SELECTED ABSTRACTS

ORAL PRESENTATIONS

IN ORDER OF PRESENTATION

150th Annual Meeting

AMERICAN OTOLOGICAL SOCIETY

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San Diego, CA

Mesenchymal Stem Cell Therapy for Chronic Tympanic Membrane Perforations

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

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

Glenn W. Knox, MD; Daniel Woodard, MD

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

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

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Exempt

Medicaid Reimbursement for Cochlear Implantation: Is it Fair?

Daniel H. Coelho, MD; Joseph Conduff, BS

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

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Exempt

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

Yann Nguyen, MD, PhD; Renato Torres, MD
Mylène Drouillard, MD; Daniele De Seta, MD, PhD
Evelyne Ferrary, MD, PhD; Daniele Bernardeschi, MD, PhD
Olivier Sterkers MD, PhD

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

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

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

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

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

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

Learning Objectives: Understand the importance of the insertion axis during cochlear implantation

Desired Results: An insertion in an inaccurate axis is more traumatic than an optimal axis insertion

IRB or IACUC Approval- Exempt

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

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Vivek Kanumuri, MD; Ariel E. Hight, MS
Elliott D. Kozin, MD; M. Christian Brown, PhD
Daniel J. Lee, MD

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

Tyler S. Weaver, MD; Corey S. Shayman, BS
Bahir H. Chamseddin, BS; Martina Mancini, PhD
Timothy E. Hullar, MD

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

Damiano Zanotto, PhD; Erin M. Mamuyac, BA
Adam R. Chambers, BA; John A. Stafford, MD
Sunil K. Agrawal, PhD; Anil K. Lalwani, MD

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

Study design: Cross-sectional
Setting: Outpatient Otology Clinic

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

RESIDENT RESEARCH TRAVEL AWARD

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

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

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

Study design: matched-pair, retrospective review.

Setting: Tertiary hospital.

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

Intervention(s): ITG

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

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Timothy Meehan, MD; Jennifer Shin, MD
Joseph B. Nadol Jr., MD; Michael J. McKenna, MD
Amy Juliano, MD

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Exempt

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

Nicholas L. Deep, MD; Jake G. Besch-Stokes, BS
Colin L.W. Driscoll, MD; Matthew L. Carlson, MD

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

Study Design: Retrospective chart review.

Setting: Tertiary referral center

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

Validation of A Novel Summative Temporal Bone Dissection Scale

Michael Gousseau, MD; Bertram Unger, MD, PhD
Justyn Pisa, AuD; Brian Westerberg, MD, MHSc
Jordan Hochman, MD

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

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Christopher M. Discolo, MD, MSCR
Shaun A. Nguyen, MD; Ted A. Meyer, MD, PhD

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

Study Design: Retrospective analysis

Setting: Tertiary academic referral center

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

Intervention: Diagnostic

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

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

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

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

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

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

IRB or IACUC Approval: Exempt

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

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Steven Messina, MD; Michael Seidman, MD
James Baumgartner, MD

Objective: To assess the safety of intravenous autologous human umbilical cord (hUCB) treatment of acquired sensorineural hearing loss in children.

Study Design: Phase 1 trial (IND 16231/IRB 434269-33): 11 children aged 6 weeks to 6 years with acquired profound to severe sensorineural hearing loss of less than 18 months duration were treated with autologous human umbilical cord blood mononuclear fraction intravenously from 2013-16. To assess safety, systemic blood pressure and oxygen saturation were monitored during the cord blood infusion. Infusion related toxicity was determined by following hepatic, renal, pulmonary and hematologic laboratory measures. 3T MRI with DTI sequences were obtained pre- and one year post treatment. Typanometry, ABR & OAE were measured pre-, 1, 6 and 12 months post treatment. Standard speech assessments were obtained pre-, 6 and 12 months post-treatment.

Results: All patients survived. No adverse events or infusion related toxicities occurred. 4 subjects, who received higher hUCB cell doses, experienced improvements in either ABR thresholds and/or CN VII conduction latencies beginning at one month post treatment. The improvements were stable over the duration of the trial.

Conclusion: Autologous hUCB treatment is safe. At higher cell doses, improvement in ABR threshold and CN VIII latency may occur following this treatment.

Define Professional Practice Gap and Educational Needs: The treatment for sensorineural hearing loss is supportive. No curative options are currently available. We present the results of a phase one immunomodulatory stem cell treatment which is a new and potentially reparative treatment for sensorineural hearing loss. The treatment is designed to bridge a treatment gap and provide optimum patient care. Many healthcare professionals are unaware of the potential of immunomodulatory stem cell treatment.

Learning Objective: Our submission will raise awareness and improve contemporary knowledge. Our presentation will explain the basic principals of this treatment, and present phase one results for 11 children with acquired sensorineural hearing loss treated with this approach.

Desired Result: Attendees will become familiar with the concept and basic methodology of immunomodulatory stem cell treatment. They will also understand how this treatment has been applied to sensorineural hearing loss in a pediatric phase 1 clinical trial.

IRB or IACUC Approval: Approved

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

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B. Gregory Thompson, MD; Steven A. Telian, MD

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

Study Design: Retrospective case series.

Setting: Tertiary academic referral center.

Patients: Adult patients with isolated/sporadic vestibular schwannoma

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

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

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

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

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

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

Learning Objective: characterize occupational noise exposure during otology/neurotology procedures

Desired Result: Consideration of actions to reduce noise exposure among Otological/Neurotological surgeons

IRB or IACUC Approval: Exempt

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

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Judy R. Dubno, PhD

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

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

Setting: Multicenter prospective FDA clinical trial

Patients: Ninety-one adult active MEI recipients

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

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

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

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

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

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

IRB or IACUC Approval: Exempt

RESIDENT RESEARCH TRAVEL AWARD

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

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Nathaniel T. Greene, PhD; Nyssa F. Farrell1, MD
Samuel P. Gubbels, MD; Daniel J. Tollin, PhD

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Exempt

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

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Joe Walter Kutz Jr, MD

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

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

Setting: Three tertiary care academic centers.

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

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

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

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

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

IRB or IACUC Approval: Exempt

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

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Exempt

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

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

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

Study Design: Retrospective chart review.

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

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

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

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

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

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

IRB or IACUC Approval: Approved

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

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Robert Frank, MD; Matthew Cox, MD
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Objective: To review our use of intraoperative testing during cochlear implantation (CI) and determine its impact on surgical decision-making.

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

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

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

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

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

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

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

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

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

IRB or IACUC Approval: Approved