

SELECTED ABSTRACTS

***POSTER
PRESENTATIONS***



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Vestibular Schwannoma Tumor Volume by Location Correlated with Postoperative Facial Nerve Weakness

*Jacob Kahane, MD; Madelinn R. Fink, MS; Jacob L. Seicshnaydre, MS
MAJ Isaac D. Erbele, MD Moisés A. Arriaga, MBA, MD*

Objective: Determine where vestibular schwannoma tumor volume might be a factor in postoperative facial nerve weakness

Study design: Retrospective review

Setting: Two tertiary care centers between January 2015 to December 2019

Patients: Sporadic vestibular schwannoma patients undergoing surgery, excluding patients with previous surgery for their tumor.

Intervention: Vestibular schwannoma tumor volume of the entire tumor, the cerebellopontine angle, and the internal auditory canal were correlated with facial nerve outcomes as measured by House-Brackmann (HB) scores.

Main Outcome Measures: Facial nerve weakness up to one year postoperatively

Results: A total of 53 surgical vestibular schwannoma patients had imaging available to analyze. The median House-Brackmann score was II/VI at both the three and 12 month follow up. The median tumor size was 1.5 cm³ (interquartile range (IQR) 0.5-4.7 cm³). The median tumor volume within the cerebellopontine angle (CPA) was 1.2 cm³ (IQR 0.2-4.3 cm³), while the median tumor within the internal auditory canal (IAC) and median bony canal IAC were both 0.3 cm³ (IQR 0.2-0.4 cm³). There was a statistically significant moderate correlation between 12 month follow up HB scores and both IAC tumor volume ($\rho = 0.51$, $p = 0.007$) and IAC bony canal volume ($\rho = 0.44$, $p = 0.03$).

Conclusions: A vestibular schwannoma filling and widening the IAC portends worse long-term facial nerve outcomes.

***Professional Practice Gap & Education Need:** Identify and prevent causes of postoperative facial weakness after vestibular schwannoma surgery

***Learning Objective:** Identify patients at high risk for facial nerve weakness after surgery

***Desired Result:** Aid in safely dissecting vestibular schwannomas from the facial nerve to prevent postoperative weakness

Level of Evidence: IV

IRB: Approved (OLOL-9419)

Multi-Disciplinary Skull Base Conference and its Effects on Patient Management

*Scott B. Shapiro MD, Nathan Kemper MD, Joseph Breen, MD Michael Hazenfield MD
Mario Zuccarello MD, Jonathan Forbes MD, Ravi N. Samy MD*

Objective: Examine the effects of a multi-disciplinary skull base conference (MDSBC) on the management of patients seen for skull base pathology in a neurotology clinic.

Study Design: Retrospective case review

Setting: Tertiary care academic medical center.

Patients: Patients who were seen in a neurotology clinic for pathology of the lateral skull base and were discussed at an MDSBC between July 2019 and February 2020.

Intervention(s): Discussion at MDSBC.

Main Outcome Measure(s): Percentage of patients for which management changed as a result of discussion at an MDSBC.

Results: 82 patients with pathology of the lateral skull base were discussed at a MDSBC during the 8-month study period. 54 (65.9%) had a mass in the internal auditory canal and/or cerebellopontine angle while 28 (34.1%) had other pathology of the lateral skull base. Forty-nine (59.8%) were new patients and 33 (40.2%) were established. The management plan changed in 11 (13.4%) patients as a result of the skull base conference discussion. The planned management changed from some form of treatment to observation in 4 patients, and changed from observation to some form of treatment in 4 patients. For 3 patients who underwent surgery, the planned approach was altered.

Conclusions: For a significant proportion of patients with pathology of the lateral skull base, the management plan changed as a result of discussion at an MDSBC. Although participants of a MDSBC would agree of its importance, it is unclear how an MDSBC affects patient outcomes.

***Define Professional Practice Gap & Educational Need:** Though multidisciplinary skull base conferences are probably commonplace, their actual effects on patient management are unknown.

***Learning Objective:** Participants will understand the effects of a multidisciplinary skull base conference on patient management.

***Desired Result:** Improve outcomes in patients with skull base pathology, as well as improve satisfaction of patients and treating physicians.

Level of Evidence - Level IV

Indicate IRB or IACUC : IRB protocol 8258

Diagnostic Imaging of Pulsatile Tinnitus: A Retrospective Review

*Patrick Lynch, BA; Mark Newcomer, MD; Tanner Mitton, BS
Daniel Killeen, MD; Walter Kutz, MD*

Objective: To ascertain the frequency of different etiologies of pulsatile tinnitus and determine the diagnostic accuracy of different head and neck (H&N) imaging studies in the evaluation of pulsatile tinnitus.

Study Design: Retrospective Review

Setting: Tertiary Academic Center

Patients: All patients with a diagnosis of pulsatile tinnitus who received a H&N imaging study or a lumbar puncture to evaluate the etiology of their pulsatile tinnitus at our institution.

Intervention: Diagnostic imaging study or lumbar puncture

Main Outcome Measures: Definitive diagnosis for etiology of pulsatile tinnitus

Results: Of 220 charts reviewed, 37% of patients met the inclusion criteria with common reasons for exclusion including: no physician diagnosis of pulsatile tinnitus (15%), did not obtain imaging (5%), did not present at our institution (36%), and imaging was not for pulsatile tinnitus (6%). The most common etiologies of pulsatile tinnitus were idiopathic (52%), paragangliomas (7%), atherosclerotic disease (8%), and SSCD (6%). The most commonly obtained imaging studies included MRI with contrast, MRA, MRV, CT without contrast, and CTA. An MRI with contrast most effectively diagnosed paragangliomas and neuromas, while MRA and CTA most effectively diagnosed atherosclerosis & aneurysms. CT without contrast most effectively diagnosed SSCD. Lumbar punctures most effectively diagnosed IIH. Male gender and subjective ipsilateral hearing loss were associated with a significantly higher likelihood of a non-idiopathic etiology of pulsatile tinnitus.

Conclusions: Most patients with pulsatile tinnitus have an idiopathic cause. No single imaging study can effectively diagnose all non-idiopathic etiologies of pulsatile tinnitus. A provider's choice of imaging study must incorporate the patient's demographics, medical history, concomitant symptoms, and their physical exam.

***Define Professional Practice Gap & Educational Need:** There are several potential causes of pulsatile tinnitus with multiple different imaging modalities that have varied efficacy in diagnosing specific etiologies of pulsatile tinnitus, and there is still uncertainty with regard to the most efficacious imaging study for the diagnosis of pulsatile tinnitus.

***Learning Objective:** Overview the different etiologies of pulsatile tinnitus, the diagnostic imaging studies available, and an algorithm for investigating the cause of a patient's pulsatile tinnitus

***Desired Result:** To provide a framework for approaching the patient with pulsatile tinnitus

Level of Evidence – Level IV

Indicate IRB or IACUC: IRB #STU-2020-0651, UT Southwestern. Approval obtained July 8th, 2020.

Matched Cohort Analysis of the Effect of the Facial Recess Approach on Cerebrospinal Fluid Leak after Translabyrinthine Surgery for Schwannoma

*Laura H. Christopher, MD; Gregory P. Lekovic, MD, PhD; William H. Slattery, MD
Gautam U. Mehta, MD; Mia E. Miller, MD*

Objective: Translabyrinthine surgery for vestibular schwannoma (VS) has been described with and without a facial recess approach, which can be used to further expose the Eustachian tube (ET) for packing. We sought to determine the effect of including this technique on the development of postoperative nasopharyngeal cerebrospinal fluid (CSF) leaks.

Study Design: Retrospective chart review.

Setting: Private practice.

Patients: Two cohorts of patients with VS underwent translabyrinthine surgery with and without a facial recess approach.

Interventions: Translabyrinthine surgery for tumor resection.

Main Outcome Measures: Postoperative nasopharyngeal CSF leaks were recorded and utilized as the primary outcome measure.

Results: Using an exact matching protocol based on tumor size, 102 patients were included in each group (204 total, 111 female, 93 male). Overall, 9 patients (4.4%) demonstrated a postoperative nasopharyngeal CSF leak. Postoperative CSF rhinorrhea was noted in 3.9% of the group who underwent a facial recess approach for packing of the ET and 4.9% of the group who did not undergo a facial recess approach. This rate was not significantly different between groups ($P=0.99$, Odds ratio: 0.79, 95% CI: 0.15 to 3.8). Secondary variables including age, tumor size, diagnosis of NF2, and packing material used were not significant predictors of nasopharyngeal CSF leaks.

Conclusions: CSF rhinorrhea is infrequent after translabyrinthine surgery. The incidence of this complication is not affected by whether or not a facial recess approach is performed during surgery to pack the ET. Based on these data, use of this technique should be based on surgeon preference.

Define Professional Practice Gap & Educational Need: Practice patterns vary among neurotologists regarding whether a facial recess is performed during translabyrinthine surgery for vestibular schwannoma removal. This study attempts to provide evidence and support regarding whether a facial recess approach changes outcomes.

Learning Objective: To provide the reader with information regarding the effect of a facial recess approach on the development of postoperative nasopharyngeal cerebrospinal fluid (CSF) leaks during translabyrinthine surgery.

Desired Result: To provide surgeons with evidence-based outcomes pertaining to the facial recess approach in translabyrinthine surgery for vestibular schwannoma removal to help in during surgical decision making and prediction of potential postoperative complications.

Level of Evidence - IV

Indicate IRB or IACUC : Exempt

Outcomes of Endolymphatic Sac Surgery for Meniere's Disease with and without Comorbid Migraine

*Norman A. Orabi, MD; Brian M. Kellermeyer, MD; Christopher A. Roberts, MD
Stephen J. Wetmore, MD; Adam M. Cassis, MD*

Objective: To explore outcomes of endolymphatic sac surgery (ESS) for patients with Meniere's disease with and without the co-morbid condition of migraine.

Study Design: A retrospective chart review of adult patients undergoing ESS at a single tertiary care center from 1987 to 2019 was performed.

Setting: Single tertiary care center

Patients: Adult patients who underwent ESS were included. Exclusion criteria were prior ESS, contralateral ESS within 2 years, or lack of a minimum postoperative follow-up time of 6 months.

Interventions: Endolymphatic sac surgery

Main Outcome Measures: Major vertigo episodes, 1995 AAO vertigo class, and functional level scale (FLS) score were compared preoperatively and postoperatively following ESS. Subsequent surgical intervention was tracked as well.

Results: Of 60 patients, 49 patients had good control we defined as 1995 AAO vertigo classes A-B and 11 patients had poor control with classes C-F. Migraine was associated in 18.4% vs 27.3% of the good and poor control groups respectively ($p=0.677$, $N=12$). Good control was associated with higher preoperative vertigo frequency of 19.3 vs 5.9 per month ($p=0.001$). Overall, ESS improved major vertigo frequency and FLS with 16.8 vs 2.8 per month ($p<0.001$) and 4.2 vs 2.7 ($p<0.001$) respectively after intervention. Revision surgery was required in 54.5% vs 24.5% of the poor and good control groups respectively.

Conclusions: ESS is an effective surgical intervention for intractable Meniere's disease. Co-morbid migraine should be routinely assessed.

Define Professional Practice Gap & Educational Need: The comorbid condition of migraine is often overlooked and its effect on ESS outcomes is unknown.

Learning Objective: Demonstrate the importance of assessing for comorbid migraine in patients who may be considered for ESS.

Desired Result: Otolaryngologists should assess comorbid migraine as part of routine preoperative factors when selecting patients for ESS.

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

Indicate IRB or IACUC: IRB 2004966591. West Virginia University

Quantitative Analysis of the Lateral Skull Base in Search for Predictors of Tegmen Demineralization

*Sean P. Holmes, MD; Atefeh Geimadi MD; Ahmed Mamilly, MD; Mickie Hamiter, MD
Hugo Cuellar MD, PhD DABR; Gauri Mankekar, MD, PhD*

Objective: Develop a novel refined measurement algorithm for quantification of bone mineral density (BMD) of the lateral skull base. Compare bone density between obese and non-obese patient groups. Identify predictors of tegmen bone mineral density.

Study design: Blinded retrospective case-control series

Setting: Tertiary referral center

Patients: Patients placed into obese group if BMI>30, sequential matched controls with BMI<30 were selected for the control group.

Intervention(s): CT scans from each patient were analyzed by three blinded reviewers, inter-rater reliability was assessed. Average Tegmen BMDs were compared between obese and non-obese (control) group.

Main outcome measure(s): Differences in tegmen BMD between obese and non-obese patients, relationship between medications for hypertension and tegmen BMD, patient demographics.

Results: 23 patients in obese group, 27 matched controls in non-obese group. Inter-rater reliability was “strong” to “near complete” ($k=0.75-0.86$). No differences in tegmen BMD were found between groups ($P=.64$). Number of active blood pressure medications correlated positively with lateral skull base BMD.

Conclusions: Prior studies have reported lateral skull base thinning in relation to obesity, however the majority of these were qualitative. Here, we have developed and validated a novel refined quantitative measurement algorithm for assessment of lateral skull base BMD. Obesity did not significantly affect tegmen BMD. We propose that other underlying processes affect tegmen demineralization independently of obesity, possibly congenital predispositions which become uncovered by a chronic tegmen insult.

***Define Professional Practice Gap & Educational Need:** We are submitting this manuscript because we would like to contribute to the foundation of quantitative CT-imaging analysis. Our novel measurement algorithm has been employed to analyze Tegmen and lateral skull base bone mineral density in this current study. Certain clinical factors have been reportedly linked to lateral skull base thinning, possibly predisposing to spontaneous CSF leak. Our measurement algorithm analysis hopes to improve the understanding of factors that may contribute to spontaneous CSF leak through lateral skull base demineralization or erosion.

***Learning Objective:** We hope for our readers to learn more about quantitative lateral skull base analysis as it applies to Tegmen thinning in patients who are at risk.

***Desired Result:** That all practitioners will be able to employ our measurement algorithm if they'd like at any time to assess for Tegmen demineralization in patients whom they think may be at risk

Level of Evidence – level IV

IRB: Approved by LSU HSC Shreveport IRB, approval number: STUDY00001399

Prevalence of Macrophages within the Cochlear Vessels following Cochlear Implantation in the Human

Tadao Okayasu, MD, PhD; Jennifer T. O'Malley, BA; Joseph B. Nadol Jr., MD

Objective: To exam the prevalence of monocyte-derived macrophages in the cochlea following cochlear implantation.

Background: Recently, we reported an increase in the number of Iba1-positive macrophages in selected cochlear sites such as the osseous spiral lamina and Rosenthal's canal following cochlear implantation. Since activation of the immune system induces the recruitment of monocyte-derived macrophages, the prevalence of monocyte-derived macrophage in the cochlear vessels may increase following cochlear implantation. However, the delivery system of macrophages to the human cochlea is incompletely understood.

Study Design: Otopathology study.

Setting: Otopathology laboratory.

Methods: The prevalence of monocyte-derived macrophages within cochlear blood vessels in 10 human subjects who had undergone unilateral cochlear implantation was studied by light microscopy using anti-Iba1 immunostaining. The densities of Iba1-positive monocytes within vessels in the sections near the round window in implanted ears were compared with the contralateral unimplanted ears.

Results: The prevalence of Iba1-positive monocytes in vessels near the round window in implanted ear was significantly greater than in the opposite unimplanted ear ($p < 0.01$). The density of Iba1-positive monocytes per area of lumen of cochlear vessels in implanted ears tended to be greater than that in unimplanted ears ($p = 0.06$). The density of Iba1-positive macrophages within the cochlear vessels was significantly correlated with duration but not in the unimplanted ear.

Conclusions: An increase in prevalence of monocyte-derived macrophages in cochlear blood vessels after cochlear implantation was demonstrated. These findings suggest the presence of a delivery system of Iba1-positive macrophages in cochlear vessels in human following cochlear implantation.

***Define Professional Practice Gap & Educational Need:** There is a little evidence on the delivery system of macrophages to the human cochlea following cochlear implantation.

***Learning Objective:**

Learners will be better able to understand immune-system of human cochlea following cochlear implantation.

***Desired Result:**

The prevalence of Iba1-positive monocytes within cochlear vessels is expected to be significantly increase following cochlear implantation.

Level of Evidence - Level V Case series.

Indicate IRB or IACUC : The study was approved by the institutional review board of the Massachusetts Eye and Ear (exemption #4). Principal Investigator: Joseph B. Nadol Jr., MD

Multiple Audiometric Analysis in the Screening of Vestibular Schwannoma

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Heloisa Coutinho-De Toledo, MD, Alfredo Vega-Alarcón, MD, Blanca Nuñez-Millan MD*

Objective: To identify the audiometric pattern that would serve as a predictor of vestibular schwannoma compared to the diagnostic gold standard of gadolinium-enhanced nuclear magnetic resonance imaging (MRI) in patients with asymmetric hearing loss.

Study Design: Cross sectional study.

Setting: secondary and tertiary care center

Patients: patients with asymmetric hearing loss

Interventions: Clinical, audiometric and imaging (MRI with contrast) variables were collected. Asymmetric hearing loss was defined as a difference of 15 dB in one or more frequencies between both ears.

Main Outcome Measures: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of different audiometric patterns were analyzed.

Results: : A total of 107 patients were studied and divided into two groups: group 1 without vestibular schwannoma (n=98); and group 2 with vestibular schwannoma (n=9). The audiometric pattern with the best results was a difference >20 dB in the 4000 Hz frequency, with sensitivity of 77.78%, specificity of 30.61%, PPV of 8.33%, NPV of 93.75% and accuracy of 34.50%.

Conclusions: The audiometric pattern with the best results was a difference >20 dB in the 4000 Hz frequency range; however, patients with asymmetric hearing loss could not be differentiated from patients with retrocochlear lesions based only on audiometry. Asymmetrical hearing loss must be studied with MRI.

***Define Professional Practice Gap & Educational Need:** Asymmetric hearing loss evaluation

***Learning Objective:** Identify multiple audiometric patterns for asymmetric hearing loss, determine their value.

***Desired Result:** Emphasize on the multiple audiometric patterns, review their sensitivity and specificity, understand there is no audiometric pattern that can obviate the use of MRI.

Level of Evidence – Level IV

Indicate IRB or IACUC : Approved by the INNN research committee.

Natural History of Cystic Vestibular Schwannomas

Noor-E-Seher Ali, MD; Zahra N. Sayyid, MD, PhD; Jennifer C. Alyono, MD

Objective: To determine the growth rate of cystic vestibular schwannomas (VS)

Study Design: Retrospective cohort

Setting: Single tertiary academic hospital

Patients: Adults diagnosed with cystic VS who had at least two MRIs performed at least six months apart between 2008 and 2016 with no intervening treatment.

Main Outcome Measures: Volumetric growth rates of both the entire tumor and the cystic components of each tumor were measured. In addition, linear growth rate of the entire tumor was assessed using the largest diameter parallel to the petrous face at the cerebellopontine angle (CPA).

Results: Twenty-four patients met inclusion criteria. The average volumetric growth rate of the tumor was 1.2 ± 1.9 (range: $-1.2 - 7.8$) cm^3/year , while the average growth rate of the cystic component was 0.7 ± 1.5 (range: $-0.5 - 5.25$) cm^3/year . The CPA diameter of the tumor demonstrated an average linear growth rate of 1.3 ± 4.3 (range: $-8 - 13.5$) mm/year . With regards to tumor diameter, 8/24 (33%) remained stable, 4/24 (17%) decreased in size, while 12/24 (50%) increased in size. Linear growth rates amongst growing tumors was 4.1 ± 3.1 ($0.7 - 13.5$) mm/year .

Conclusions: Compared to literature meta-analyses of solid VS, cystic tumors may demonstrate wider variability in growth rate. Larger, multi-center studies will be required to further clarify this relationship.

REQUIRED:

Define Professional Practice Gap & Educational Need: Growth rate of cystic VS has not been studied extensively. Multiple case reports have shown cystic VS to behave differently than solid VS. Hence, there is a need to understand the natural history of cystic VS in a larger study.

Learning Objective: To determine the growth rate of cystic VS

Desired Result: Physicians will be able to counsel cystic VS patients on risk of enlargement and growth rate of their tumor.

Level of Evidence: V

Indicate IRB or IACUC: IRB approved – 40717 (03/08/18)

Evaluation of Contralateral Routing of Signal (CROS) Hearing Aid Use after Translabrynthine Resection of Vestibular Schwannoma

Jacob Kahane, MD; MAJ Isaac D. Erbele, MD; Moisés A. Arriaga, MBA, MD

Objective: Evaluate the differences between those patients using CROS hearing aids and those not using CROS hearing aids after translabyrinthine craniotomy for resection of vestibular schwannoma.

Study design: Cross Sectional Analysis

Setting: Two tertiary care centers between January 2015 to December 2019

Patients: Sporadic vestibular schwannoma patients undergoing translabyrinthine craniotomy, excluding patients without information on hearing rehabilitation methods.

Intervention: The cohort of patients using a CROS hearing aid at any time in the postoperative period was compared to those patients not using CROS aids.

Main Outcome Measures: The use of a CROS hearing aid at any point in the postoperative period within a 5 year follow up after translabyrinthine resection of vestibular schwannoma

Results: A total of 101 translabyrinthine vestibular schwannoma patients had data as to their CROS hearing aid use. A total of 35 patients (35%) used a CROS aid, while 66 patients (65%) did not. The median age in years of CROS users and non-users was 48 and 63 respectively ($p < .001$). The median preoperative speech discrimination in the operated ear for users and non-users was 36% and 4% respectively ($p = .01$). The median postoperative speech recognition thresholds in the non-surgical ear for users and non-users was 30dB and 60dB respectively ($p = .026$). There was no statistically significant difference between postoperative House-Brackmann scores, complications, and postoperative dizziness handicap inventory scores for CROS users and non-users.

Conclusions: Within this sample, users of CROS hearing aids after translabyrinthine surgery were more likely to be younger and have better contralateral hearing and speech discrimination when compared to non-users.

***Professional Practice Gap & Education Need:** Improve postoperative hearing rehabilitation after translabyrinthine vestibular schwannoma surgery.

***Learning Objective:** Identify patients who would likely benefit from CROS hearing aids after translabyrinthine surgery.

***Desired Result:** Improve patient selection for CROS hearing aid use as an auditory rehabilitation method after translabyrinthine craniotomy.

Level of Evidence: IV

IRB: Approved (OLOL-9419)

Analysis of Hearing Preservation in Middle Cranial Fossa Resection of Vestibular Schwannoma

*Olivia A. La Monte, BS; Kareem O. Tawfik, MD
Usman Khan, MD, PhD; Rick Friedman, MD, PhD*

Objective: Describe the effect of preoperative hearing on the likelihood of hearing preservation after middle cranial fossa (MCF) resection of vestibular schwannoma (VS) and the effect of hearing preservation on postoperative quality of life (QOL).

Study Design: Retrospective chart review.

Setting: Academic tertiary care skull base surgery program.

Patients: Adult (18 years or older) patients with preoperative word recognition score (WRS) $\geq 50\%$ who underwent MCF resection of VS between 2017 and 2020.

Interventions: All patients underwent MCF VS resection with attempted hearing preservation.

Main Outcome Measures: Hearing preservation (postoperative WRS $\geq 50\%$).

Results: 63 patients with mean age 47.4(± 9.6) years and tumor size 11.5(± 0.5) millimeters were analyzed. Hearing was preserved (+HP) and lost (-HP) in 37 (58.7%) and 26 (41.3%) patients, respectively. Preoperatively, pure tone average was significantly lower among the +HP group (20.0 dB) vs. -HP (31.0 dB, $p < .003$) and AAO-HNS Class A hearing and WRS higher among +HP vs. -HP (94% vs. 84%, respectively; $p < .002$). Linear regression showed that intra- vs extrameatal tumor status, sudden hearing loss history, fundal fluid cap thickness, and tumor size had no relationship with HP outcomes.

When evaluating postoperative QOL data ($n=37$) hearing-related PANQOL score differed between +HP and -HP ($t_{35}=2.458$, $P=.0191$) groups.

Conclusions: In this cohort of patients undergoing MCF resection of VS, rates of HP were higher for patients with excellent preoperative hearing. Postoperatively, +HP patients reported improved hearing PANQOL scores vs. -HP.

Define Professional Practice Gap & Educational Need: The success of hearing preservation in middle cranial fossa (MCF) approaches for resection of VS is variable across practitioners and institutions. Here we provide a single institution retrospective cohort analysis of hearing preservation using MCF. Hearing preservation was analyzed in a general linear model (GLM) with PANQOL measures, suggesting benefits to several key quality of life measures. These findings favor surgical resection, even in the absence of hearing preservation, to preserve quality of life in patients with VS.

Learning Objective: To learn the utility of the MCF in hearing preservation for VS resection. To identify the benefits that resection, even in the absence of hearing preservation, may have on quality of life in VS patients.

Desired Result: To provide evidence that supports resection as the dominant strategy to treat VS when hearing preservation is desired. To provide evidence that surgical resection provides substantial benefits to quality of life.

Level of Evidence - III

Indicate IRB or IACUC : Exempt

The Parietal Notch (Brammer's Pointer): Accuracy of a Surface Landmark for Temporal Bone Surgery

Michael S. Castle, MD; Orrin B. Myers, PhD; Bradley P. Pickett, MD

Hypothesis: The parietal notch is a reliable surface landmark of the sigmoid sinus at the sinodural angle.

Background: Currently no surface landmark approximates the anterior boarder of the sigmoid sinus. Additionally, the temporal line may not accurately identify the tegmen near the sinodural angle. This study examines the reliability of the parietal notch as a surface landmark of the sigmoid sinus at the sinodural angle.

Methods: Forty-seven cadaveric temporal bones were used to identify the parietal notch by two independent observers. The parietal notch and sinodural angle were labeled with radiopaque markers, mounted on foam, and CT imaged in the axial plane. The horizontal and vertical distances between the labeled landmarks were measured using PACS software.

Results: The parietal notch location was identified in 43/47 (91%) of specimens by both observers. The notch was posterior to the sinodural angle in 90.6% and superior to the sinodural angle in 65% of the specimens. The average horizontal and vertical distance between the two landmarks was 6.1 mm (SD=5.4) and 0.8 mm (SD=8.7) respectively. In 60% of the specimens the parietal notch was within 6 mm of the sinodural angle in the horizontal dimension.

Conclusions: The parietal notch is identified in most temporal bones. It also approximates the anterior boarder of the sigmoid sinus and level of the tegmen due to its proximity to the sinodural angle. Combined with other landmarks, the parietal notch helps to define the posterior and superior margins of a mastoid dissection.

Define Professional Practice Gap & Educational Need: Temporal bone anatomy is complex and the challenge of learning the surgical anatomy is compounded by anatomic variation of important structures. Having reliable anatomic landmarks during temporal bone surgery improves both efficiency and safety. Currently no surface landmark has been used for approximating the anterior boarder of the sigmoid sinus and this study proposes that the use of the parietal notch can help define the location of this vascular structure.

Learning Objective: Otologic surgeons will be able describe the potential benefits of using the parietal notch as an anatomic landmark to define the posterior and superior aspects of a mastoid dissection.

Desired Result: Use of the parietal notch will serve as a reliable surface landmark in temporal bone surgery for experienced and novice surgeons improving surgical efficiency and safety.

Level of Evidence – N/A – basic science study utilizing cadavers to observe anatomic relationships and measurements.

Indicate IRB or IACUC: University of New Mexico (IRB No. 18-377)

Surgical Outcomes after Conservative Resection of Vestibular Schwannoma in the Elderly

*Alexander L. Luryi MD, Seilesh Babu MD, John F. Kveton, MD,
Dennis I. Bojrab MD, Elias M. Michaelides MD, Christopher A. Schutt MD*

Objective: To assess outcomes after surgery for vestibular schwannoma in patients over 70 years of age.

Study Design: Retrospective chart review.

Setting: Two tertiary otology and neurotology centers.

Patients and Interventions: Patients undergoing their first surgery for vestibular schwannoma between 2007 and 2018.

Main Outcome Measures: Post-operative complications and surgical outcomes.

Results: A total of 452 patients met inclusion criteria, 31 of whom (6.9%) were over 70 years of age. Age ranged from 18 to 90 years with a mean of 53 years. Patients over 70 years old were more likely to have pre-existing hypertension (58.1% vs. 34.0%, $p = 0.007$) and diabetes mellitus (19.4% vs. 7.4%, $p = 0.02$). Elderly patients were less likely to achieve a gross total resection of their tumor (35.5% vs. 60.6%, $p = 0.05$) although they were not statistically significantly more likely to undergo a subtotal (<95%) resection (25.8% vs. 14.7%, $p > 0.05$). Patients over 70 years of age were less likely to undergo a second stage procedure (0% vs. 9.5%, $p = 0.05$). There were no significant differences between patients over 70 and under 70 years of age in the rates of any complications, ultimate facial nerve function, or duration of surgery. No patients over 70 years of age expired within 1 year of surgery.

Conclusions: Conservative surgery for vestibular schwannoma in appropriately selected elderly patients is appropriate and safe, given adequate consideration is given to risk-benefit analysis and goals of care.

***Define Professional Practice Gap & Educational Need:** Management of vestibular schwannoma is controversial, particularly in older patients in whom surgery is ostensibly riskier. However, some elderly patients are candidates for surgery due to rapid tumor growth or debilitating vestibular symptoms. More information about surgical outcomes for these patients is needed.

***Learning Objective:** To understand the decisions involved in choosing a treatment modality in elderly patients with vestibular schwannoma, and to understand expected outcomes for surgery.

***Desired Result:** Participants will learn about treatment strategies for vestibular schwannoma in the elderly.

Level of Evidence - IV

Indicate IRB or IACUC : IRB approved; Yale University School of Medicine #2000023466

The “Clinical History” of Neurotology-Otology Fellowship Training in the United States

*Geoffrey C. Casazza, MD; Bradley W. Kesser, MD; Hilary C. McCrary, MD
Clough Shelton, MD; Richard K. Gurgel, MD*

Objective: Determine patterns in neurotology-otology fellowship training in the United States (USA)

Study Design: National database review

Setting: USA

Subjects: Active neurotologic surgeons

Interventions: The American Neurotology Society and ENThealth.org membership databases were used to identify neurotologic surgeons within the USA. Only providers practicing independently as of June 2020 were included. Fellowship-training institution and practice affiliation (academic vs. non-academic) were identified. The practitioner’s H-index was collected from Scopus.com as a proxy-measurement of academic productivity.

Main Outcome Measures: Providers were compared based on fellowship location and practice affiliation.

Results: 482 neurotologic surgeons were identified with 408 training at one of the 23 accredited fellowship programs or former academic-affiliated fellowships (academic-affiliated), 10 at international fellowships, 57 at non-accredited, non-academic-affiliated fellowships, and 7 with no formal fellowship training. Of those training at an academic-affiliated fellowship, the mean generational-gap to the House Ear Clinic is 1.3 ± 0.8 (range 0-3) generations. Those training in academic-affiliated fellowships are more likely to be currently employed at an academic institution (63% vs. 36.5%; $p < 0.0001$; OR 2.9, 1.74-4.85) and have a higher H-index (12.9 ± 10.5 vs. 8.9 ± 9.8 ; $p = 0.0003$). For those training at an academic-affiliated fellowship, H-index was associated with fellowship training location ($F = 3.88$; $p < 0.0001$).

Conclusions: Fellowship training in neurotology-otology is associated with future clinical practice patterns and academic productivity. As neurotology-otology fellowship training continues to grow, these factors may be an important consideration for future applicants to the specialty.

***Define Professional Practice Gap & Educational Need:** Fellowship training and clinical practice in neurotology-otology

***Learning Objective:** To better understand patterns in neurotologic fellowship training and its potential effect on clinical practice in the United States

***Desired Result:** Improved understanding of patterns in neurotology-otology fellowship training practice patterns

Level of Evidence – Level IV

Indicate IRB or IACUC : Exempt

Comparing Outcomes and Operating Room Costs of Middle Cranial Fossa and Transmastoid Approaches for Otogenic Encephalocele and Cerebrospinal Fluid Leak Repair

*Tirth R. Patel, MD; Ali Z. Piracha, BS; Alexa S. Roy, BS; Richard Byrne, MD
Miral Jhaveri, MD, MBA; Elias Michaelides, MD; R. Mark Wiet, MD*

Objective: Comparison of outcomes and operating room materials costs of patients treated at our institution using transmastoid (TM), middle cranial fossa (MCF), and combined approaches for repair of otogenic cerebrospinal fluid (CSF) leaks and encephaloceles.

Study Design: Retrospective cohort review

Setting: Tertiary-care hospital

Patients: Seventy-three patients with 79 ears who underwent repair of an otogenic encephalocele or CSF leak between January 2010 and March 2020.

Interventions: Surgical repair of an otogenic encephalocele or CSF leak using either a TM, MCF, or combined approach.

Main Outcome Measures: Failure of repair, length of operation, cost of operating room materials, post-operative need for intensive care, post-operative length of stay

Results: Forty-two repairs (53%) were performed by TM approach, 27 (34%) by MCF, and 10 (13%) by combined TM/MCF approach. Mean procedure length was longer for TM (170 minutes) compared to MCF (142 minutes; $p=0.006$). However, the TM group included 24 patients who had cholesteatoma that was simultaneously addressed with mastoidectomy. The mean cost of operating room materials charged to the patient was significantly greater in the MCF group (\$10,988) than the TM group (\$6191; $p=0.002$). All MCF patients were admitted to intensive care compared to 3/42 (7%) TM patients. Mean length of stay was significantly shorter in TM patients (2.0 days) than MCF (3.3 days; $p<0.001$). On follow-up, CSF leak recurred in 4/79 (5%) cases: 3/27 (11%) MCF, 1/42 (2%) TM, and 0/10 combined TM/MCF patients.

Conclusions: In carefully selected patients, the TM approach is an effective and less costly alternative to MCF approaches for repair of otogenic cerebrospinal fluid (CSF) leaks and encephaloceles.

***Define Professional Practice Gap & Educational Need:** The TM and MCF approaches are both commonly used for repair of otogenic CSF leaks and encephaloceles. The success rate of the repair must be weighed against the financial costs of either approach to deliver the most efficient care.

***Learning Objective:** TM approaches for CSF leak or encephalocele repair are highly effective. The TM approach offers a shorter length of stay, and quicker return to work after surgery. When utilizing the TM approach, patients should be counseled that the MCF approach may be necessary should the TM approach fail. In our experience, the majority of otogenic CSF leaks can be repaired with the TM approach.

***Desired Result:** For surgeons to consider the greater costs associated with the MCF approach compared to the TM approach for CSF leak and encephalocele repair.

Level of Evidence – Level IV

Indicate IRB or IACUC : Rush University; ORA #: 20031701-IRB01

Initial Observation versus Upfront Microsurgical Resection Yields Comparable Outcomes for Small to Medium-sized Vestibular Schwannoma

*Ankita Patro, MD MS; Elizabeth Perkins, MD; Douglas Totten, BA; Alexander Sherry, MD;
Marc L. Bennett, MD; Matthew R. O'Malley, MD; David S. Haynes, MD*

Objective: To assess postoperative outcomes and predictive factors of patients observed prior to surgery and those undergoing upfront resection for small and medium-sized vestibular schwannoma (VS).

Study Design: Retrospective cohort.

Setting: Tertiary referral center.

Patients: VS patients who had surgery from 2003 to 2018 for tumors up to 2.5 cm.

Main Outcome Measures: Postoperative facial nerve function and interventions, complications, extent of resection, and salvage therapy.

Results: Of 220 patients, 118 were initially observed, and 102 pursued upfront surgery. There was no significant association between initial observation and upfront surgery for postoperative facial nerve function at 2-3 weeks ($p=0.14$) or 12 months ($p=0.5$), facial nerve intervention ($p=0.4$), major/minor complications ($p=0.4/0.7$), recurrence ($p=0.8$), subtotal resection ($p=0.6$), or salvage therapy ($p=0.9$). Time from initial consultation to surgery did not significantly impact outcomes. Intrameatal tumors were more likely to be observed (OR 3.08; 95% CI 1.61-5.92; $p<0.001$). Patients with larger tumor volume (OR 0.50; 95% CI 0.36-0.70; $p<0.0001$), brainstem compression (OR 0.29; 95% CI 0.09-0.94; $p=0.04$), or higher pure tone averages (PTA) were less likely to undergo observation (OR 0.99; 95% CI 0.97-0.998; $p=0.02$). On multivariable analysis, predictive factors for observation were smaller tumor volume (OR 0.52; 95% CI 0.37-0.73; $p<0.001$), lower PTA (OR 0.99; 95% CI 0.98-1.00; $p=0.04$), and diabetes (OR 2.69, 95% CI 0.996-7.27, $p=0.051$).

Conclusions: Patients with worse hearing, larger tumor volume, and brainstem compression were more likely to pursue upfront surgery. A watchful waiting period does not appear to worsen outcomes and can be considered for patients with better hearing and smaller tumors without brainstem compression.

Define Professional Practice Gap & Educational Need: Lack of awareness regarding the outcomes of observing prior to surgery for small and medium-sized vestibular schwannoma.

Learning Objective: Evaluate the postoperative outcomes and predictive factors for observation prior to resection versus immediate surgery for vestibular schwannomas up to 2.5 cm.

Desired Result: This information can guide clinicians in management of small and medium-sized tumors and improve patient counseling with regards to treatment selection.

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

Indicate IRB or IACUC: IRB Approved (151481, Vanderbilt University).

Image Analysis of Epithelial Migration of the Tympanic Membrane and Ear Canal

*Hany M. El-Adle BA, Sudeepti Vedula BS (presenter), Lena A. Kheir BA, Shree Nadkarni BS
Sejal K. Shah BA, Ron Despain BS, Robert Jyung MD*

Objective: Epithelial migration (EM) is an established mechanism of epithelial outflow from the tympanic membrane to the external auditory meatus. Impairment of outflow results in buckling of the cornified epithelial surface into corrugations known as epithelial ridges (ER), which are readily visible in endoscopic photographs. We had previously observed ER formation distal to retraction pockets (RP) of the tympanic membrane (TM), suggesting direct influence of RP on EM. We assessed whether image analysis using artificial intelligence (AI) could objectively quantify ER in photographs of TMs with RPs versus normal TMs, using ER as a proxy for impaired EM.

Study Design: Case-Control study. FIJI Weka segmentation software was used to build a model which specifically detected epithelial ridges to analyze endoscopic images, using the area (pixels²) of epithelial ridges as a proxy for epithelial migration in control vs. RP images.

Setting: Tertiary-care Neurotology practice at an academic medical center.

Patients: Patients drawn from above practice, with normal TMs versus RPs.

Interventions: Endoscopic photography and subsequent image analysis.

Main Outcome Measures: Average Number of Ridges, Average Total Ridge Area (pixels²), Average Size of Ridge (pixels²), Average Percent Area of Image Occupied by Ridges, compared using a two-tailed T-Test.

Results:

Image Type (Number of Images)	Average Number of Ridges	Average Total Ridge Area (pixels ²)	Average Size of Ridge (pixels ²)	Average Percent Area of Image Occupied by Ridges
Control (N=25)	121.76	704.64	5.80	11.60
RP (N=25)	206.00	1166.52	5.65	19.21
p-value	0.001858	0.007049	0.652921	0.006162

Conclusions:

The AI Weka Segmentation model used in this study reliably identified epithelial ridges in endoscopic images. Images with retraction pockets featured more ridges on average, larger average ridge areas, and a higher share of each image's area being occupied by ridges. The average size of a ridge, however, was similar in control TMs and RPs.

Define Professional Practice Gap & Educational Need: 1) To determine if an AI WEKA segmentation model can reliably identify epithelial ridges in endoscopic images. 2) To determine if the quantity of ER differs in images with RPs vs. normal TMs.

Learning Objective: To understand if RPs alter epithelial migration.

Desired Result: To help physicians better understand the utility of AI-based image analysis for interpreting endoscopic imaging.

Level of Evidence: Level III, Case-Control Study

Indicate IRB or IACUC: Pro20170000936 Date of Approval: 9/11/2017

Favorable Cochlear Implant Performance in an Adult Patient with Prior Neonatal Hyperbilirubinemia

Jeffrey P. Aldinger, MD; Peter G. Volsky, MD

Objective: To describe initial observations following cochlear implantation with hearing preservation in a young adult with hearing loss attributed to neonatal hyperbilirubinemia.

Study Design: Case report

Setting: Tertiary care

Patients: Single female patient, with speech and movement disorder, normal Mini-Mental Status Exam score, and bilateral moderate to severe sensorineural hearing loss satisfying cochlear implant criteria. She had absent distortion-product otoacoustic emissions and absent brainstem auditory evoked potentials.

Interventions: Bilateral, sequential cochlear implantation (CI 522, Cochlear Ltd.) by the senior author

Main Outcome Measures: AzBio scores and pure-tone thresholds

Results: Four months after implantation of the right ear, she preferred the CI to her left hearing aid, and scored 25% (AzBio) and 30% (CNC words), improved from 12% and 20%, respectively, before surgery. The left ear was implanted 6 months after the right. Two months later, using left CI alone, she scored 51% (AzBio), improved from 26% before surgery. Interestingly, neural response telemetry (NRT) post-implantation was detectable. Low-tone (125, 250, and 500 Hz) pure tone averages (PTA) bilaterally were 48 dB before implantation and 52-55 dB postoperatively. Late-term follow-up to be reported as it becomes available.

Conclusions: In young adults with hearing loss from neonatal hyperbilirubinemia, cochlear implantation can be achieved with hearing preservation and provides benefit to the patient.

***Define Professional Practice Gap & Educational Need:** Because this pathology is also associated with auditory neuropathy/dys-synchrony, and outcomes data is scant for this population of youth and adults, these observations valuable to audiologists and surgeons, who may remain guarded when counseling patients. Good results are achievable in spite of preoperative evidence of central auditory dysfunction.

***Learning Objective:** Hearing loss in the setting of chronic bilirubin encephalopathy is caused by pathology of the cochlea, brainstem nuclei, and central nervous system. We report the case of a patient with bilateral moderate to severe sensorineural hearing loss, absent otoacoustic emissions, absent brainstem auditory evoked responses, who experienced benefit from cochlear implantation with hearing preservation.

***Desired Result:** Inform surgeons and audiologists in their counseling of patients with moderate to severe hearing loss attributed to chronic bilirubin encephalopathy.

Level of Evidence - Level V

Indicate IRB or IACUC : Exempt

Migraine Features in Patients with Migraine-Related Aural Fullness

*Adwight Risbud, BS; Mehdi Abouzari, MD, PhD; Ariel Lee, BS
Sina Soltanzadeh-Zarandi, BS; Ethan Muhonen, MD; Elaine Martin, MD; Hamid R. Djalilian, MD*

Objective: To evaluate the presence of migraine features between patients with migraine-related aural fullness (AF) who meet the International Classification of Headache Disorders (ICHD) 3rd edition criteria for migraine headache and those who do not.

Study Design: Retrospective cohort.

Setting: Tertiary-care neurotology clinic.

Patients: Seventy-seven patients diagnosed with migraine-related AF (defined as prolonged aural fullness concurrent with migraine features and other etiologies ruled out with exam, audiometry, CT, and MRI) between 2014-2020, with a mean age of 56 ± 15 years.

Interventions: Patients were evaluated for meeting the ICHD 3rd edition criteria for migraine headache.

Main Outcome Measures: We compared the prevalence of migraine features in patients who met the full ICHD 3rd edition criteria for migraine headache to those who did not.

Results: There were 55 females (71%) and 22 male patients (29%). Eleven patients (14%) fulfilled the full ICHD criteria for migraine headache (migraine group). Of the patients who did not meet the full criteria (non-migraine), 17 (22%) met 4/5 criteria, and 32 (42%) met 3/5 criteria, for a total of 49 (64%) patients. The migraine and non-migraine groups were only different in 5 of 20 migraine features, including family history of migraine ($p=0.007$), sound sensitivity ($p<0.001$), mental foggiess ($p=0.008$), visual motion sensitivity ($p=0.008$), and light sensitivity ($p<0.001$).

Conclusions: The lack of meaningful differences in migraine features between patients in our cohort with migraine-related AF who fulfilled the ICHD migraine criteria and those who do not suggests that the diagnostic criteria for migraine may be too strict and unnecessarily exclude many patients from receiving migraine treatment.

Define Professional Practice Gap & Educational Need: Recent literature described the clinical entity of isolated, prolonged aural fullness as a potential symptom of otologic migraine, with many patients experiencing symptomatic and quality of life improvement following treatment with migraine prophylaxis and lifestyle modification. However, many patients with migraine-related AF 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 isolated aural fullness for possible migraine disorder when other causes have been ruled out.

Learning Objective: To educate ANS members on a series of patients with aural fullness and further characterize migraine-related AF 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 AF 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.

Distribution of Neurotology-Otology Practitioners Across the United States

*Geoffrey C. Casazza, MD; Bradley W. Kesser, MD; Clough Shelton, MD
Richard K. Gurgel, MD; George T. Hashisaki, MD*

Objective: Determine the geographic and per capita distribution of neurotologic surgeons within the United States (USA).

Study Design: National database review

Setting: USA

Subjects: Active neurotologic surgeons

Interventions: The American Neurotology Society and ENThealth.org membership databases were used to identify neurotology-otology practitioners within the USA. Only providers practicing independently as of June 2020 were included. Providers were divided by regional national census areas, state, and by largest population statistical area based on 2019 USA Census population estimates.

Main Outcome Measures: Number of neurotology-otology practitioners per one million populations determined. Correlation between number of practitioners and population size calculated.

Results: 482 practitioners were identified, representing 49 states. The East-North-Central (Wisconsin, Michigan, Illinois, Indiana, Ohio) was the most concentrated region (1.89 per million) whereas the West-South-Central (Texas, Oklahoma, Arkansas, Louisiana) was the least concentrated region (0.9 per million). The highest concentration of practitioners by state are within the District of Columbia (4.25), Vermont (3.21), North Dakota (2.62), Massachusetts (2.61), and New York (2.21) (per million), whereas Mississippi (0.67), Georgia (0.66), New Mexico (0.48), Nevada (0.15), and Wyoming (0.0) (per million) were the least concentrated. Increasing number of practitioners was significantly correlated to largest census designation ($r=0.94$; $p<0.0001$), state ($r=0.9$; $p<0.0001$), and regional national census area ($r=0.92$; $p=0.0005$).

Conclusions: Neurotology-otology practitioners are distributed disproportionately across the USA, where higher population areas show higher numbers per capita of practitioners. Some regions are significantly under-represented. Variability in clinical practice may account for increasing under-representation not captured in this analysis.

***Define Professional Practice Gap & Educational Need:** distribution of neurotologic practitioners across the United States

***Learning Objective:** to better understand the national distribution of neurotologic practitioners with identification of under- and over-served regions, and the effect of various regional population size on number of providers

***Desired Result:** improved understanding of the national distribution of neurotologic surgeons and identification of under-served regions

Level of Evidence – Level IV

Indicate IRB or IACUC: Exempt

Post-Traumatic Superior Semicircular Canal Dehiscence: A Newly Described Phenomenon

*Hilary McCrary MD, MPH; Eric Babajianian MD; Neil Patel MD
Matthew L. Carlson MD; Richard K. Gurgel MD, MSCI*

Objective: To evaluate patients who become symptomatic for superior semicircular canal dehiscence (SSCD) immediately following trauma.

Study Design: Retrospective case series.

Setting: Two academic medical centers.

Patients: 11 patients diagnosed with SSCD following trauma.

Interventions: Imaging, VNG/VEMP testing, audiometric assessment, and surgical repair.

Main Outcome Measures: 1) Description of audio-vestibular symptoms, 2) Mean pre- and post-operative pure tone average (PTA), word recognition score (WRS), and air bone gap (ABG)

Results: Among patients included in the study, 82% were male. A majority of patients suffered a fall (68%) as the mechanism of trauma. Approximately 36% were found to have bilateral SSCD on imaging, with 65% of patients pursuing surgical management of their SSCD. The most common presenting symptoms were: pulsatile tinnitus (91%), hearing loss (64%), vertigo (55%), autophony (46%), and somatosounds (27%). 54% of patients underwent VNG/VEMP testing, with 83.3% of those demonstrating abnormal results. The mean audiometric findings on the symptomatic side were the following: PTA=36.6 dB, WRS=79%, and ABG=17.4 dB. Among patients that underwent surgery, there was no statistically significant change in the PTA (preoperative=45.2 dB versus postoperative=45.6 dB; $p=0.89$) or WRS (preoperative=73% versus postoperative=60%; $p=0.53$). However, there was a reduction in the ABG (preoperative=25 dB versus postoperative=15 dB; $p=0.04$).

Conclusions: A subset of SSCD patients become symptomatic following trauma, most commonly presenting with pulsatile tinnitus and hearing loss. A proposed mechanism is an abrupt elevation in labyrinthine or intracranial pressure that results in a critical "break" of an already thin or minimally dehiscient superior semicircular canal.

Define Professional Practice Gap & Educational Need: Currently, there are only sparse case reports describing the potential effects of trauma on patients with SSCD. Given concern for the potential effects of trauma on this subset of patients, a case series is presented to further describe this unique patient population.

Learning Objective: To understand the presenting symptoms and objective assessments of patients presenting with SSCD after a trauma.

Desired Result: Increased awareness of a unique subset of patients presenting with SSCD after trauma.

Level of Evidence – Level V: Case series, studies with no controls

Indicate IRB or IACUC: Approved: University of Utah IRB #00045048

Endolymphatic Sac Surgery in Intractable Meniere's Disease: A Single-Center Retrospective Cohort Study

Oliver Y. Chin, MD; Doron Sagiv, MD; Hilary A. Brodie, MD, PhD; Rodney C. Diaz, MD

Objective: To demonstrate the impact that endolymphatic sac surgery (ELS) has in patients with Ménière's disease as measured by vertigo control and hearing results.

Study Design: Retrospective cohort review.

Setting: Tertiary care referral center.

Patients: 26 adult patients who underwent ELS for Ménière's disease were included. All patients suffered from debilitating episodic vertigo despite maximal medical therapy.

Interventions: Endolymphatic sac surgery was performed with either decompression alone or shunting. Techniques differed between 2 surgeons.

Main Outcome Measures: Vertigo symptom control and hearing outcomes

Results: Improvement in vertigo symptom control was reported in 15 patients (57.7%), while hearing was improved or stable in 25 patients (96.1%). Only one patient endorsed hearing loss thought to be unrelated to surgical trauma. Drop attacks were reported in 2 patients and complete control was achieved in both. Four patients were able to return to work or play. Only 1 patient required labyrinthectomy for continued debilitating vertigo. There was a median change in 4-tone average of -0.5 dB (95% CI -6.5 to 10.8) and a median change in word-recognition score average of 0% (95% CI -20.9 to 6.9).

Conclusions: Endolymphatic sac surgery remains a highly effective surgical option for Ménière's disease in patients with incapacitating vertigo while preserving hearing.

***Define Professional Practice Gap & Educational Need:** Provide further evidence that endolymphatic sac surgery is safe and efficacious in the algorithm for treatment of debilitating episodic vertigo of Ménière's disease for patients who fail maximal medical therapy

***Learning Objective:** Review endolymphatic sac surgery as a safe and efficacious treatment option for Ménière's disease to address debilitating vertigo low hearing morbidity and potential subjective and audiometric improvement of sac surgery.

***Desired Result:** To convince the audience to alter their practice and incorporate endolymphatic sac surgery in escalation therapy.

Level of Evidence - Level IV

Indicate IRB or IACUC: Approved, #1610645-1 UC Davis IRB Administration

The Laterality of Age-Related Hearing Loss and Depression

Alexander Chern, MD; Alexandria L. Irace, BA; Justin S. Golub MD, MS

Objective: There is a known association between hearing loss (HL) and depressive symptoms. The objective was to establish if there is a stronger association with the left or right ear.

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

Setting: Hispanic Community Health Study (US, multicentered)

Patients: 5,499 adults ≥ 50 years old

Interventions: none

Main Outcome Measures: The main outcome was depressive symptoms, measured by the 10-Item Center for Epidemiologic Studies Depression Scale-10 (CESD-10) and defined continuously and binarily. Subjects with CESD-10 ≥ 10 were categorized as having clinically significant depressive symptoms (CSDS). Linear and logistic regressions were performed to assess the association between depressive symptoms and hearing in each ear, adjusting for age, sex, education, cardiovascular disease, and hearing aid use.

Results: Mean age was 58.5 ± 6.3 years. Mean pure-tone average (PTA) was 20.3 ± 11.7 dB (range=0-125) in the right ear and 20.3 ± 12.4 dB (range=-2.5-120) in the left. Multivariable regression adjusting for covariates demonstrated significant associations between depressive symptoms and HL in both the left and right ear. For every 10-dB worsening in right ear PTA, there was 0.89-point increase in CESD-10 (95% confidence interval=0.59-1.2), and odds of CSDS increased 1.31 times (1.17-1.46). For every 10-dB worsening in left ear PTA, there was a 0.85-point increase in CESD-10 (0.55-1.14), and odds of CSDS increased 1.34 times (1.2-1.49).

Conclusions: Worsening hearing in both right and left ears was associated with increased depressive symptoms and odds of CSDS. No ear laterality was demonstrated. This will help inform understanding of the laterality of central auditory connections.

REQUIRED:

Define Professional Practice Gap & Educational Need: Age-related hearing loss is a highly prevalent and severely undertreated disease. Studies have established an independent association between hearing loss and neuropsychiatric disorders of the elderly (e.g., depression). However, there is minimal literature examining the laterality of this association (i.e., if hearing loss of one side contributes to this association more than the other side) and existing studies demonstrate conflicting results. Understanding laterality differences in central auditory pathways may help elucidate mechanisms explaining the relationship between age-related hearing loss and depression. This will help inform healthcare personnel of hearing loss as a targetable modifiable risk factor (i.e., with hearing aids) for prevention of neuropsychiatric disorders of the elderly.

Learning Objective: After this presentation, the learner will be able to describe the relationship between age-related hearing loss and depressive symptoms and posit why hearing loss has been identified as a modifiable risk factor for prevention of neuropsychiatric disorders of the elderly.

Desired Result: Otolaryngologists will better understand the complex relationship between age-related hearing loss and neuropsychiatric diseases of the elderly, such as depression.

Level of Evidence – Level III

Indicate IRB or IACUC: AAAQ9546(M00Y01): Designated Not Human Subjects Research Under 45 CFR 46

Traumatic Perilymphatic Fistula: A Systematic review

Rebecca A. Compton, MD; Julian F. Oviedo, BA; Jonathon S. Sillman, MD

Objective: To identify cases of traumatic perilymphatic fistula reported in the literature in order to review the optimal management of this condition.

Study Design: Systematic review

Setting: Case reports of traumatic perilymphatic fistula identified between 1968 to present

Patients: 60 patients who presented with cochleovestibular symptoms following blunt or penetrating trauma, with evidence of perilymphatic fistula on examination, audiogram, or imaging

Interventions: None

Main Outcome Measures: Resolution of vertigo and improvement in hearing loss on audiogram after either conservative or surgical therapy

Results:

A total of 60 cases were identified during the study time frame, including 38 cases of blunt trauma and 22 cases of penetrating trauma. Perilymphatic fistula was suspected based upon a positive fistula test, abnormal audiovestibular testing, and/or pneumolabyrinth on computed tomography. Treatment information was available in 55 cases; 7 patients were managed conservatively, with improvement in vertigo in all cases and improved hearing in 4 cases. For the remaining 48 cases, middle ear exploration was performed and this was typically in delayed fashion when such information was reported (average 3 months after injury). There was improvement in vertigo symptoms in 92% (44/48) and in hearing loss in 63% (30/48).

Conclusions: Vertigo and hearing loss after traumatic perilymphatic fistula may resolve with conservative measures. Middle ear exploration can be offered in delayed fashion for those cases that do not.

***Define Professional Practice Gap & Educational Need:** The optimal management of traumatic perilymphatic fistula remains unclear, and there is a need for consensus statements on this condition.

***Learning Objective:** To identify cases of traumatic perilymphatic fistula reported in the literature in order to review the optimal management of this condition.

***Desired Result:** To find and collate greater than 50 cases of traumatic perilymphatic fistula in order to investigate the management of this condition.

Level of Evidence: Level V

Indicate IRB or IACUC: Exempt

Intravenous Sodium Fluorescein and Vestibular Schwannoma Surgery

C. Scott Brown, MD; Ashish H. Shah, MD; Michael Ivan, MD; Christine Dinh, MD

Objective: Describe the operative experience using intravenous (IV) sodium fluorescein (SF) during vestibular schwannoma (VS) surgery

Study Design: Case report

Setting: Tertiary Care Hospital

Patients: A 39-year-old male with right-sided hearing loss was diagnosed with a large tumor involving the right internal auditory canal (IAC) and cerebellopontine angle (CPA) with brainstem compression. The IAC was severely dilated and without a fundal fluid cap.

Interventions: Informed consent was obtained and IV SF (2 mg/kg) was administered shortly after anesthesia induction. A retrosigmoid craniotomy with IAC drilling was performed. Once the CPA was exposed, the FL560 fluorescence module was applied to the operative microscope (~160 minutes after SF administration). Intraoperative video and photography were performed.

Main Outcome Measures: Ability of surgeons to visualize tumor and distinguish from adjacent cranial nerves

Results: When the FL560 module was applied, surgeons were able to distinguish tumor from adjacent vessels and cranial nerves, by observing the tumor's green fluorescence. As time progressed, the tumor's green fluorescence diminished and the tumor-tissue interfaces were difficult to distinguish. A sliver of tumor was left in the IAC, where it was encasing the blood supply to the facial nerve. The facial and cochlear nerves were grossly preserved and the facial nerve stimulated at 0.05 mA. Pathology confirmed a diagnosis of VS.

Conclusions: In this patient, the VS demonstrated preferential uptake of IV SF, which helped surgeons distinguish tumor from normal intracranial structures under fluorescent conditions. Future studies are needed to determine optimal dosing strategies and the utility of fluorescein guidance in challenging VS surgeries.

***Define Professional Practice Gap & Educational Need:**

Although preferential sodium fluorescein uptake by vestibular schwannoma has been shown in vitro, in vivo, and in isolated case reports, no specific protocols or guidelines exist for fluorescein-guided vestibular schwannoma surgery.

***Learning Objective:**

Recognize the potential of sodium fluorescein for delineating tumor from adjacent vessels and cranial nerves during challenging vestibular schwannoma surgery.

***Desired Result:**

Understanding that fluorescein guidance may potentially improve tumor visualization during vestibular schwannoma surgery and clinical trials to determine optimal dosing strategies are warranted.

Level of Evidence - V

Indicate IRB or IACUC: Exempt

Primary Vestibular Schwannoma Cells Activate RAD51-Associated DNA Repair Following Radiation-Induced DNA Damage

*Torin P. Thielhelm, BS; Stefania Goncalves, MD; Scott Welford, PhD
Eric Mellon, MD, PhD; Michael E. Ivan, MD; Fred Telischi, MD; Christine T. Dinh, MD*

Hypothesis: Vestibular Schwannoma (VS) can avoid cell death following radiation injury by entering cell cycle arrest and activating RAD51-related DNA repair.

Background: Although the radiobiology of various cancers is well-studied, the biological effects of radiation on VS are poorly understood. In this study, we describe how VS cells enter cell cycle arrest (through p21 and phospho-Rb expression), activate DNA repair mechanisms (through RAD51 upregulation), and avoid cell death, in response to radiation-induced double-strand breaks (DSB) in DNA (as measured by gamma-H2AX).

Methods: Primary human VS cells were cultured on 96-well plates and 16-well culture slides at 10,000 cells/well and exposed to either 0 or 18 Gray of radiation. Viability assays were performed at 96 hours in vitro and compared between cell lines. Immunofluorescence for gamma-H2AX, RAD51, p21, and phospho-Rb were performed at 6 hours.

Results: Radiation (18 Gray) induced the expression of gamma-H2AX in cultured VS, suggesting that radiation initiated DSBs in DNA. Cell cycle proteins, p21 and phospho-Rb, were also upregulated in irradiated cells, indicating that VS cells enter into cell cycle arrest following radiation injury. While in cell cycle arrest, VS initiated RAD51 expression in an effort to repair radiation-induced DNA damage to evade cell death, as demonstrated by viability assays.

Conclusions: In response to radiation-induced DNA damage, primary VS cells can enter cell cycle arrest and express RAD51 DNA repair mechanisms to avoid cell death. Further investigation into the expression of DNA repair proteins and cell cycle checkpoints in VS may provide important insight on radiation resistance.

Define Professional Practice Gap & Educational Need:

The biological mechanisms responsible for radiation resistance in vestibular schwannoma are unknown. Understanding the mechanisms behind radiation-induced DNA damage and the activation of DNA repair pathways in vestibular schwannoma will provide important insight into ways of overcoming radiation resistance in the future.

Learning Objective:

Recognize that ionizing radiation can cause DNA damage in vestibular schwannoma and that tumors can activate mechanisms to evade radiation-induced cell death.

Desired Result:

Understand that radiation resistance in vestibular schwannoma may be related to the ability of tumor cells to enter into cell cycle arrest to repair DNA damage.

Level of Evidence: N/A

Indicate IRB or IACUC: Approved 9/26/2017. University of Miami, IRB #20150637

Middle Ear Exploration and Application of Steroid Soaked Gelfoam in Treatment of Meniere's Disease

*Luis P. Roldan, MD, Meghana Kalaver, MS (presenter), Lilliana Ein MD
Caralin Schneider MS, Michael Hoffer MD*

Objective: To evaluate vertigo control with application of steroid-soaked gelfoam to the middle ear in patients with Meniere's Disease (MD)

Study Design: Retrospective review

Setting: Single institution review at University of Miami Hospital

Patients: Adult patients with MD undergoing labyrinthotomy with steroid application to the middle ear between 1/12/2014 - 7/1/2019

Interventions: Middle ear exploration (MEE) with direct placement of dexamethasone soaked gelfoam to the round and oval window

Main Outcome Measures: Primary outcome measures included patient reported frequency of vertigo attacks and subjective vertigo response post intervention. Secondary outcome measures included subjective responses to hearing, tinnitus, and aural fullness.

Results: 30 adult patients were included in final analysis. Frequency of pretreatment vertigo occurred at an average of 8.84 vertigo attacks per month. Post treatment vertigo at one month follow up occurred at average of 1.76 attacks per month with similar findings observed at 1-3 months (average 0.067 vertigo attacks/month) and 3-6 months (1.667 attacks/month). 23/30 (76%) reported subjective improvement in vertigo symptoms following intervention.

Conclusions: Operative placement of steroid soaked gelfoam to the oval and round window yields favorable results in patient with MD with respect to vertigo control

Define Professional Practice Gap & Educational Need: Transtympanic steroid therapy is an alternative method for treatment of MD associated vertigo. The ideal way to deliver steroids to the inner ear has not yet been proven.

Learning Objective: Our study describes an alternative method for delivering steroid therapy to the inner ear that involves middle ear exploration and placement of steroid soaked gelfoam to the oval and round windows. This allows for sustained steroid delivery to the inner ear which may improve vertigo symptoms in patients with MD.

Desired Result: This review yielded favorable preliminary data in highlighting the proposed intervention as an effective means of vertigo control in MD

Level of Evidence Level V

Indicate IRB or IACUC : IRB 20180646 at University of Miami

Remote Intraoperative Neural Response Telemetry: Technique and Results in Cochlear Implant Surgery

Ali Kouhi, MD; Austin Swanson, PhD; Matthew Fitzgerald, PhD; Nikolas Blevins, MD

Objective: Present results with remote intraoperative neural response telemetry (NRT) during cochlear implantation (CI) and its utility in overcoming the inefficiency of in-person NRT.

Study Design: Case series

Setting: Tertiary academic otology practice

Patients: All patients undergoing primary or revision CI, both adult and pediatric, were enrolled.

Interventions: Remote intraoperative NRT performed by audiologists using a desktop computer to control a laptop in the operating room. Testing was performed over the hospital network using commercially available software. A single system was used to test all 3 FDA-approved manufacturers' devices.

Main Outcome Measures: Success rate and time savings of remote NRT.

Results: Out of 254 procedures, 252 (99.2%) underwent successful remote NRT. In 2 procedures (0.7%), remote testing was unsuccessful, and required in-person testing to address technical issues.

Both failed attempts were due to hardware failure (OR laptop or headpiece problems). There was no relation between success of the procedure and patient/surgical factors such as difficult anatomy, or the approach used for inner ear access. The audiologist time saved using this approach was considerable when compared with in-person testing.

Conclusions: Remote intraoperative NRT testing during cochlear implantation can be performed effectively using standard hardware and remote-control software. Especially important during the Covid-19 pandemic, such a procedure can reduce in-person contacts, and limit the number of individuals in the operating room. Remote testing can provide additional flexibility and efficiency in audiologist schedules.

***Define Professional Practice Gap & Educational Need:** In-person NRT can be time consuming and requires considerable resources, especially in centers with high physical distance between the OR and the audiology department. Remote testing can be easily and effectively implemented to address these concerns.

***Learning Objective:** benefits and feasibility of remote NRT in CI surgery

***Desired Result:** Remote NRT can be reliably and successfully performed

Level of Evidence - IV

Indicate IRB or IACUC : Stanford University IRB (Protocol number: 48035)

**Primary Melanoma of the Middle Ear and Petrous Temporal Bone Treated
with Radiation Therapy and Single-Agent Nivolumab**

Kevin J. Carlson, MD; Peter G. Volsky, MD

Objective: We present a case of primary melanoma of the middle ear and petrous temporal bone with remission achieved following radiation and single-agent nivolumab.

Study Design: Single Case Report

Setting: Tertiary Care

Description of Case: A 74-year-old male developed sudden right sided unilateral deafness, disequilibrium, and otalgia with CN V and VII weakness. Imaging demonstrated an osteolytic lesion involving the right middle ear and anterior petrous apex with encasement of the carotid artery. Middle ear biopsy demonstrated melanoma. Initial treatment consisted of radiation therapy (30 Gy, 10 Fractions) followed by induction nivolumab. Following 5 cycles every 2 weeks of nivolumab, cranial neuropathies resolved, and PET/CT imaging demonstrated complete response. Following maintenance therapy (6 cycles, q3w), an FDG-avid retroperitoneal lymph node responded to continued treatment. Remission was achieved after completion of one year of nivolumab and stable remission was demonstrated after four months of active surveillance. Nine months following cessation of treatment, imaging demonstrated a progressive right parafalcine frontal lobe lesion, treated with Gamma Knife radiosurgery. The patient later underwent craniotomy and biopsy of the frontal lesion, confirming melanoma. The patient expired from cardiac complications shortly after surgery, 2 years and 8 months from diagnosis.

Conclusions: Primary mucosal melanoma of the middle ear and petrous temporal bone is exceedingly rare, with less than 25 reported cases. Management is case specific and often involves surgical resection. In this case, an unresectable tumor demonstrated complete response and reversal of cranial nerve neuropathies following radiation and anti-PDL1 therapy, suggesting a non-surgical option for similar lesions.

***Define Professional Practice Gap & Educational Need:** The rarity of primary mucosal melanoma of the middle ear makes treatment case specific. There is a paucity of literature describing non-surgical options for these patients.

***Learning Objective:** To describe a case of unresectable mucosal melanoma of the middle ear and petrous apex in which cranial nerve deficits were reversed and remission achieved after treatment with radiation and nivolumab.

***Desired Result:** Appreciate nivolumab as potential treatment for non-resectable mucosal melanoma of the middle ear and petrous apex.

Level of Evidence - Level V

Indicate IRB or IACUC : Exempt.

Endoscopic Medial Reepithelization for Inflammatory Canal Stenosis

Sonia M. Scaria; Aaron D. Tward, MD, PhD

Objective: Inflammatory External Auditory Canal (EAC) Stenosis arises from infiltration of inflammatory cells, edema and eventual sclerosing of the medial EAC, leading to complete obstruction and conductive hearing loss. Current treatment includes surgical resection of the affected area with widening and reepithelization of the EAC via post-auricular incision, but the condition is reported to recur with high frequency. Our aim was to assess the feasibility of endoscopic treatment as an alternative to open surgery and understand its effect on recurrence rates.

Study Design: Retrospective case review

Setting: Tertiary referral center

Patients: 4 patients were included who had conductive hearing loss and inflammatory canal stenosis all with gross thickening of the tympanic membrane.

Interventions: Patients underwent endoscopic removal of obstructive tissue and reepithelization with split-thickness skin grafting.

Main Outcome Measures: Post-operative air-bone gap (ABG), lack of recurrence, subjective reporting of hearing improvement, and lack of drainage.

Results: 8 out of 8 ears (n = 4 patients) had significant improvement in hearing. No recurrence has been observed in any of the patients over a mean follow-up time of 46 months (range =31-65). Average reduction in ABG was 14 dB (SD = 7) with a statistically significant difference between the pre-operative and post-operative ABG at 512 Hz (p =.0014)

Conclusions: Endoscopic treatment of Inflammatory EAC Stenosis obviates the need for post-auricular incision and results in clinical improvement with a favorable recurrence rate.

REQUIRED:

Define Professional Practice Gap & Educational Need: Currently, Inflammatory EAC Stenosis is treated via a post-auricular approach, and there is a high rate of recurrence.

Learning Objective: Review the current practice in regard to treatment of inflammatory EAC stenosis; Analyze the utility of an endoscopic treatment for EAC Stenosis; Observe the change in patient outcomes using the Endoscopic Medial Reepithelization

Desired Result: The patients will report significantly better hearing loss post-surgery, and the air-bone gap will be decreased substantially using an endoscopic medial reepithelization, while also reducing recurrence rates. Physicians can then see the value in potentially adopting a non-invasive treatment for Inflammatory EAC stenosis.

Level of Evidence – V – case series

Indicate IRB or IACUC : IRB

Auricular Cartilage Resection for Treatment-Refractory Chronic Chondritis: A Case Series

*Steven A. Gordon, MD, MPH; Ashley M. Nassiri, MD, MBA; Colin L. Driscoll, MD
Matthew L. Carlson, MD; Neil S. Patel, MD*

Objective: Describe a series of cases of chronic auricular chondritis refractory to antibiotics and steroids treated successfully with surgery

Study Design: Case Series

Setting: Two tertiary academic medical centers

Patients: We analyzed four patients diagnosed with chronic auricular deformity, pain, and drainage for a period of 1-5 years who had failed prolonged treatment consisting of antibiotics, corticosteroids, and incision and drainage. All four patients were smokers, three were diabetic. One patient suffered a gastrointestinal bleed related to prolonged corticosteroid therapy during her medical treatment.

Interventions: Operative subcutaneous partial auriculectomy (removal of diseased cartilage and excess skin) was performed.

Main Outcome Measures: Resolution of pain and drainage, need for additional procedures, and reduction in narcotics required for pain control were analyzed.

Results: Two of the four patients were given an immediate post-operative course of doxycycline and ciprofloxacin. With a minimum of 6 weeks' follow-up, all four patients had complete resolution of pain and recurrent drainage post-operatively. One patient requiring multi-daily narcotic medication for pain and benzodiazepine for sleep preoperatively no longer required prescription medication. All specimens revealed chronic dermal and cartilage inflammation. Three of four cases had polymicrobial infection. One case had only skin contaminant growth on culture following multiple oral and parental antibiotic regimens.

Conclusions: Surgical excision of diseased cartilage as a result of chronic chondritis is an effective treatment in those cases refractory to antibiotics and incision and drainage, and should be considered early in the treatment algorithm for similar patients to avoid morbidity related to prolonged medical treatment.

***Define Professional Practice Gap & Educational Need:** Chronic chondritis refractory to antibiotics and incision and drainage presents a treatment challenge. There exists little data to support treatment decision-making. This case series describes a promising surgical approach to treatment with excellent results and resolution of presenting symptoms and should serve as a resource for surgeons who encounter similar cases.

***Learning Objective:** Understanding the effect of surgical management in the treatment of patients with refractory chronic auricular chondritis.

***Desired Result:** To offer an additional tool in the armamentarium for treatment of refractory chronic auricular chondritis.

Level of Evidence - Level V

Indicate IRB or IACUC: Exempt.

Transmastoid Repair of Encephaloceles and Cerebrospinal Fluid Leaks in Patients with Canal Wall Down Mastoidectomy

*Tirth R. Patel, MD; Alexa S. Roy, BS; Ali Z. Piracha, BS
Elias Michaelides, MD; R. Mark Wiet, MD*

Objective: To describe the efficacy of single-stage transmastoid repair of encephaloceles or cerebrospinal fluid (CSF) leaks in patients requiring canal wall down mastoidectomy (CWD).

Study Design: Case series

Setting: Tertiary-care hospital

Patients: A total of 14 patients were included in the study. Three patients had a CWD mastoidectomy performed in a separate operation prior to repair of the encephalocele or CSF leak. The remaining 11 patients had an encephalocele repaired concurrently with CWD mastoidectomy.

Interventions: Surgical repair of an otogenic encephalocele or CSF leak using a CWD transmastoid approach or in patients with a prior CWD cavity.

Main Outcome Measures: Failure of repair, size of defect repaired, materials used for repair, use of lumbar drain.

Results: Eight patients had cholesteatoma noted at the time of surgery. Mean size of the encephalocele repaired was 0.91 cm. Three patients had mastoidectomy cavities obliterated with fat graft and closure of the external auditory canal. A lumbar drain was used for one patient. No patient required repeat surgery for encephalocele repair or CSF leak.

Conclusions: In appropriately selected cases single-stage transmastoid repair of encephaloceles or CSF leaks in patients with pre-existing CWD cavities or patients undergoing concurrent CWD mastoidectomy, without the addition of a simultaneous middle fossa craniotomy, is effective and safe.

***Define Professional Practice Gap & Educational Need:** While transmastoid repair of these encephaloceles has been reported previously, there have been very few reports of the efficacy of single-stage transmastoid repair of encephaloceles in patients requiring CWD mastoidectomy or with a prior CWD cavity.

***Learning Objective:** A single-stage transmastoid approach to CSF leak or encephalocele repair for patients requiring CWD or with a prior CWD cavity may be effective and reduces the morbidity associated with multi-stage or middle cranial fossa craniotomy procedures.

***Desired Result:** For surgeons to consider using a single-stage transmastoid approach to CSF leak or encephalocele repair for patients requiring CWD or with a prior CWD cavity.

Level of Evidence – Level V

Indicate IRB or IACUC: Rush University; ORA #: 20031701-IRB01

Surgical Management of Temporal Bone Osteoradionecrosis

*Peter L. Nguy, MD; Christine Stuart, BS; Kelly Moyer, MD; Peter Ahn, MD
K. William Harter, MD; Bruce Davidson, MD; H. Jeffrey Kim, MD*

Objective: To review the relevant literature and discuss the surgical management of osteoradionecrosis of the temporal bone

Study Design: Retrospective chart review

Setting: Tertiary academic medical center

Patients: Patients diagnosed with and surgically managed for temporal bone osteoradionecrosis from 2009 to 2019

Interventions: Surgical management of temporal bone osteoradionecrosis

Main Outcome Measures: Incidence and factors influencing surgical management, surgical techniques

Results: In 24 patients (58.3% male) diagnosed with temporal bone osteoradionecrosis, 7 (29.2%) patients ultimately received surgical management. Women were diagnosed significantly earlier than men, at 4.2 years compared to 9.7 years ($p=0.0197$). After conservative management of all patients via aural toilet, progression of osteoradionecrosis or recurrent otorrhea prompted surgical intervention in seven patients after a mean of 22 months. The procedures performed on these ears included lateral temporal bone resection with mastoid obliteration ($n=1$), ear canal reconstruction with autograft ($n=4$), and vascularized pedicled flaps ($n=5$). 2 patients received more than 1 operation for de novo areas of osteoradionecrosis. Hyperbaric oxygen was used in 3 cases as a preoperative measure prior to surgery for osteoradionecrosis. Parotid ($n=45.8\%$) and nasopharynx (25.0%) primary subsites represented the majority of the sample, with a higher predominance of parotid primaries ($n=86\%$) among those who underwent surgery.

Conclusions: A variety of surgical techniques have been described previously for temporal bone osteoradionecrosis. Vascularized pedicled flaps are a viable option for reconstructing defect of the external auditory canal after unsuccessful conservative measures.

***Define Professional Practice Gap & Educational Need:** Osteoradionecrosis of the temporal bone is an extremely rare occurrence and surgical management is controversial, but should be considered in cases with intractable pain.

***Learning Objective:** The objective of this study is to better acquaint providers with the surgical management options for osteoradionecrosis of the temporal bone

***Desired Result:** Providers will have better knowledge and competence for the surgical management options for temporal bone osteoradionecrosis

Level of Evidence – Level IV

Indicate IRB or IACUC : Georgetown University IRB STUDY00001290

Sound Distortion with Loud Sound: A Possible Otologic Migraine Phenomenon

*Adwight Risbud, BS; Mehdi Abouzari, MD, PhD; Ariel Lee, BS
Ethan Muhonen, MD; Elaine Martin, MD; Harrison W. Lin, MD; Hamid R. Djalilian, MD*

Objective: To describe a novel series of cases of noise-induced sound distortion in patients with migraine-related tinnitus and hyperacusis.

Study Design: Retrospective cohort.

Setting: Tertiary-care neurotology clinic.

Patients: Four patients with a diagnosis of migraine-related tinnitus and symptoms of sound distortion and ear crackling when exposed to loud noises (at the end of the sounds).

Interventions: All patients were counseled on lifestyle and dietary modification with supplementation with vitamin B2 200 mg bid and magnesium 400 mg bid and if not improved, patients were prescribed migraine prophylactic medications per protocol. MRI and CT of the temporal bones were obtained on all patients and were normal.

Main Outcome Measures: The main outcome measure was reduction or resolution of sound distortion/ear crackling, migraine, and tinnitus symptoms at 4-month follow up.

Results: Three out of four patients had unilateral tinnitus with ipsilateral symptoms of ear crackling heard at the end of loud sounds. All four patients presented with hyperacusis and reported additional migraine features including headache, ocular pain, otalgia, and aural fullness. All patients were treated with lifestyle and diet changes and two patients required migraine prophylactic therapy. All four patients had significant improvement (>50% decrease) in frequency of tinnitus, sound distortion, and migraine symptoms within a 4-month follow-up period. Two of the patients had complete resolution of the sound-induced distortion/crackling.

Conclusions: We report the first cases of sound distortion with loud sound in patients with atypical migraine who responded positively to migraine therapy. Our report adds further support to recent studies proposing an association between migraine disorder and various otologic symptoms.

Define Professional Practice Gap & Educational Need: Until recently, symptoms such as tinnitus and hyperacusis were thought to result exclusively from primary otologic disorders. Furthermore, researchers have attempted to explore the relationship between these audiological symptoms and other disorders, particularly migraine, given the high prevalence of these symptoms observed in migraine cohorts. At present, many patients present with only a minority of the classic migraine symptoms and may not fulfill the current International Classification of Headache Disorders criteria for migraine. However, with a complete history and exam, we may uncover additional features suggestive of migraine disorder and potentially expand the number of patients who may benefit from migraine therapy. This would help further elucidate the pathophysiology of migraine, through a better understanding of the less common otologic manifestations that may contribute to the underdiagnosis and undertreatment of this disabling condition.

Learning Objective: To inform clinicians on a series of patients experiencing loud noise-induced sound distortion and ear crackling and to further characterize the potential otologic manifestations of migraine and migraine-related tinnitus/hyperacusis.

Desired Result: Increased awareness and consideration of sound distortion and ear crackling as migraine symptoms and expanded use of migraine prophylaxis and lifestyle management in patients with these atypical features.

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.

Prevalence of Polypharmacy in Patients with Vestibular and Balance Complaints: a Single-Center retrospective review

*Tatianna Timor, PharmD Candidate; Adrienne Busch, PharmD Candidate;
James Sterrett, PharmD; Habib Rizk, MD, MSc*

Objectives: The aim of this study is to analyze the prevalence of polypharmacy in a diverse patient population referred to a tertiary multidisciplinary vestibular clinic and to investigate to what extent polypharmacy is a contributing factor to the symptoms.

Background: Dizziness is a commonly observed side effect of prescription medications with or without vestibulotoxicity. Previous literature has determined that the risk of dizziness is increased with advanced age, certain classes of medications, and with polypharmacy.

Methods: A retrospective, observational review was conducted over a 6-month period from September 2019 to March 2020 of 1496 patients who presented to a multidisciplinary vestibular clinic. Patient demographics, medication lists, diagnosis, and interventions were retrieved from the healthcare system's electronic medical record.

Results: Preliminary analysis of our dataset shows that out of the 1000 patients reviewed so far, 68 patients were on 5 or more medications, therefore meeting the criteria for polypharmacy. The most commonly prescribed medications were cardiovascular, with the most common classes including ACE inhibitors 20.2% (19/94) and ARB antihypertensives 16.0% (15/94). Antihistamines and benzodiazepines were also common, with 37% and 24% of patients found to be on these medication classes.

Conclusions: Our preliminary findings suggest that polypharmacy is a prevalent comorbidity in patients referred to a multidisciplinary vestibular clinic. These findings demonstrate the utility of performing a thorough medication history and to consider polypharmacy as a causative factor even in the presence of other etiologies; especially since it can affect the pharmacologic treatment of associated conditions causing dizziness.

Define Professional Practice Gap & Educational Need: 1. Understand the prevalence and the interaction of polypharmacy with other causes and other treatments needed for the cause of dizziness. 2. Polypharmacy can cause dizziness independently of vestibulotoxicity and can independently affect the quality of life of vestibular patients 3. Pharmacologic treatment of Meniere's disease and Vestibular Migraine and other vestibulopathies may be affected by the presence of polypharmacy.

Learning Objective: 1. To determine the prevalence of polypharmacy in patients referred to a vestibular clinic 2. To investigate the correlation between polypharmacy and specific etiologies of vestibular dysfunction 3. To determine the impact of polypharmacy on quality of life outcome measures.

Desired Results: Attendees will understand the importance of polypharmacy in the vestibular patients' population. In addition, they will learn which specific diagnoses have a higher correlation with polypharmacy. This will allow a better assessment of quality of life impact and treatment plans.

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

Indicate IRB or IACUC: IRB Approved Pro 00050097

**Comparison of Cranioplasty Techniques following Translabrynthine Surgery:
Effect on Postoperative Pain and Reduced Opioid Requirements**

*Pedrom C. Sioshansi, MD; Mulin Xiong, BA; Nathan Tu, MD; Robert S. Hong, MD
Christopher A. Schutt, MD; Dennis I Bojrab, MD; Seilesh C. Babu, MD*

Objective: To assess differences in postoperative pain, opioid usage, and surgical outcomes between cranioplasty using abdominal fat graft (AFG) versus hydroxyapatite cement (HAC) following translabyrinthine surgery.

Study Design: Retrospective case control

Setting: Tertiary referral center

Patients: Thirty translabyrinthine procedures was evaluated, including 15 consecutive HAC patients and 15 matched AFG patients. Patients were matched by age, gender, body mass index, and tumor size.

Intervention: Cranioplasty using HAC or AFG following translabyrinthine resection of vestibular schwannoma.

Main Outcome Measures: Postoperative patient pain ratings, narcotic usage, inpatient length of stay, and complication rates.

Results: Patients that underwent HAC cranioplasty had lower postoperative pain scores on several measures ($p < 0.05$) and less postoperative narcotic usage (mean 55.3 morphine equivalents, $p = 0.0031$) when compared to those that received AFG closure. There was no difference in length of stay. Postoperative CSF leaks in both groups and skin reactions in AFG closure patients were infrequent.

Conclusion: HAC cranioplasty is a safe technique comparable to AFG closure following translabyrinthine surgery which can decrease postoperative pain and narcotic usage.

***Define Professional Practice Gap & Educational Need:** Assess differences between cranioplasty techniques on surgical outcomes and narcotic utilization rates.

***Learning Objective:** Compare patient rated subjective outcomes and objective differences in opioid requirements between cranioplasty techniques.

***Desired Result:** Assess differences in postoperative pain scores and opioid use following translabyrinthine surgery.

Level of Evidence: III

Indicate IRB or IACUC : Ascension Providence IRB approval 1534095-1

**Management of Superior Semicircular Canal Dehiscence Syndrome:
Impact of Disease Severity on Management and Outcomes
with Tragal Cartilage Cap Resurfacing Technique**

*Rohan Basu ,BS; Tiffany P. Hwa, MD; Adam C. Kaufman, MD, PhD
Jason A. Brant, MD; Steven J. Eliades, MD, PhD; Michael J. Ruckenstein, MD*

Objective: To report outcomes after surgical intervention with tragal cartilage cap resurfacing for patients with superior semicircular canal dehiscence (SSCD)

Study: Retrospective chart review

Setting: Academic tertiary referral center

Patients: Thirty-one consecutive patients (17 operative) from a single clinician with SSCD from 2012-2019

Interventions: Transmastoid tragal cartilage cap resurfacing technique

Primary Outcome Measure: Patient-reported symptom severity in vestibular, otologic, and global disease severity

Results: Thirty-one adult patients, including 18 males and 13 females, were evaluated for SSCD. Seventeen patients chose surgical intervention, while the remainder opted for observation. Mean age and gender distribution were similar between the treatment and observation groups, but patients opting for surgery reported significantly more severe vestibular symptoms on a Likert scale (treatment 2.68 vs. observation 1.32, $p<0.01$). For patients undergoing surgery, mean operative time was 78.1 minutes, with a mean postoperative stay of 1.11 days. Significant postoperative improvements were seen in subjective ratings for balance (2.68 vs. 1.38, $p<0.01$), hearing (3.26 vs. 2.20, $p<0.01$), and global symptom severity (3.50 vs. 2.17, $p<0.01$). One patient experienced persistent vertigo requiring admission with subsequent resolution, and one patient required revision surgery, which resulted in improvement in all symptom domains. There were no other complications and no cases of postoperative sensorineural hearing loss.

Conclusions: For patients electing to undergo surgery, transmastoid tragal cartilage occlusion is an effective technique in the management of symptomatic SSCD syndrome. Benefits include surgical familiarity for the neurotologist, avoidance of a craniotomy, decreased operative time, and noninferior symptomatic outcomes without increased postoperative complications.

Define Professional Practice Gap & Educational Need: To report outcomes on the conservative surgical intervention of tragal cartilage resurfacing; To report patient decision-making for elective surgical intervention based on a self-reported symptom severity index

Learning Objective: To identify and characterize surgical outcomes after tragal cartilage cap resurfacing for superior semicircular canal dehiscence

Desired Result: Improvement in symptomatology for vestibular, otologic, and global disease severity

Level of Evidence – Level IV

Indicate IRB or IACUC: Approved by the University of Pennsylvania Institutional Review Board. Approval#833914. Date of Approval 8/12/2019.

Endoscope-assisted Superior Semicircular Canal Dehiscence Repair: Single Institution Outcomes

*Douglas J. Totten, BA; Miriam R. Smetak, MD; Elizabeth L. Perkins, MD
Nathan D. Cass MD; David S. Haynes, MD, MMHC
Alejandro Rivas, MD; Marc L. Bennett, MD, MMHC*

Objective: To determine efficacy of endoscope-assisted middle cranial fossa (MCF) repair of superior semicircular canal dehiscence (SSCD) compared to microscopic MCF repair.

Study Design: Retrospective cohort.

Setting: Tertiary medical center neurotology practice

Patients: SSCD patients who underwent surgical repair via MCF with or without endoscope assistance from 2010-2019.

Main Outcome Measures: Pre- and post-operative changes in symptom burden, as calculated from eight patient-reported symptoms. Pre- and post-operative changes in symptom burden were assessed using paired t-tests. Single-predictor binary logistic regression was used to compare final reported symptoms between cohorts. Linear regression was performed to assess air-bone gap (ABG) changes postoperatively between cohorts.

Results: 46 patients received surgical management for SSCD. Of these, 27 (59%) were male and 19 (41%) were female. Bilateral SSCD was present in 14 cases (29%), of which three underwent surgical management bilaterally, for a total of 49 surgical ears. Surgery was performed on the right ear in 19 cases (39%) and on the left in 30 cases (61%). 40 ears (82%) underwent microscopic repair while 9 (18%) underwent endoscope-assisted repair. Microscopic and endoscope-assisted MCF repair both demonstrated significantly improved symptom burden postoperatively ($p < 0.001$ for each). There was no significant difference in change in ABG between the two cohorts. On average, patient-reported symptoms and audiometrically-tested hearing improved postoperatively in both groups.

Conclusions: Endoscope-assisted MCF repair yields similar results and is equivalent to microscopic MCF repair while possibly providing better visualization of medial and downslope defects.

Define Professional Practice Gap & Educational Need: Lack of understanding regarding outcomes of endoscope-assisted repair of SSCD.

Learning Objective: Evaluate outcomes of endoscope-assisted SSCD repair compared to repair via the traditional microscopic MCF approach.

Desired Result: This study can identify preliminary results of endoscope-assisted SSCD repair and may guide clinical and surgical management as well as future studies.

Level of Evidence - IV

Indicate IRB or IACUC: IRB Approved (201632, Vanderbilt University Medical Center)

**Cost Analysis following Microsurgical Resection of Vestibular Schwannomas:
Does Extent of Resection matter?**

*Elizabeth L. Perkins, MD; Douglas J. Totten, BA; Nathan D. Cass, MD
Alexander D. Sherry, MD; Ankita Patro, MD, David S. Haynes, MD, MMHC
Marc L. Bennett, MD, MMHC*

Objective: Compare costs of surgery and complications, cost and number of postoperative interventions, and facial nerve outcomes following subtotal resection (STR) or near-total resection (NTR) and gross total resection (GTR) of vestibular schwannomas (VS).

Study Design: Retrospective case series.

Setting: Tertiary referral center.

Patients: 117 Patients who underwent microsurgical resection of VS between 2014-2018.

Main Outcome Measures: Initial cost of surgery and postoperative care, number and cost of postoperative magnetic resonance images (MRIs) and interventions, surgical or otherwise, and facial nerve function one-year postoperatively.

Results: STR/NTR was not associated with significantly greater cost of admission vs. GTR (average: \$47,211 vs \$44,252, respectively) ($p=0.21$) or length of stay (4.2 vs 4.0 days, respectively) ($p=0.73$). Average House-Brackmann (HB) score for facial nerve function at one year was 1.5 for the STR/NTR cohort compared to 1.6 for GTR ($p=0.81$). STR/NTR was associated with significantly greater number of post-intervention MRIs compared to GTR (3.0 MRIs vs 2.5 MRIs) ($p=0.039$). Average length of follow-up was 18 months for STR and 41 months for GTR. There was no significant difference between groups regarding readmissions or facial nerve interventions ($p=0.45$ and 0.50 , respectively).

Conclusions: Within our cohort, STR/NTR was not associated with significantly greater initial costs of admission but was associated with a greater number of postoperative MRIs of compared to GTR. There was no significant difference in one-year facial nerve outcomes between the STR/NTR and GTR cohorts.

Define Professional Practice Gap & Educational Need: Lack of understanding differences in costs of care and overall outcomes between gross total resection and subtotal resection of vestibular schwannomas.

Learning Objective: Demonstrate costs of care and clinical outcomes, particularly regarding facial nerve function associated with subtotal resection compared to those associated with gross total resection.

Desired Result: This preliminary study can provide context for decision-making regarding extent of tumor resection.

Level of Evidence - IV

Indicate IRB or IACUC: IRB Approved (201632, Vanderbilt University Medical Center)

The Fallopian Bridge Technique for Access to a Giant Infratemporal Fossa Cholesteatoma: A Case Report

*Amir Mohammadzadeh, BS; Joshua A. Stramiello, MD
Rick A. Friedman, MD, PhD; Jeffrey P. Harris, MD, PhD*

Objective: To report management of a giant infratemporal cholesteatoma using the fallopian bridge technique and blind sac closure of the external auditory canal.

Methods: Case report.

Results: We present the case of a patient with an acquired cholesteatoma secondary to an iatrogenic inferior bony canal wall defect. An infratemporal approach was employed for this cholesteatoma that partially exposed the vertical segment of the carotid artery, the dura, and the jugular bulb. Rather than transpose the facial nerve, we performed a fallopian bridge technique to attain appropriate surgical access to these critical structures. The patient had a House-Brackmann 1 throughout his postoperative course.

Conclusion: Giant cholesteatomas that erode the critical structures of the skull base require wide access that can result in transposing the facial nerve. The fallopian bridge technique allowed excellent exposure and access for management of this extensive cholesteatoma without increasing risk of facial nerve injury.

***Define Professional Practice Gap & Educational Need:** Cholesteatoma has a recidivism rate as high as 70% and requires significant exploration to ensure all disease is removed. While the use of the fallopian bridge technique has been well-described for jugular foramen tumors and exploration of the retrotympnum, this technique has proven utility in the extirpation of a giant cholesteatoma of the temporal bone that invades the infratemporal fossa.

***Learning Objective:** In the setting of a giant cholesteatoma with hypotympanum and infratemporal fossa extension, the fallopian bridge technique proved to increase surgical access without increasing risk of facial nerve injury.

***Desired Result:** The fallopian bridge technique remains a good option in the surgeon's armamentarium to manage a number of pathologies including glomus jugulare and jugular foramen tumors, as well as extensive cholesteatomas. Increasing awareness of its utility may improve patient facial nerve outcomes for practicing neurotologists.

Level of Evidence - V

Indicate IRB or IACUC: Exempt

Preoperative Vestibular Schwannoma Functional Testing as a Correlate of Size, Volume, and Location

*MAJ Isaac D. Erbele, MD; Jacob L. Seicshnaydre, MS
Madelinn R. Fink, MS; Moisés A. Arriaga, MBA, MD*

Objective: Evaluate preoperative functional vestibular schwannoma as correlated with linear size, total tumor volume, and tumor volume within the internal auditory canal (IAC) and cerebellopontine angle (CPA)

Study Design: Retrospective review

Setting: One tertiary care center over five years

Patients: Surgical sporadic vestibular schwannoma patients, excluding revision surgery

Interventions: Preoperative tumor linear size, total volume, IAC volume, and CPA volume. Volumes measured using contrast enhanced T1 MRI with radiation mapping software.

Main Outcome Measures: Preoperative caloric testing, cervical vestibular evoked myogenic potentials (cVEMP), electroneurography, audiogram thresholds, and word recognition scores (WRS)

Results: Fifty-eight patients were included. Statistically significant correlation was found with caloric testing and total tumor volume ($r=0.42$, $p=0.002$), CPA tumor volume ($r=0.39$, $p=0.004$), and linear size ($r=0.49$, $p=0.0001$). Similarly, cVEMP was correlated with total tumor volume ($r=0.41$, $p=0.003$), CPA tumor volume ($r=0.39$, $p=0.004$), and linear size ($r=0.49$, $p=0.0001$). WRS were also correlated with total tumor volume ($r=-0.30$, $p=0.03$), CPA tumor volume ($r=-0.30$, $p=0.03$), and linear size ($r=-0.33$, $p=0.01$). Linear size alone was correlated with hearing thresholds at 0.25kHz ($r=0.27$, $p=0.04$). No statistically significant correlations were found with IAC tumor volumes.

Conclusions: Total tumor volume, CPA tumor volume, and linear size were correlated with elements of audiovestibular testing, but IAC tumor volumes were not. Volumes were not clearly favored over linear size in predicting functional loss. While measuring vestibular schwannoma tumor volumes may have a role for other clinical purposes, its role for evaluating functional loss may be of greater academic than clinical interest at this time.

***Define Professional Practice Gap & Educational Need:** Determine role of vestibular schwannoma volume in evaluating and managing functional audiovestibular loss

***Learning Objective:** Choose appropriate tumor measure for managing functional loss in vestibular schwannomas

***Desired Result:** Assess how tumor dimensions influence audiovestibular loss in vestibular schwannoma

Level of Evidence - IV

Indicate IRB or IACUC : IRB Approved (OLOL – 9419)