5430 *O&N* articles published between 1980-2020 were reviewed and top 100 cited studies (1.8%) were identified. Year 2001 and 2004 had most highly cited studies (n=13 each). Topics of discussion in top 100 were heavily weighted towards cochlear implants (n=38), vestibular disorders (n=15), and sensorineural hearing loss and tinnitus (n=11). Top 3 countries with highest numbers of articles published included U.S. (n=56), United Kingdom (n=11), and Australia (n=9). The top 5 contributing institutions included Massachusetts Eye and Ear Infirmary (n=13), Johns Hopkins University (n=7), University of Washington (n=6), University of California San Francisco (n=3), and University of Sydney (n=2). After adjusting the citation ranking for year of publication, 39 of the original top 50 studies (78%) remained among the adjusted top 50 highly cited studies.

Conclusions: This study provides important historical and topical trends within the top 100 articles of *O&N*, providing otolaryngologists and other research scientists with a better comprehension of the developments and discoveries regarding otology and neurotology topics.

Define Professional Practice Gap & Educational Need: Bibliometric analyses of journals could present researchers and physicians with a broad perspective on general trends of their respective fields. This applies to the fields of otology and neurotology as well, and a need for a bibliometric analysis of the *O&N* Journal is warranted.

Learning Objective: To explain prominent research topic and trends within the *O&N* Journal through identification of its top 100 cited articles.

Desired Result: Informing otologists of important research topics and trends in the fields of otology and neurotology over the past 40 years.

Level of Evidence – N/A

Indicate IRB or IACUC: Exempt

Optimal Number of Intratympanic Steroid Injections in Sudden Sensorineural Hearing Loss

Ariel Lee, BS; Mehdi Abouzari, MD, PhD; Adwight Risbud, BS
Janice T. Chua, BS; Emily Nguyen, BS; Elaine Martin, MD; Hamid R. Djalilian, MD

Objective: To identify the optimal number of intratympanic steroid injections for treatment of sudden sensorineural hearing loss (SSNHL).

Study design: Retrospective chart review.

Setting: Tertiary care neurotology clinic.

Patients: Patients presenting to a referral otology clinic with SSNHL were included. All patients received at least two intratympanic steroid injections.

Interventions: Prednisone 1 mg/kg (up to 80 mg) daily for 7 days and a 6-day taper. In addition, all patients were injected with dexamethasone 10 mg/mL intratympanically at least twice, on a frequency of 2 times a week. If there was improvement in the word discrimination (>15%), at least 10 dB improvement in two adjacent frequencies, or a subjective qualitative improvement reported by the patient, a third injection was given. Injections were continued until there was no change from one visit to the next.

Main outcome measure(s): Post-injection improvements in hearing thresholds, low and high-frequency pure tone average (PTA), word recognition score (WRS), and speech recognition threshold (SRT).

Results: 106 patients (43% female) with a mean age of 62 years were included. Post-third steroid injection hearing thresholds significantly improved at 250 Hz ($p=0.02$), 500 Hz ($p=0.01$), 1000 Hz ($p<0.001$), 2000 Hz ($p=0.03$), and 4000 Hz ($p=0.03$). Low-frequency PTA ($p<0.001$), high-frequency PTA ($p=0.03$), WRS ($p=0.02$), and SRT ($p=0.04$) were also significantly improved after third injection. The improvement after the third injection was greater than the improvement after the first or second injections. Detailed data on pre- and post-each injection will be presented.

Conclusions: Intratympanic dexamethasone injections significantly improved hearing frequencies, low- and high-frequency PTA, WRS, and SRT, after the third injection. These findings suggest that the three IT steroid injections are optimal for the treatment of SSNHL.

Define Professional Practice Gap & Educational Need: Although the effectiveness of treatment of SSNHL with IT steroid injections has been clearly studied, the number of injections has not been clearly identified. For this reason, a need to educate clinicians on the clinical efficacy of a specific number of IT steroid injections for SSNHL is warranted.

Learning Objective: To propose an evidence-based best practice in treatment of SSNHL patients.

Desired Result: Informing clinicians of an evidence-based practice that can inform better treatment for patients with SSNHL.

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.

Risk Factors Associated with Development of Post-Craniotomy Headache after Retrosigmoid Resection of Vestibular Schwannoma

Yin Ren, MD, PhD; Marin A. McDonald, MD; Paul Manning, MD; Bridget V. Macdonald, BS
Marc S. Schwartz, MD; Rick A. Friedman, MD, PhD; Jeffrey P. Harris, MD, PhD

Objective: Dispersion of bone dust in the posterior fossa during retrosigmoid craniectomy could lead to meningeal irritation and development of persistent headaches. We aim to determine risk factors, including whether the presence of bone spicules, that influence postoperative headaches after retrosigmoid resection of vestibular schwannoma.

Study Design: Retrospective case series.

Setting: Tertiary skull-base referral center.

Patients: Adult patients undergoing VS resection between November 2017 and February 2020.

Interventions: Retrosigmoid craniectomy.

Main Outcome Measures: Development of persistent post-operative headache lasting $\geq$ 3 months.

Results: Of 64 patients undergoing surgery, 49 had complete data (mean age, 49 years; 53% female). Mean follow-up time was 1.4 years. At latest follow up, 16 (32.7%) had no headaches, 14 (28.5%) experienced headaches lasting < 3 months, 19 (38.8%) reported persistent headaches lasting $\geq$ 3 months. Twenty-seven (55.1%) patients had posterior fossa bone spicules detectable on postoperative CT. Age, gender, body-mass index, length of stay, tumor diameter, size of craniectomy, the presence of posterior fossa bone spicules or the amount of posterior petrous temporal bone drilled did not differ significantly between patients with persistent headaches and those without. On multivariate logistic regression, patients with persistent headaches were less likely to have preoperative brainstem compression by the tumor (Odds ratio [OR]=0.21, p=0.028) and more likely to have higher opioid requirements during hospitalization (OR=1.023, p=0.045).

Conclusions: The presence of bone spicules in the posterior fossa did not contribute to headaches following retrosigmoid VS resection. Preoperative brainstem compression may be associated with a decreased risk of persistent headaches.

*Define Professional Practice Gap & Educational Need: The incidence of post-craniotomy headache after retrosigmoid approach to vestibular schwannoma resection is variable. The exact cause of these headaches is still poorly understood. It has been hypothesized that chemical meningitis from bone dust in the subarachnoid space of posterior fossa may result in persistent headaches. Therefore, there is a need to better define risk factors for the development of headaches after retrosigmoid resection.

*Learning Objective: To characterize the intensity, frequency, and duration of post-craniotomy headaches and determine risk factors that are associated with the development of persistent headaches lasting more than three months after surgery.

*Desired Result: Neurotologists and skull-base neurosurgeons will better understand the rate of post-craniotomy headaches after retrosigmoid resection of vestibular schwannomas and identify risk factors associated with headaches.

Level of Evidence – Level IV

Indicate IRB or IACUC : IRB approval was acquired before data collection (University of California San Diego IRB 180978XL, approved October 2018).

Healthcare Utilization following Different Modalities of Cholesteatoma Surgery
United States 2003-2019

Z. Jason Qian, MD; Jennifer C. Alyono, MD; Alan G. Cheng, MD
Iram N. Ahmad, MD; Kay W. Chang, MD

Objective: To describe national trends in cholesteatoma management.

Study Design and Setting: Retrospective analysis Optum Clinformatics® Database from 2003-2019.

Patients: 16,179 unique patients who received cholesteatoma surgery.

Interventions and Main Outcome Measures: Patients were categorized into three groups by initial surgical modality: trans-tympanic (TT), canal wall up mastoidectomy (CWU), and canal wall down mastoidectomy (CWD). Four major comparisons between groups were performed: 1) temporal trends, 2) clinical and sociodemographic determinants, 3) total healthcare costs before and after, and 4) utilization of surveillance imaging and subsequent surgeries.

Results: Overall, 32.5% received initial TT surgery, 44.3% CWU, and 23.2% CWD. 1) The incidence of initial CWU surgery increased ($p<0.050$) while CWD decreased ($p<0.050$) and TT remained stable ($p=0.084$) over time. 2) Relative to CWU, age<18, prior complicated diagnoses, and non-white race were negatively predictive of TT ($p<0.050$ each), while annual household income >$100K was positively predictive of TT (aOR=22.90, 95%CI [2.74,43.06], $p=0.026$). Contrastingly, age>18 and non-white race were positively predictive of CWD compared to CWU ($p<0.050$ each) while income had no effect. 3) For preop costs, TT<CWU<CWD ($p<0.050$ each). While for postop costs, CWU=CWD ($p=0.852$), while TT was less than both ($p<0.050$ each). 4) In patients with at least six years of continuous enrollment, post-op imaging and/or subsequent surgery was performed in 41.62% of TT, 57.42% of CWU, and 45.48% of CWD patients.

Conclusions: Rates of postoperative imaging and second look surgery are less than expected for non-CWD surgery. Socioeconomic difference in care were observed.

*Define Professional Practice Gap & Educational Need: Management of cholesteatoma remains controversial and assessment of national practice patterns is critical for defining areas for overall improvement.

*Learning Objective: Utilization of imaging and operative surveillance after trans-tympanic and canal wall up cholesteatoma surgery is lower than is expected, while canal wall down surgery may not be as definitive as traditionally thought.

*Desired Result: To provide awareness of national patterns in cholesteatoma management and help otologists be cognizant of factors associated with deviations from best practices.

Level of Evidence – Level V

IRB: Exempt

Analysis of the Characteristics and Co-Morbidities of Patients with Pseudohypoacusis

Benjamin D. Liba, MD; Paige M. Pastalove, AuD
Pamela C. Roehm, MD, PhD

Objective: Across the world the inability to hear affects millions of people and results from many causes, including, congenital disorders, acoustic trauma, infection, and aging. Pseudohypoacusis or non-organic hearing loss is an underdiagnosed disorder which can occur fairly frequently and which can lead to inappropriate medical and surgical therapy. Our study analyzed a series of patients with this issue to better identify the characteristics of these patients and to shed light on this understudied issue.

Study Design: Retrospective chart review

Setting: Otolaryngology Clinic of a Tertiary Referral Center

Patients: Patients with diagnoses of pseudohypoacusis, functional hearing loss, or non-organic hearing loss

Main Outcome Measures: Pure tone averages, speech reception thresholds, word recognition scores, auditory brainstem response waveforms.

Results: Our review yielded 28 patients with evidence of pseudohypoacusis. The majority of these patients were female (n= 21, 75%) and showed bilateral non-organic hearing loss (n=14, 50%). Many patients suffered from a coexisting psychiatric disorder (n=13, 46%) with depression and anxiety occurring most frequently. In those patients in which auditory brainstem responses (ABR) were obtained the average difference between pure tone average and ABR were statistically significant at an average of 44 dB ±27 (p=0.0002) for the left ear and 43 dB ±19 (p=0.0009) for the right ear

Conclusions: Pseudohypoacusis is an issue that is more common than might be realized and is often associated with co-morbid psychiatric issues. Recognizing these patients therefore carries increased importance to ensure they are receiving appropriate treatment for their disorder.

Define Professional Practice Gap & Educational Need: To better understand and identify those patients presenting with functional hearing loss.

Learning Objective:
To be able to diagnose patients with pseudohypoacusis
To understand the co-morbidities and that these patients typically exhibit

Desired Result:
Improved understanding of the diagnostic criteria and underlying comorbidities associated with pseudohypoacusis

Level of Evidence – Level IV

Indicate IRB or IACUC : Temple University Hospital IRB Protocol 26091

Resource Utilization and Outcomes in Mastoidectomies
between 2007-2015 in Adult Patients

Rahul K. Sharma BS; Alexander Chern MD; Anil K. Lalwani MD

Objective: Over the past several decades, mastoid surgery has become a routine outpatient procedure, reducing hospital spending and increasing patient comfort during recovery; however, this has not always been the case. We aim to examine the effect of hospital volume on same-day discharge and readmission rates for mastoidectomies in New York State over time.

Study design: Longitudinal Cohort Study

Setting: New York State Insurance Claims Database

Patients: Patients receiving a Mastoidectomy between 2007-2015

Intervention: None

Main outcome measure(s): 30-day readmission rates, Same-day discharge

Results: 9,948 unique mastoidectomy claims were analyzed in the New York Statewide Planning and Research Cooperative System (SPARCS) database. High-volume centers were defined as >=75th percentile of procedures/year (78 procedures/year) and were compared to lower-volume centers (<75th percentile). The proportion of same-day discharges increased from 85% in 2007 to 93% in 2015 ($p < 0.01$). High-volume centers had increased odds of same-day discharge compared to the comparison group (OR 1.13, 95% 1.10-1.15, $p < 0.001$) on multivariable logistic regression models after controlling for covariates (complications, year of surgery, pathologies, age, sex, race and comorbidities). High-volume centers had a lower risk of 30-day readmissions (OR 0.56, 95% CI 0.32-0.97, $p=0.042$) after controlling for covariates.

Conclusions: Same-day discharge rates have increased in New York State between 2007-2015, with high volume centers more likely performing ambulatory surgery compared to lower volume centers. High volume centers have a lower likelihood of 30-day readmission rates despite higher rates of same-day discharges.

Define Professional Practice Gap & Educational Need: Mastoidectomy has largely become an outpatient procedure over the past several decades. Understanding the adoption of same-day discharge in New York State, and its effect on readmission rates, will help us define clinical guidelines.

Learning Objective: After this presentation, the learner will be able to describe the relationship high-volume centers, same-day discharge, and 30-day readmission rates for mastoidectomies in New York state

Desired Result: Otolaryngologists will better understand the effect of high-volume centers on resource utilization and outcomes in mastoid surgery.

Level of Evidence – Level III

Indicate IRB or IACUC: Approved IRB-AAAT2769

Tympanoplasty Healing Outcomes

Casey L. Kolb, Carolyn O. Dirain, PhD, Patrick J. Antonelli, MD

Objective: Tympanoplasty is usually successful for perforation closure, but postoperative healing may be suboptimal. The aim of this study is to quantify rates of normal and suboptimal healing outcomes with tympanoplasty.

Study Design: Retrospective chart review

Setting: Academic, tertiary hospital

Patients: 101 randomly selected patients that had tympanoplasty

Interventions: Observation only

Main Outcome Measures: Postoperative healing problems (eg, granulation tissue, perforation, myringitis, bone exposure, lateralization, medial canal fibrosis, and lateral canal stenosis) and hearing outcomes up to 2 years postoperatively.

Results: 78 patients had 1 to 2-year postoperative data. 52 subjects (67%) had no healing or postoperative issues, 19% had adverse healing outcomes (perforation 6.4%, granulation tissue 6.4%, medial fibrosis 3.8%, and myringitis, bone exposure, webbing, lateralization, and lateral stenosis (all 1.3%), and 14% have other post-op issues such as otorrhea (11.5%), otitis externa(9%), otitis media (1.3%), and atelectasis (2.6%). Air-bone gap at 1 to 2-years did not differ between these three groups (p=0.87).

Conclusions: Despite a high success rate of perforation closure with tympanoplasty, a considerable percentage of patients developed adverse healing events. Fortunately, these healing issues did not significantly compromise hearing 1 to 2-year post-op. Opportunity remains to improve wound healing with tympanoplasty.

Define Professional Practice Gap & Educational Need: Tympanoplasty is routinely performed to treat a variety of diseases and improve hearing. While success rates are high, healing can be complicated in a range of ways. All of tympanoplasty healing sequelae may cause poor hearing, persistent infection, and require additional surgery. Thus, it is important to assess the adverse healing outcomes with tympanoplasty to further improve outcomes.

Learning Objective: At the conclusion of this presentation, the attendees will learn that tympanoplasty is commonly associated with complicated healing.

Desired Result: Attendees may be able to apply this knowledge by considering the potential adverse impact of tympanoplasty on healing outcomes when performing tympanoplasty and thereby seek to refine techniques to improve these outcomes.

Level of Evidence: Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC: This study has been approved by the University of Florida IRB #201901717

Bezold's Abscess with Lateral Skull Base Osteomyelitis, Lemierre's Syndrome and Dural Sinus Thrombosis

Mahnoor S. Khan, MD; Nicholas W. Pritchard, MD, MA; Kestutis P. Boyev, MD

Objective: We present a severe case of malignant otitis externa resulting in a Bezold's abscess (BA), dural venous sinus thrombosis and Lemierre's Syndrome in a patient with multiple contributing comorbidities.

Study Design: Case Report

Setting: Tertiary Referral Center

Patients: A 53-year-old female with a past medical history is notable for heavy tobacco use, previous right sided mastoidectomy due to recurrent ear infections, uncontrolled DM type 2, schizophrenia.

Interventions: Radical mastoidectomy with mastoid obliteration and a left neck exploration and wash out. Initiation of broad spectrum antibiotics, which were later tailored to intra operative cultures.

Main Outcome Measures: CT imaging with extensive osseous destruction throughout the left temporal bone, large abscess adjacent to the left sternocleidomastoid muscle, extensive dural venous thromboses throughout the left sigmoid and transverse sinuses, along with a venous thrombus of the left internal jugular vein.

Results: Patient was transferred from an outside hospital to be evaluated for left sided otalgia and otorrhea with concerns for lateral skull base osteomyelitis. The patient was initially found to have otorrhea and otalgia six weeks prior and was treated with a ten-day course of oral and otic antibiotics and was lost to follow up. She presented with anterior displacement of the left auricle due to swelling and erythema of the mastoid which tracked inferiorly along the sternocleidomastoid (SCM) muscle. She was noted to have a large area of firm induration superficial to the SCM with a diameter of four cm. CT showed extensive dural venous thromboses throughout the left sigmoid and transverse sinuses, along with a venous thrombus of the left internal jugular vein. Patient was discharged with IV Zosyn and PO doxycycline to an outside hospital one month post-operatively. Patient followed up one month after discharge with well healed incisions and reported antibiotic compliance.

Conclusions: Our report highlights the need for serious appraisal and timely management of common ear infections in immunocompromised psychiatric patients.

*Define Professional Practice Gap & Educational Need: BA is an extremely rare complication of otitis media and mastoiditis with only 41 cases recorded in the literature between 1975-2014. However, the pathology of mastoiditis can occur by other infectious processes such as malignant otitis externa (MOE). Those in immunocompromised states may have an unusual and severe presentation with atypical organisms as the culprit of their disease. This case reports is only the second case of MOE induced BA and the first complicated by dural venous sinus thrombosis and Lemierre's Syndrome.

*Learning Objective: To elucidate that BA can occur as a result of otitis externa with serious complications resulting from patient comorbidities.

*Desired Result: An elevated level of suspicion is needed for smokers, diabetics, the elderly and those with psychiatric illness.

Level of Evidence - Level V

Indicate IRB or IACUC : Case report/did not require

Susceptibility to Cisplatin-Induced Hearing Loss in Mice within the Hybrid Mouse Diversity Panel

Tammy B. Pham, BA; Danielle M. Gillard, MD; Ely Cheikh Boussaty, PhD
M. Eileen Dolan, PhD; Rick A. Friedman, MD, PhD

Objective: To use the Hybrid Mouse Diversity Panel (HMDP) to study the phenotypic variation and genetic susceptibility of cisplatin-induced hearing loss (CIHL).

Background: Cisplatin-based chemotherapy for solid tumors is associated with permanent bilateral hearing loss. The mouse is an excellent animal model for the study of human deafness because the mouse cochlea is anatomically similar to that of humans, and the genes related to hearing loss are highly conserved. Inbred mouse genome wide association studies (GWAS) can be used as a model for the study of CIHL.

Methods: Thirty-one HMDP strains underwent Auditory Brainstem Response testing at baseline and seven days after administration of 15mg/kg intraperitoneal cisplatin. Hearing threshold shifts were determined at 4, 8, 12, 16, 24 and 32 kHz. Efficient Mixed-Model Association algorithm was applied to phenotypes at 12, 16, and 24 kHz separately to identify genetic associations for each frequency.

Results: We observed variation in CIHL susceptibility at each tested frequency. We identified one significant genome-wide association on chromosome 7, where the single nucleotide polymorphism (SNP) rs48373903 was significant at more than one frequency. Regional mapping reveals several genes associated with membrane transport and oxidation reduction reactions associated with this SNP.

Conclusions: Our results provide the first large scale phenotypic data on cisplatin-sensitivity in mice. We demonstrate clear strain variation in sensitivity and highlight the genetic component of CIHL using HMDP mouse GWAS. The methods used in this study provide a potential resource for the study of specific genes that may be associated with CIHL.

Professional Practice Gap & Educational Need: There remains no FDA-approved agent to reduce CIHL for patients who receive cisplatin. A greater understanding of the genetics of CIHL will facilitate the development of potential otoprotective agents as well as allow *a priori* identification of those of individuals who are at a greater risk of CIHL who might be offered reduced dose regimens or alternative therapies when possible.

Learning Objectives: To appreciate the large variation in susceptibility to CIHL across strains in the HMDP. To understand the promising utility of HMDP mouse GWAS in guiding candidate gene selection for the study of CIHL susceptibility.

Desired Result: To encourage use of HMDP mouse GWAS to guide candidate gene selection for the study of CIHL susceptibility.

Level of Evidence - Level III

Indicate IRB or IACUC: The Institutional Care and Use Committee (IACUC) at the University of California, San Diego, approved the animal protocol for the HMDP strains (Protocol #S17178).

Primary non-Hodgkin Lymphoma of the External Auditory Canal: Case Report

Sarah A. Schmoker, MD; Steven D. Curry, MD, MPH; Jonathan L. Hatch, MD

Objective: To describe a rare presentation of non-Hodgkin lymphoma (NHL) isolated to the external auditory canal (EAC) and mastoid.

Study Design: Case report and review of the literature.

Setting: Tertiary care academic medical center.

Patient: A 62-year-old female.

Main Outcome Measures: Imaging studies, biopsy for analysis of histopathology and tumor markers.

Case Report: A 62-year-old woman was referred to the otolaryngology clinic for right EAC mass. She presented with right aural fullness, hearing loss, and otalgia without otorrhea for 8 months. Exam revealed a mass obstructing the canal and impeding a view of the tympanic membrane (TM). Pure tone audiometry in the right ear showed mild sloping to profound mixed hearing loss. Temporal bone CT demonstrated a 2 cm solid mass in EAC with erosion of the mastoid air cells, posterior EAC and of the sigmoid plate. Incisional biopsy of the mass was performed. Histopathology exam was consistent with diffuse large B-cell non-Hodgkin lymphoma (DLBCL). FISH cytogenetics were negative for BCL2, BCL6, and C-MYC. Clinical staging PET/CT and bone marrow biopsy showed no evidence of malignancy outside of the EAC and temporal bone. She was referred to the hematology-oncology service and LP was negative for CNS involvement. She is undergoing treatment with R-CHOP regimen.

Discussion: Although primary tumors of the EAC are rare, hematologic malignancy should be considered in the differential diagnosis of an EAC mass lesion. NHL makes up 10% of head and neck cancers and presents with extranodal involvement in up to 40% of cases. DLBCL is the most common subtype of NHL and is characterized by aggressive tumor growth. Nonspecific symptoms of aural fullness, otalgia, and hearing loss make early diagnosis challenging, but diagnostic workup supplemented by imaging and biopsy can guide the correct diagnosis for this rare malignancy.

Define Professional Practice Gap & Educational Need: Common causes of EAC obstruction and associated conductive hearing loss such as cerumen impaction are frequently seen in the otolaryngology clinic, but other less common etiologies such as hematologic malignancy are possible, even in the absence of signs and symptoms beyond the ear or previously identified malignancy.

Learning Objective: Understand that hematologic malignancies, such as non-Hodgkin lymphoma, can present as isolated masses of the external ear canal.

Desired Result: At the conclusion of this presentation, the participants should be able to recognize the presentation of hematologic malignancies of the ear and temporal bone, and understand the appropriate diagnostic workup required.

Level of Evidence - Level V

Indicate IRB or IACUC: Exempt

Image Analysis of Otosclerosis Using Artificial Intelligence

Susanna Betti, BS; Ron DeSpain, BS; Kirolos Georges, BA; Aatin Dhanda, BA
Mary George, BA; Alicia Quesnel, MD; Robert W. Jyung, MD

Objective: Image analysis using artificial intelligence (AI) has great potential to classify temporal bone histopathology. Human input for such tasks is prone to subjectivity. We assessed the capability of AI to detect regional differences within otosclerotic lesions corresponding to accepted criteria that differentiate active and inactive regions.

Study Design: ImageJ/Trainable Weka Segmentation (TWS) were used to create models to analyze photomicrographs of otosclerotic lesions (n=7). These models were designed to distinguish otosclerotic bone of pink (eosinophilic) or purple (basophilic) hue imparted by H&E staining. To validate this method of separation, we quantified microvessel density (MVD) and percentage occupancy of pseudovascular spaces. Manual vessel counts were divided by surface area to generate MVD.

Patients: Temporal bone cases had been obtained from the Massachusetts Eye and Ear Infirmary and the House Ear Clinic according to protocol. Specimens were processed with conventional H&E staining for light microscopy and anonymized for analysis.

Results: TWS was able to delineate otosclerotic regions from surrounding normal bone matrix as well as pseudovascular spaces from otosclerotic bone. TWS reliably differentiated eosinophilic and basophilic regions within otosclerotic foci, allowing comparative analysis. With H&E criteria alone, we found no significant differences in terms of total pseudovascular space area or percent occupancy of pseudovascular space between eosinophilic and basophilic regions. We did discover significantly higher MVD in basophilic regions.

Conclusions: TWS is a powerful tool for analysis of otosclerotic lesions and can provide a more quantitative evaluation of pathologic features of disease activity, such as pseudovascular spaces. Further refinement is required.

Define Professional Practice Gap & Educational Need: To determine if automated segmentation/AI can reliably differentiate active from inactive otosclerosis.

Learning Objective: To educate the learner on the value of AI for analysis of temporal bone pathology.

Desired Result: Increased understanding and acceptance of AI driven technology to assist in analysis of temporal bone pathology.

Level of Evidence: Level V

Indicate IRB or IACUC: Exempt

Classification of Advanced Otosclerosis and Bone Conduction Outcomes of Stapedotomy

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

Objective: To examine the degree of advanced otosclerosis on outcomes of bone conduction (BC) thresholds

Study Design: Retrospective chart review

Setting: Single tertiary care center

Patients: Adult patients undergoing primary stapedotomy with advanced otosclerosis

Interventions: Stapedotomy

Main Outcome Measures: Pre- and postoperative bone conduction threshold means based on frequencies of 500, 1000, 2000, and 4000 hertz (Hz) compared between different classification methods. Methods of classification for advanced otosclerosis were based on mean BC thresholds (>50 dB HL and > 60 dB HL), speech discrimination (<70%), and pure tone average (PTA) (>85 dB HL).

Results: For the >50 dB HL (36 patients) and >60 dB HL (15 patients) mean BC threshold classifications there was a statistically significant improvement in mean BC thresholds from 58.46 to 53.75 dB HL and 66.5 to 60.25 dB HL, respectively (p<.001, p<.001). Bone conduction thresholds improved for classifications based on speech discrimination (13 patients) and PTA (24 patients), however, this was not statistically significant.

Conclusions: When the classification of advanced otosclerosis is based on bone conduction threshold, there is a statistically significant improvement of mean bone conduction thresholds compared to classification based on speech discrimination or PTA.

*Define Professional Practice Gap & Educational Need: Expands audiologic outcomes of stapedotomy in advanced otosclerosis patients, specifically looking at different potential classifications of advanced otosclerosis.

*Learning Objective: Identify which advanced otosclerosis patients may have improved bone conduction thresholds after stapedotomy

*Desired Result: Provide evidence to help identify advanced otosclerosis patients whom may improve with stapedotomy and hearing aid usage

Level of Evidence - IV

Indicate IRB or IACUC : 1130957-4

Volumetric Accuracy Analysis of Virtual Safety Barriers for Cooperative Control Robotic Mastoidectomy

Andy S. Ding, BA; Sarah Capostagno, PhD; Christopher R. Razavi, MD
Russell H. Taylor, PhD; John P. Carey, MD; Francis X. Creighton, MD

Background and Objectives: Cooperative control robots (CCRs) allow for a surgeon and robot to hold and manipulate an instrument simultaneously, allowing robotic precision while still capitalizing on surgeon motor skills and haptic feedback. CCRs can implement virtual safety barriers to prevent surgeon motion into undesired locations. This study assesses the accuracy of CCR-imposed safety barriers in a cortical mastoidectomy.

Methods: Temporal bone phantoms were registered to a CCR using preoperative CT imaging. Virtual safety barriers were created using 3D Slicer, with 2D planes placed along the external auditory canal, tegmen, and sigmoid, converging on the antrum. Five mastoidectomies were performed by novice surgeons, moving the drill to the limit of the safety barriers. Postoperative CT scans were obtained, and Dice coefficients and Hausdorff distances were calculated between preoperative and postoperative drilled volumes.

Results: Procedural success rate was 100% (5/5) with a mean time to completion of 221 ± 35 seconds. Hausdorff distances between drilled bone and the preplanned volume resulted in an average point-to-point distance of 0.351 mm. Compared to the preplanned volume of 0.947 cm^3, the mean volume of bone removed was 1.045 cm^3 (difference of 0.0982 cm^3 or 10.36%). Dice coefficient calculations yielded an average of 0.741.

Conclusions: This study shows feasibility for the use of virtual safety barriers in CCRs for otologic surgery. Future studies will focus on developing 3D virtual safety barriers placed around relevant surgical anatomy rather than 2D planes.

*Define Professional Practice Gap & Educational Need: Although there are previous studies describing the use of robotic guidance in performing mastoidectomy, prior work has focused on autonomous designs. Our work in developing a CCR for surgery, in which the surgeon and robot work together to manipulate the surgical instrument, is a semi-autonomous method which allows the system to benefit from the surgeon's inherent skill and knowledge, while providing increased safety. To our knowledge, this is the first assessment of the accuracy of CCR-enforced virtual barriers for otologic surgery.

*Learning Objective: The learning objectives were to examine the efficacy of using a cooperatively controlled robotic system to perform a cortical mastoidectomy and to determine the accuracy of robot-enforced virtual safety barriers in this system.

*Desired Result: We hope our study will highlight the role of robotics in otology and will spark discussion of methods to improve this technology in the future.

Level of Evidence – NA – This is a feasibility study of a robotic system using temporal bone phantoms.

Indicate IRB or IACUC: Exempt.

Otopathological Findings following Mild Traumatic Brain Injury in a Porcine Model

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Hypothesis: We hypothesize that discrete changes occur to the inner ear after mild traumatic brain injury (mTBI) in a validated porcine model.

Background: Labyrinthine concussion has long been recognized as a possible consequence of head injury. While audiovestibular dysfunction following head trauma with concurrent temporal bone (TB) fracture is generally well described, little is known about the pathophysiology of head injury without TB fracture (i.e. mTBI).

Methods: Swine were subjected to sham conditions (n=1) or head rotational acceleration using a HYGE pneumatic actuator (n=3) and euthanized 2 weeks post-injury. TBs were harvested and processed for histological evaluation under light microscopy. Degenerative changes in the cochleovestibular membranous labyrinth and presence of endolymphatic hydrops (EH) were assessed.

Results: All mTBI and sham TBs presented normal stria vascularis and spiral ligaments, in addition to scattered areas of outer hair cell (HC) degeneration in the apical turns. However, one mTBI TB showed outer HC degeneration in the middle and basal turns. Cellular debris and basophilic precipitate were found within the scala media in 3 mTBI TBs, whereas sham TBs were unremarkable. Mild cochlear EH was found in 4/6 mTBI TBs. Although HC and dendrites of vestibular-end organs were normal in all TBs, collapse of the membranous labyrinth (n=4 TBs) and otoconia debris in the semicircular canals (n=5 TBs) were found only in mTBI TBs.

Conclusions: This is the first study to investigate the inner ear following mTBI using a validated large animal model. Larger studies are needed to elucidate whether or not our findings are directly attributable to trauma.

*Define Professional Practice Gap & Educational Need: TBI is a major public health issue and contributes to injury-related morbidity and mortality worldwide. While auditory and vestibular dysfunction secondary to TBI is a recognized clinical phenomenon, the precise mechanism remains poorly described. Highly controlled and validated animal models of mTBI are necessary to correlate mechanisms of audiovestibular injury with pathologic findings in the acute and, eventually, chronic settings.

*Learning Objective: Expand our understanding of the pathophysiology of auditory and vestibular dysfunction after mTBI.

*Desired Result: Our evolving understanding of changes that occur in the auditory and vestibular peripheral systems may provide a new paradigm to study audiovestibular dysfunction following mTBI.

Level of Evidence - Does not apply

Indicate IRB or IACUC: Exempt

Cochlear Implant Hearing Outcomes Are Not Affected by Hearing Status in Non-Implanted Ear

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Objective: The Food and Drug Administration recently expanded cochlear implant (CI) indications to include asymmetric hearing loss and single-sided deafness. In this study, we determine whether higher word discrimination scores (WDS) in non-implanted ears hinders hearing outcomes in implanted ears.

Study Design: Retrospective cohort study

Setting: Tertiary care hospital

Patients: Adult patients with unilateral CIs (N=71), implanted between 2014-2018, were stratified by preoperative WDS in non-implanted ears (Groups 1-5: 0-20%, 21-40%, 41-60%, 61-80%, 81-100%, respectively)

Interventions: CI surgery in the poorer performing ear

Main Outcome Measures: Word and sentence test scores pre- and post-operatively

Results: The mean age for each group ranged from 66.2-71.9 years. Overall, 63.4% were female, 71.8% reported English as their primary language, and 66.2% had hearing loss for <10 years. In English-speakers, CNC and AzBio scores in quiet were significantly higher at 12 months in implanted ears compared to pre-operative scores ($p<0.05$); mean improvements were 44.3% and 52.8%, respectively. In Spanish-speakers, significant improvements in Bisyllables and HINT (Spanish) scores in quiet were also observed post-operatively ($p<0.05$). However, when stratified by groups, there were no significant differences in CNC, AzBio, Bisyllables (Spanish), and HINT (Spanish) scores in the implanted ear. In addition, there were no correlations between preoperative WDS in the non-implanted ear and post-operative hearing outcomes in the implanted ear ($p>0.05$).

Conclusions: CI patients with higher pre-operative WDS in non-implanted ears performed similarly to traditional CI patients on aided word and sentence tests in the implanted ear. These findings support the recent expansion of CI candidacy to incorporate patients with serviceable hearing in the non-implanted ear.

Define Professional Practice Gap & Educational Need: It is thought that cochlear implant patients with good hearing on one side may not achieve maximum benefit from cochlear implants due to comfort and preference for acoustic hearing. A better understanding of cochlear implant outcomes in patients with asymmetric and single-sided deafness, as it compares to traditional cochlear implant patients, is needed.

Learning Objective: Recognize that cochlear implant patients with serviceable hearing in the non-implanted ear obtain comparable hearing outcomes to traditional cochlear implant patients in the implanted ear.

Desired Result: Physicians will gain knowledge about the benefits of cochlear implant surgery in patients with asymmetric hearing loss and single-sided deafness and take these outcomes into consideration when counseling patients.

Level of Evidence – Level IV

Indicate IRB or IACUC : University of Miami IRB # 20181028, approved 03/04/2019