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## Temporal Encoding of Voice Onset Time in Young Children

Aseel Almeqbel Kuwait University

**Objectives:** Voice onset time (VOT) is an important parameter of speech that denotes the time interval between consonant onset and the onset of low frequency periodicity generated. In this study we examined the temporal encoding of voice onset time in the cortical auditory evoked response (CAEP) of young children.

**Background:** Voice onset time (VOT) is an important temporal cue for speech perception. is important speech parameter signifies the interval between consonant release (onset) and the start of rhythmic vocal-cord vibrations (voicing). In English, the VOT for voiced stop consonants such as/ga/ is short, voiceless stop consonants such as /ka/ have a much longer VOT duration. For speech perception, rapidly changing acoustic cues such as VOT are used to discriminate stop consonants while steady-state cues such as formant transition provide information on vowel discrimination.

**Method:** Scalp recoded CAEP were measured in 18 children aged from 5-8 participated (n=18). The N2 latency was evoked using differences in voice-onset-times (VOTs) using stop consonant-vowel syllables /ga/-/ka/.

**Results:** A significant and systematic shift in the N2 latency was observed for differences in VOT.

**Conclusions:** Our results demonstrate that temporal encoding of VOT exists in the developing cortical evoked response.

#### Comparison of Statistical Methods for the Objective Detection of Speech-Evoked Envelope Following Responses

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**Objectives:** This study aimed to investigate the sensitivity, specificity and efficiency of various statistical tests that can be used to detect speech-evoked Envelope Following Responses (EFRs).

**Background:** EFRs reflect neural activity phase-locked to the stimulus envelope periodicity. To evaluate if EFRs, elicited at the envelope frequency, are significantly different from the noise floor (i.e. detected), frequency-domain statistical tests utilize EFR amplitude and/or phase. Performance of statistical tests vary due to the usage of different aspects of the recorded signal as well the underlying assumptions of each test. Identifying optimal statistical tests for EFR detection will improve clinical viability of speech-evoked EFRs by shortening test times while increasing the area under the receiver operating characteristic (ROC) curve. In the present study, we compare the d-prime and test time necessary for response detection using previously proposed statistical tests in a large dataset of speech-evoked EFRs that vary by participant age.

**Methods:** EFRs evoked by vowels and fricatives in the male-spoken token /susashi/ were recorded in 23 young normal hearing adults (20-27 years) and 44 normal hearing infants (1-13 months). Responses were analyzed using the F-test, Phase Coherence, Rayleigh-Moore, Hotelling's T^2 and Circular T^2 statistical methods. By comparing the accuracy of the statistical tests in a clinically viable timeframe (<20 minutes), we will determine which test is best suited for EFR detection.

**Results:** Preliminary analyses indicate that statistical tests that use both phase and amplitude are more effective than those that use either phase or amplitude. The impact of between-subject response variability and magnitude in both adult and infant populations on the performance of statistical tests is currently underway.

**Conclusions:** Preliminary analyses indicate that accurate and efficient detection of speechevoked EFR is possible within a clinically viable time frame, especially if response amplitude and phase are analyzed together.

#### Concussion and Its Impact on the Auditory System Greg Noel Dalhousie, School of Communication Sciences and Disorders

**Objectives:** Summary data of clients referred for audiological evaluation following concussion to the neuroaudiolgical clinic at Dalhousie University, School of Communication Sciences and Disorders, over an 18 month period will be reviewed to outline auditory impact of such clients.

**Background:** Canadian Concussion Guidelines suggest obtaining an audiogram for those sustaining a traumatic brain injury. While there is evidence that head trauma can have an impact on the peripheral hearing mechanisms, it generally requires significant head trauma to induce temporal bone fractures, resulting in either conductive or inner ear damage. In contrast, clients suffering mild concussions can experience significant auditory difficulties including difficulty hearing in the presence of background noise, localizing sounds, loss of enjoyment of music, balance and sound sensitivity issues (including tinnitus, hyperacusis). These conditions can interact with other sensory and cognitive deficits that can cause clients to isolate themselves resulting in job loss, social isolation and depression.

**Methods:** Client audiological data from the last 18 month period will be reviewed and summarized to analyze patterns and trends within behavioural and evoked potentials including auditory middle and late latency responses along with auditory P300.

**Results:** Results indicate that clients with auditory complaints after concussion display varied behavioural and evoked potential responses.

**Conclusions:** Audiology complaints resulting from concussion cannot be appreciated by pure tone audiogram only. Advanced testing in the form of behavioural and evoked potentials are recommended in order to help delineate a rehabilitation plan and monitor outcomes. Recommendations include changes to the Canadian Concussion Guidelines will be discussed.

# The effect of Environmental Noise on Speech Recognition Threshold Results Obtained with the Canadian Digit Triplet Test

Christian Giguère, Myriam Grenier, Véronique Fugère, Josée Lagacé University of Ottawa

**Objectives:** To determine the maximum environmental noise level in which the Canadian Digit Triplet Test (CDTT) can be administered without affecting results when used for speech screening in public areas.

**Background:** A Canadian English and French version of the digit triplet test has recently been developed by the University of Ottawa and Toronto (Ellaham et al. 2016, Canadian Acoustics 44(3), 220-221) using the ICRA test development guidelines (Akeroyd et al. 2015, Int. J. Audiol. 54, 17-22). A list of 24 digit triplets (e.g., 5-2-8) is presented in a 65-dBA masking noise and the listener is asked to enter the digits heard on a keypad. The test uses an adaptive procedure to find the speech recognition threshold defined as the signal/noise ratio at which 50% of triplets are correctly identified. The test requires little practice and can be administered in less than 5 minutes, making it ideal for speech screening.

**Methods:** French speaking adults with normal hearing were tested with the French male and female voices of the CDTT using supra-aural (Radioear DD45) and circum-aural (Radioear DD450) earphones while immersed in environmental noise at different levels (none, 60, 70 80 dBA). Two cohorts of 16 participants were tested, one in noise from a crowded shopping centre and the other from a busy hospital pharmacy.

**Results:** Recognition thresholds were unaffected by shopping centre noise up to 60 dBA of noise when using the supra-aural earphones, and up to 70-80 dBA when using the circum-aural earphones, consistent with the difference in attenuation between the two earphone sets. Testing in the pharmacy noise is ongoing.

**Conclusions:** Use of supra-aural earphones is adequate for testing in quiet offices and public areas with noise levels not exceeding 60 dBA. In busy public areas with noise levels up to 75 dBA, use of circum-aural earphones is needed.

# The Effect of Age On Speech in Noise Performance Measured With the French Version of the Canadian Digit Triplet Test.

Josée Lagacé, Alexandra Cameron, Lauren Desormeau, Véronique Vaillancourt and Christian Giguère,

School of Rehabilitation Sciences, University of Ottawa, Ottawa, Ontario

**Objectives:** This study aims to evaluate the effect of age on the speech in noise performance measured with the French version of the Canadian Digit Triplet Test.

**Background:** Speech perception gets adversely affected in the presence of competing noise. The importance of evaluating speech perception in noise within regular audiological evaluations of adult and children populations has been advocated for some years.

A Canadian English and French version of the Digit Triplet Test (CDTT) has been developed by the University of Ottawa and Toronto (Ellaham et al. 2016, Canadian Acoustics 44(3), 220-221) using the ICRA test development guidelines (Akeroyd et al. 2015, Int. J. Audiol. 54, 17-22). The test uses an adaptive procedure to find the speech recognition threshold defined as the signal-to-noise ratio at which 50% of triplets are correctly identified.

**Methods:** The speech recognition threshold of 48 normal hearing French speaking children was measured with the CDTT. Two lists of 24 digit triplets (e.g., 5-2-8) were presented in a 65-dBA masking noise. The listeners were asked to enter the digits heard on a keypad.

**Results:** Consistent with previous studies conducted with other speech in noise tests, recognition thresholds in noise measured with the CDTT was lower for the group of 8-9 years old (n=24) compared to 11-12 years old (n=24). Comparisons with adult normative data (previously published) will be presented, as well as test-retest reliability of the CDTT.

**Conclusions:** The CDTT requires little practice and can be quickly administered, making it ideal for measuring speech in noise performance in children.

#### Verification of Frequency and Amplitude Modulation Discrimination Tests on iPad-Based Psychoacoustic App Suite (iPaas)

Jordana Costa Soares<sup>1,</sup>, Winnie Ly<sup>1</sup>, Sangamanatha Ankmnal Veeranna<sup>1</sup>, Chris Allan<sup>1,2</sup>, Sheila Moodie<sup>1,2</sup>, Vijay Parsa<sup>1,2,3</sup>, and Prudence Allen<sup>1,2</sup> National Centre for Audiology, Western University<sup>1</sup>, School of Communication Science and Disorder, Western University<sup>2</sup>, Department of Electrical and Computer Engineering, Western University<sup>3</sup>

**Objectives:** To compare non-speech auditory frequency and amplitude modulation discrimination thresholds between a Gold-standard Tucker-Davis Technologies (TDT) measurement and the same thresholds measured using an iPaas application

**Background:** Auditory discrimination is the ability to identify differences in sounds, and it is important for understanding speech in quiet or in the presence of background noise. Currently, non-speech auditory discrimination tests are used for research purpose, however, these useful tests are not available clinically. Non-speech auditory discrimination tests may provide additional information about the auditory processing in individuals with listening difficulties.

**Methods:** A total of 21 normal hearing adults participated in this study. 20 adults participated in the comparison of the frequency discrimination test (0.5, 1, 2, 4 kHz) and 10 in the amplitude modulation discrimination test (20, 32, 100, and 200 Hz). A three-alternative forced choice method was used to obtain frequency and amplitude modulation discrimination tests on the TDT and the iPaas system. Stimulus characteristics and test procedures were similar between both systems.

**Results:** In an overall way, frequency discrimination thresholds were similar between the two pieces of equipment. There were no significant differences in amplitude modulation thresholds between both systems.

**Conclusions:** Frequency discrimination and amplitude modulation thresholds obtained with both systems were close to those reported in the literature. The iPaas application can generate appropriate signals and achieve similar measurements as the research-utilized TDT equipment. It is proposed that the iPaas system provides a clinically useful way that audiologists can investigate the auditory processing abilities in individuals with listening difficulties. Further research is needed in order to provide larger sample sizes and with the inclusion of research participants with hearing loss and auditory processing difficulties.

## Creation of an Auditory Processing Disorder Screening Test for Canadian French-Speaking Children Marie-Pier Pelletier CHU Sainte-Justine

**Objectives:** To develop a screening test (ST) to identify Canadian French-speaking children that are at risks of an auditory processing disorder (APD).

**Background:** APD results in listening difficulties and is present in about 2 to 3 % of schoolaged children. APD evaluation is based on a test battery assessing different auditory processing skills. To date, there is no validated APD ST available in French. Such a ST would lead in early identification of children in needs of a complete APD evaluation.

**Methods:** Participants. Twenty-one children met the following inclusion criteria: (1) aged between 7 and 13 years old; (2) with hearing thresholds within 0-15 dBHL from 250 Å 8000 Hz in both ears; (3) without known neurological disorder (ex. epilepsy, head trauma). Those with non-medicated attention deficit and/or with intellectual disabilities were excluded. Material. The ST comprised (1) two questionnaires filled by the parents and teachers of the participants and (2) four behavioral tests: (a) 10 of two-pair dichotic digits, (b) 15 monaural presentations of a frequency identification pattern test, (c) 10 monosyllables in noise in each ear and (d) a digit memory span test.

Procedures. Children who met the above criteria were assessed with the ST, before completing the clinical test (CT) battery.

**Results:** Among the 21 participants, three failed at least two ST and CT. Among the 18 remaining participants, 11 passed all the four ST, six failed only one ST and one failed two ST. None of the participants failed the CT and did not fail the ST.

**Conclusions:** These preliminary results suggest that failing two or more of the ST might be a good criterion to predict children at risk of presenting APD and to be referred for a full APD evaluation. They are promising to collect further data.

## Audiological Results Following Cartilage Tympanoplasty

Brendan McDonald, MA, MCISc & Allan Ho MBBS, MSc, FRCSEd(ORL-HNS), FRCSC Edmonton Ear Clinic, Sherwood Park, AB

**Objectives:** The aim of this study is to assess hearing improvement following cartilage tympanoplasty procedure.

**Background:** Chronic middle ear disease includes a wide variety of symptoms such as otalgia, otorrhea, impaired balance, and hearing loss. In patients with a perforated tympanic membrane, tympanoplasty is the surgical procedure performed to patch the perforation. Re-establishing an intact tympanic membrane can eliminate disease and improve hearing.

**Methods:** 15 patients presenting with subtotal perforations in ENT OPD at the Grey Nuns Community Hospital and the Edmonton Ear Clinic. All reported patients had normal bone conduction thresholds ( $\hat{a}_{W}$ ¥25 dB HL). Pre-operative audiometry was completed before tympanoplasty and approximately 3 months post-operatively.

**Results:** Closure rate was 93% with tympanometry indicating normal ear canal volume measures. Mean PTA gain was 21 dB HL with significant improvements noted from 250Hz to 4000Hz. Improvement was greatest in the lowest frequencies and less towards the higher frequencies.

**Conclusions:** Cartilage tympanoplasty results in successful restoration of middle ear status and subsequent hearing improvement. Surgical intervention proves an important role in both medical management and audiological rehabilitation.

## Cochlear Implantation and Treatment of Tinnitus In Single-Sided Deafness: A Systematic Review Brendan McDonald Edmonton Ear Clinic

**Objectives:** The aim of this study is to perform a systematic review of the literature regarding the efficacy of cochlear implantation for relief of tinnitus symptoms in patients with single-sided deafness.

**Background:** Single-sided deafness (SSD) is defined as a significant unilateral hearing loss with normal (or near normal) hearing contralaterally. SSD often presents with tinnitus which can be debilitating in some cases. Tinnitus treatment can either be sound-based or focused on psychological reaction (Tinnitus Retraining Therapy). Cochlear implantation can provide access to sound-based treatment for persons with SSD.

**Methods:** CINAHL, PubMed, PsychInfo, and Cochrane Library databases were searched from their dates of inception to June 28, 2018 using keywords SSD, tinnitus, and cochlear implantation (and synonyms). 163 articles were identified in the databases from the search terms, of which 21 were included for review after meeting eligibility criteria. Subjects from these articles were only included in the analysis if they had preoperative tinnitus and <30 dB HL in the contralateral ear.

**Results:** Critical evaluation of 21 studies included data extraction of patient age, pure-tone averages of implanted and contralateral ears, implant manufacturer, tinnitus outcome measures, and study follow up duration. Tinnitus outcome measures were analyzed and summarized across all studies. 93% (n=151) found an improvement in their tinnitus compared to preoperative levels, 6% (n=10) had no improvement, and 1% (n=1) found their tinnitus to be worse.

**Conclusions:** Cochlear implantation in patients with single-sided deafness provides an effective treatment solution for tinnitus. Current evidence base supports cochlear implantation for SSD with debilitating tinnitus; however, further high-quality studies and randomized control trials are needed.

## Novel Usage of Assistive Technology to Boost the Outcome in Post Lingual Adult Cochlear Implant Users

Dr.Mohd Ayas University of Sharjah & University Hospital Sharjah

**Objectives:** 1. Cochlear Implants(CI) in post lingual adults 2. Improving the communication with the use of Assistive listening devices(ALDs) 3. Create awareness among audiologist about the use of ALDs with CI

**Background:** Cochlear implants (CI) are widely accepted method of restoring the hearing for those with hearing loss, which is due to congenital or acquired conditions. The challenges are doubled in doing CI in acquired hearing loss, especially in post lingual hearing loss conditions. The expectation levels will be high in these groups. However, majority of them still face communication difficulties in challenging situations after CI.

**Methods:** The aim of the current topic is to highlight the importance of using Assistive Listening Devices (ALDs) in day to day life of post lingual adult CI users in order to enhance their communication abilities. Also the expertise and experience of the author will be shared with the audience who works with a multicultural population of CI users.

**Results:** The use of ALDS in Post lingual adult CI users exponentially improved the speech perception abilities in challenging situations, especially in class room situations in university level students as well as in work place settings. The outcome of ALDs usage is promising in clients seen in a tertiary care clinics, who deals with multicultural population in which language diversity plays and major role in the hindrance of communication.

**Conclusions:** At the end of the presentation, the audience will be able to understand the importance of adding ALDS in CI users, specifically post lingual CIs, which in turn excel in their communication needs

## Effect of Wireless FM System on School Life in Children with Cochlear Implant

II Joon Moon, MD, PhD, Young Sang Cho, MD, Sung Hwa Hong, MD,

PhD

Department of Otorhinolaryngology-Head & Neck Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine

**Objectives:** The purpose of this study was to investigate the effect of frequency modulation (FM) system of cochlear implant (CI) users on emotional and behavioral aspects as well as listening ability in noise in daily school life.

**Background:** Most pediatric CI recipients may experience speech recognition difficulties in acoustically challenging situations and environments, and this may affect their school life.

**Methods:** Eleven children were enrolled who had used CI for more than one year, and all were fitted with personal CI-FM system. All of the enrolled children underwent Hearing in Noise Test (HINT) at the time of enrollment, then started to use the FM system for 6 months in the actual school life. Follow up evaluation was performed after 6 months comprising of three separate investigative measures: (1) a teacher and children questionnaire to assess educational performance, (2) self-report type Behavior Assessment System for Children 2nd (BASC-2) test, and (3) teacher-report type BASC-2 test.

**Results:** Use of FM system showed significant improvement of speech reception performance in multi-talker babble noise condition. Self-report type BASC-2 revealed significant improvement of attention subcategory by use of the FM system for 6 months. Teacher report form showed improved school problems and behavior symptom index. Although no statistically significant difference was found regarding the academic achievement, scores for language subjects tended to be better than those for the other subjects.

**Conclusions:** Use of the wireless FM system in school-aged children with CI improves speech perception in multi-talker noise. Six-month use of the system may lead to improved attentiveness, hyperactivity, behavior and emotion in their school life, and this result should be considered during counselling in CI clinic

#### Use of a Remote Microphone in Schoolchildren with Unilateral Hearing Loss Mondelli, MFCG, Jacob, RTS Department of Speech Language Pathology and Audiology. Bauru School of Dentistry, University of São Paulo

**Objectives:** Was to evaluate the effectiveness of a Remote Microphone (RM) adapted bilaterally in patients with UHL in relation to speech perception, sustained auditory attention and participation in class.

**Background:** Design: the participants included 11 children diagnosed with severe/profound sensorineural UHL between 5 and 17 years of age, enrolled in regular school and hearing aid users by the Department of Clinical Speech Pathology

**Methods:** After adjustment of the RM system, the children immediately performed the following: speech perception through the Hearing in Noise Test (HINT), participation in class by "Classroom Participation Questionnaire" (CPQ) and the Sustained Auditory Attention Ability Test (SAAAT). The evaluations were conducted in four different conditions: only with hearing aids in the affected ear; hearing aids and RM system in the affected ear; hearing aid in the affected ear and RM system in both ears; and hearing aids in the affected ear and RM system in the normal ear. To not affect the learning in the evaluations, different conditions were applied with an interval of 15 days and again after three months of effective use of the devices. ANOVA and t-test were used for statistical study.

**Results:** the study of the HINT results was performed by analysis of three-way ANOVA for repeated measures, which confirmed the difference between the intervention factors (hearing aids / RM system), position (front noise, left noise, right noise, noise behind and compound noise) and time (first evaluation / at 3 months) and the significant interaction between these three factors. The comparative analysis of the results obtained in the CPQ showed significant differences in the t-test statistical analysis (P = <0.001) for all subscales: understanding of the teacher"; "understanding of colleagues"; and "positives and negatives aspects. The two-way ANOVA for repeated measures used in the study for the SAAAT results revealed differences between the intervention and time, and both interacted significantly.

**Conclusions:** The survey participants showed superior results with the RM system used in all evaluations, suggesting effectiveness of this device associated with hearing aids for individuals with UHL.

#### Patient Satisfaction with Hearing Aids and Machine Learning Technology in Real-Life Listening Environments

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**Objectives:** This study examines the effectiveness of the new Widex EVOKE hearing aids in a range of real-life situations, compared to patients own hearing aids. Patient satisfaction while streaming is also examined, as is use of a machine-learning algorithm as a means of patient-driven fine-tuning in real-life sound environments to optimize sound quality and performance in real time.

**Background:** The new Widex EVOKE hearing aid platform was recently launched with machine learning technology - a world's first. Early evidence suggests users prefer the EVOKE instruments and it's associated features over existing technology. This study aims to examine this in greater depth.

**Methods:** This study will be conducted at multiple clinics across Canada, with up to 25 subjects. Target subjects are experienced hearing aid wearers, with various hearing loss configurations. Subjects will evaluate their current hearing aids and WIDEX EVOKE 440 RICs. Subjects will assess both sets of instruments in their own daily lives and fill out survey questions (based on the MarkeTrak IX questionnaire) 4 times over a 7 week period (rating their own instruments and the EVOKE instruments 2x each over that span).

**Results:** We are particularly interested in learning whether the Widex EVOKE hearing aids will give users greater overall satisfaction compared to their own hearing aids, particularly in challenging environments, including restaurants, large lectures halls, and outdoors in wind. Satisfaction while streaming will also be evaluated, along with an app-based machine-learning tool that allow patients to personalize their hearing aid settings in real-life situations. Preliminary evidence suggests increased hearing satisfaction when using EVOKE hearing instruments alone and along with the machine-learning app.

**Conclusions:** We expect that this study will demonstrate the effectiveness of Widex EVOKE's advanced features in real-life situations, resulting in higher satisfaction levels compared to subjects own hearing aids, particularly in challenging environments.

## Does Objective Audiometry Can Predict Subjective Satisfaction in Patients with Hearing Aid?

Woo Ri Choi, Jun Woo Park, Eun Jeong Hwang, Yeo Ra Ha, Jong Woo Chung, Woo Seok Kang Department of Otolaryngology-Head & Neck Surgery, Asan Medical Center, University of Ulsan College of Medicine

**Objectives:** This study was aimed to find out which objective audiometry of the HA can be used to maximize subjective satisfaction in patients with HA.

**Background:** Hearing impairment degrades the quality of life causing poor communication, limited social activities, disability to protect oneself and even psychological depression, especially in elderly patients. Hearing aid (HA) is a crucial tool to make communication free and convenient for patients with hearing loss. Several audiometries are used to adjust the HA to obtain appropriate benefit, but patients often complain of various inconveniences after wearing a fitted HA. To achieve successful HA efficacy, it is important to confirm if the HA is well satisfying patients.

**Methods:** Twelve patients with moderate hearing loss and 8 patients with moderately-severe hearing loss were included in this prospective clinical study. All of the patients used the ITC (In the canal) type of WIDE7 HA provided by BSL. We performed Korean version of Hearing Handicap Inventory for the Elderly (K-HHIE) and K-IOI-HA (Korean version of International Outcome Inventory for Hearing Aids) before and 1, 3, 6 months after wearing a HA. We also performed pure tone audiometry (PTA), speech audiometry (SA), functional gain (FG), hearing in noise test (HINT) and central auditory processing disorder tests; frequency pattern test (CA-f), duration pattern test (CA-d), dichotic test (CA-Di). Patients were divided into two groups (group A-HHIE : improved, group B-HHIE : same or worse) by comparing the score of K-HHIE before wearing a HA and 6 month later. In the 6 month-K-IOI-HA questionnaire, 21 points were known as the average score. Based on this, we also divided patients into two groups (group A-IOI : higher than 21, group B-IOI : same or lower than 21). Age and initial audiometry results were evaluated with independent samples t test. Repeated measures ANOVA was used to analyze the differences of objective tests between the groups.

**Results:** Patients mean age was 62.5 years. Group A-HHIE included 6 patients and group B-HHIE included 14 patients. There was no statistically significant difference in age and unaided hearing between two groups. Group A-HHIE showed statistically significant improvement in CA-f. In PTA, SA, HINT, CA-d and CA-Di, Group A-HHIE showed higher improvements than group B-HHIE, which was not statistically significant.

Group A-IOI included 12 patients and group B-IOI included 8 patients. There was no statistically significant difference in age, unaided and aided audiometry results between two groups.

**Conclusions:** Patients with increased K-HHIE score showed better improvements in all audiometries. But there was no statistically significant and consistent audiometric test to reflect patients satisfaction with a HA, except for frequency pattern test of CAPD. According to K-IOI-HA questionnaire consisting of 7 questions about HA use rates and social value, patients with higher score did not necessarily show better audiometric results. There are other factors influencing HA satisfaction in real life situations such as fitting discomfort, cost, cosmetic and stigmatizing concerns. Therefore, the objective hearing test alone cannot sufficiently reflect the satisfaction of the patient with wearing a HA.

## Clinical Usefulness of Speech Mapping for Verification of Hearing Aids

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**Objectives:** To evaluate the usefulness of speech mapping based on real ear measurement for routine hearing aid verification and to compare with functional gain for evaluating subjective satisfaction of hearing aid users.

**Background:** Functional gain have been used as a tool to verify the performance of linear hearing aids for many years. But, its use on nonlinear hearing aids requires extra precaution.

**Methods:** Twenty two participants with bilateral symmetric (<10dB) sensorineural hearing loss were enrolled in this study. Baseline pure tone threshold and speech discrimination score (SDS) were obtained in each participant. All participants were fitted unilateral hearing aid with speech mapping using NAL-NL2 formula. (Aurical, GN otometrics) Two weeks after initial fitting (1st follow up), aided pure tone threshold, aided SDS, the difference between target gain and real ear aided gain using speech mapping and subjective satisfaction via K-IOI-HA questionnaire was checked and further verification was performed. One months after 1st follow up (2nd follow up), we checked same parameters. We analyzed correlation of each parameter at 1st and 2nd follow up with K-IOI-HA score.

**Results:** Average age of all participants was  $69.5\hat{A}\pm11.0$  years. Unaided, aided at 1st follow up and aided at 2nd follow up pure tone threshold were  $55.0\hat{A}\pm14.9$ ,  $37.4\hat{A}\pm10.9$  and  $31.3\hat{A}\pm8.9dB$  HL, respectively. Also, Unaided, aided at 1st follow up and aided at 2nd follow up SDS were  $78.4\hat{A}\pm16.3$ ,  $91.0\hat{A}\pm8.2$  and  $94.0\hat{A}\pm6.0\%$ , respectively. Every sequential threshold and SDS were significantly improved after hearing aid verification. (all p<0.01) In the analysis of correlation between K-IOI-HA and each parameter, aided pure tone threshold and aided SDS did not show significant correlation with subjective satisfaction in 1st and 2nd follow up. But, the difference between target gain and real ear aided gain in speech mapping showed significant negative correlation with satisfaction score in various loudness environment. (r=-0.626 to - 0.704, all p<0.01)

**Conclusions:** Speech mapping using real ear measurement was useful to expect subjective satisfaction of hearing aid users and it would be valuable tool for fine tuning to achieve individual preferences.

### Middle Ear Implants in the Elderly: Five Years' Experience at the Seoul Veterans Health Service Medical Center

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**Objectives:** To compare audiological benefits in the elderly who underwent MEI surgery between preoperation and postoperation. To evaluate the experience of 31 patients who underwent MEI surgery.

**Background:** The elderly population has increased dramatically, and so the hearing impairment of the elderly has emerged as a major problem.

Middle ear implants are suitable for those with a mild-moderate mixed or conductive hearing loss or a sensorineural hearing loss. A middle ear implant is a more recent hearing implant, offering an alternative to conventional hearing aids.

**Methods:** Records of patients who received MEI surgery at the Seoul Veterans Health Service Medical Center. Preoperative and postoperative bone and air-conduction thresholds, auditory gain, and speech discrimination were compared.

**Results:** The range of hearing benefit shown by functional gain in patients with implantable middle ear implants (median) was 20.5 dB. Median preoperative unaided word recognition was 62% at 60 dB HL, improved postoperatively to median 78% correct at 65 dB HL and 85% at 80 dB HL

**Conclusions:** MEI could be one of the safe and reliable treatment options available for auditory rehabilitation in the elderly. Since veterans healthcare population has high hearing difficulty prevalence rate due to its' high proportion of the elderly, implantable middle ear implants carries an important role in case of conventional hearing aids are ineffective to provide audiologic gain.

A Semi-Implantable Active Bone Conduction Device for Single Sided Deafness, Conductive, and Mixed Hearing Loss: Performance and Quality of Life at 12 months Julija Adamonis, MSc (Appl), Leah Smith MA, CCRA, Ken Williams, MSc, Nils Gritters, BSc, Matthew G. Crowson MD FRCSC, Euna A Hwang MD FRCSC, Trung Le MD PhD FRCSC, Vincent Lin MD FRCSC, Joseph Chen MD FRCSC Sunnybrook Health Sciences Centre, Toronto, ON

**Objectives:** The objective of this study was to prospectively assess speech and quality of life outcomes with an active, semi-implantable bone-conduction auditory prosthesis indicated for patients with conductive or mixed hearing loss (CMHL), as well as single-sided deafness (SSD).

**Background:** This device is a relatively recent alternative to bone-anchored or passive bone conduction systems like bone conduction headbands or contralateral routing of signal hearing aids. Our centre was the first in Canada to use this device as an alternative to the other devices.

**Method:** 49 patients, 31 CMHL and 18 SSD, were implanted with a transcutaneous active bone conduction device; ages ranged from 19 to 78, (mean age 48.8). All patients underwent preoperative testing including air and bone conduction audiometry in pure tone and speech, high resolution CT scanning and health related quality of life questionnaire assessment. Interaural attenuation measurements and the adaptive Hearing In Noise Test (HINT) with noise at 0, 90, and 270 degrees and speech at 0 degrees azimuth was also collected with the SSD patients. Follow up was performed at 1, 6 and 12 months post activation.

**Results:** Significant functional gain was demonstrated across all testing frequencies from 500 to 4,000 Hz in the CMHL group post-operatively, ps<.02. For SSD patients, there was a significant improvement ps<0.003 in aided thresholds which were obtained with the good ear plugged and muffed, but the mean signal-to-noise ratio on the HINT showed no significant differences when the device was compared on to off. Preoperative to 12 month post-operative HUI3 scores demonstrated significant improvement over time for CMHL group (ps<.001), but no significant improvement for the SSD group. Significant improvements were realized in all subsets of the SSQ (ps<0.001) for the CMHL group and the SSD group (p = .0.2). Mean tinnitus handicap measured by the THI revealed no differences preoperatively to 12 months postoperatively, and none of the patients who did not have tinnitus prior to implantation reported developing tinnitus post-operatively.

**Conclusions:** Results suggest that this active bone conduction device, while showing overall improvements in quality of life measures and functional gain for both SSD and CMHL patients, is truly only a preferred choice for CMHL patients as it does not improve signal-to-noise ratios for SSD patients. It remains a viable and promising option for those with the appropriate indications.

## Change of Video Head Impulse Test Parameters after Intratympanic Gentamicin Injection in Intractable Meniere's Disease

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**Objectives:** This study was to determine changing pattern of vestibule-ocular reflex (VOR) gain of each semicircular canal in Head IMpulse Paradigm (HIMPs) and saccades in Suppression Head IMpulse Paradigm (SHIMPs) for intractable Meniere's disease patients after intratympanic gentamicin injection (ITGM).

**Background:** ITGM is a well-accepted means to treat intractable Meniere's disease because of feasibility and long-term results. ITGM affect to VOR gain of each semicircular canal and it can be measured by HIMPs. And SHIMPs evaluate anti compensatory saccades that imply residual vestibular function. But, there are a few studies about results of HIMPs and SHIMPs after ITGM in Meniere's disease. We hypothesized that VOR gain or saccades could be one of the prognostic factors in Meniere's disease after ITGM.

**Methods:** 16 patients suffering from definite Meniere's disease treated by ITGM were retrospectively reviewed. We conducted HIMPs, caloric test and pure tone audiometry (PTA) in all patients and SHIMPs in 5 patients each before ITGM and 1 month after ITGM. Patients were followed up 1, 3, 6 months after ITGM. We defined VOR gain difference as an amount of decreased gain during 1 month after ITGM. Patients were classified into two groups: single injection vs multiple injections. Multiple injections group had poor vertigo control in 6 months that required second or third ITGM later in follow up period.

**Results:** The patients mean age was  $59.44\hat{A}\pm14.79$  (min: 40 years, max: 83 years). 6 patients were included in multiple injections group and 10 patients were included in single injection group. In 16 subjects, six didn't have canal paresis on the affected ear before ITGM. VOR gains of each semicircular canal in the treated side were decreased in all patients (p<0.05). Mean VOR gain differences of the treated side were  $0.32\hat{A}\pm0.21$ ,  $0.18\hat{A}\pm0.22$  and  $0.26\hat{A}\pm0.19$  in each horizontal, anterior and posterior canal plane. And VOR gain difference of horizontal canal plane were higher than those of anterior canal plane (p<0.05). Change of canal paresis value was correlated with VOR gain difference of horizontal canal plane (P<0.05) but not of vertical canal plane. Subjects increased threshold more than 10dB in PTA were two and they were all multiple injections group.

Between two groups, mean VOR gain differences of each canal plane were lower in multiple injections group than single injection group, but it was not statistically significant (p>0.05). In 5 patients who were conducted SHIMPs, the amplitudes of anti-compensatory saccade were decreased in 3 of 5 patients including one subject in multiple injections group and two subjects in single injections group. And other two subjects in single injections group showed increased anti-compensatory saccade after ITGM.

**Conclusions:** Our results suggest that ITGM caused a significant decrease of VOR gain in all patients treated with ITGM. However, ITGM appears to cause a differential loss of function across the three canals in the injected labyrinth. Although it was not statistically significant, if VOR gain difference is relatively low after initial ITGM, patients might have poor vertigo control and be required another ITGM.

#### Cerebellar Ataxia with Auditory Neuropathy and Vestibular Areflexia. A New Variant of CANVAS Syndrome? Elsaeid AliEldin KAMC

**Objectives:** None of the previous studies highlighted the occurrence of hearing loss with intact sensory and motor functions in CANVAS, accordingly, we present here a case report of a unique type of hearing loss in addition to absence of sensory or motor neuropathy.

**Background:** Patients with a combination of bilateral normal peripheral hearing with selective bilateral vestibulopathy and cerebellar ataxia were first described in 1990

**Methods:** Bedside vestibular examination and monothermal ice caloric test. Brain MRI Pure tone audiometry Otoacoustic emissions.

Results: ANSD

**Conclusion:** Assessment of vestibular function in addition to cochlear function using ABR and OAEs should be performed to look for other variants of CANVAS cases

Long-term Effect of Cochlear Implantation on Vestibular Function and Residual Hearing Jeong Hun Jang1, Oak-Sung Choo1, Hun Yi Park1, Yun-Hoon Choung1,2 Department of Otorhinolaryngology1,, Ajou University School of Medicine, Bk21 Plus Research Center for Biomedical Sciences, Ajou University Graduate School of Medicine2,

**Objective:** The insertion of electrodes into the scala tympani carries the risk of impairing the vestibular apparatus. This study evaluated the long-term effects of CI on vestibular function and residual hearing.

**Methods:** A total of 143 patients with CI were divided into three groups: Group I(n=65) with normal preoperative caloric function, Group II(n=37) with preoperative normal waveform in cervical-vestibular evoked myogenic potential testing(c-VEMP), and Group III(n=48) with preand postoperative pure-tone averages were available. Bithermal caloric tests, c-VEMP tests, and pure-tone audiometry were performed preoperatively and again at 3 months (3m), and 6 months(6m) postoperatively.

**Results:** In Group I, prevalence of unilateral weakness on the implanted side was 7.7% and 12.3% at 3m and 6m post-CI. While the total slow-phase velocity (SPV total; warm and cold stimulations) was significantly different at 3m post-CI (P=0.011). Subjective dizziness was associated with cochleostomy and steroid administration. The shift in the SPV total was significantly correlated with the thresholds of 125 Hz and 250 Hz at 3m post-CI. In Group II, the prevalence of an abnormal waveform on the implanted side was 16.2% and 20% at both 3m and 6m post-CI. In Group III, the SPV total on the implanted side was significantly greater among the patients, with a threshold shift<20 dB HL than those with a threshold shift>20 dB HL, at 3m post-CI (P=0.026).

**Conclusion:** CI is a relevant risk factor for damage to vestibular function. Vestibular function should be also afforded equal and simultaneous consideration in terms of preservation.

### Introducing the new Sound Sense video: A project of Western University's Audiology Class of 2019

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**Objectives:** In this presentation we will share how the Western University's Audiology Class of 2018 collaborated to update The Hearing Foundation of Canadas hearing awareness Sound Sense video which is included as an important component of the Sound Sense: Save Your Hearing for the Music program. This program fills an important educational need since research shows that 86.5% of adolescents engage in at least one high-risk noise activity.[1]

The Sound Sense program established in 2005 and seen by thousands of students each year, complements the educational curriculum of Grades 4 to 6. While being offered nationally, Sound Sense has been delivered in recent years by 2nd year audiology students at Western University to schools within the London and surrounding areas.

Recently the audiology students have noted that the 10-minute video portion of the program would benefit from important updating and as part of their course CSD9523 students took this on as a major project.

This provided the professor for the course (S Moodie) an opportunity to educate her class about the important components of instructional design that might be useful to them after graduation. Using the ADDIE framework [2] the students were provided with a systematic process that could be used to achieve their desired outcomes for the development of the video AND the implementation / evaluation of the video in educational settings.

This presentation will describe each step of the ADDIE process undertaken including:

Analyzing the Issues with the current version of the video as well as analyzing the educational needs of the learners;

Designing Learning Objectives and Educational Goals;

Developing / creating the Sound Sense Video (2018 Edition);

Attendees will be provided with a viewing of the video created by the students.

Finally plans for Implementation and Evaluation (the last 2 steps of the ADDIE process) of the Sound Sense video will be provided along with lessons learned by CSD9523 students.

References:

[1] Warner-Czyz, A. D., & Cain, S. (2016). Age and gender differences in children and adolescents attitudes toward noise, International Journal of Audiology, 55:2, 83-92, DOI: 10.3109/14992027.2015.1098784

[2] Branch, R. M. (2009). Instructional Design: The ADDIE model. New York: Springer

#### **Community Hearing Awareness Outreach Program**

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**Objectives:** The purpose of this presentation is to create Universal hearing awareness, especially in underserved communities of developing world. We present a model of Audiology services at grassroots level and highlight the challenges, limitations and follow up of delivery model. The effort is to train local healthcare personnel to conduct pure tone audiometry and keep a record of baseline audiograms, followed by Hearing Health care Providers.

**Background:** Audiology is nearly nonexistent in Pakistan, a population of approximately 200 million. 67% of the population reside in rural areas and rely on available health care services in their respective jurisdictions. Audiology services are very limited across the country. Most of the hospitals do not have basic audiometry services. Some major Private hospitals have limited services at an exuberant price. There are approximately 20 foreign trained, Master level qualified Audiologists in the country of 200 million people i.e. one Audiologist per 10 million people. Whereas, the country has advanced medical and surgical options for health care but the field of Audiology has been introduced quite recently in the past 5 years. There are 5 undergraduate programs in Audiology with little mentorship opportunities.

**Methods:** We initiated this project 5 years ago with the support of my wife, Farkhanda Sajjad, an ESL instructor and a social worker in Calgary.

We selected a small village, Nara Sagri, District Attock, Pakistan. It is about 160 KM from the residential city of Islamabad, Pakistan. The village population is approximately 5,000. I used my personal portable Interacoustics Audiometer, AD 25, an Audio Scan for Real Ear measurement, Otoscope and Cerumen management equipment. We initiated with Community Hearing Outreach program for hearing assessment only and soon realized the immense gap in the services and affordability of hearing aids.

**Results:** I am a registered Physician in Pakistan, my first home and registered Audiologist in Canada. We have been able to test 150 individuals, both men and women, Seniors and children. We were able to diagnose type of hearing loss, provide medical prescriptions if needed and referred to local ENT Specialists for surgical interventions. For sensorineural hearing loss, select and dispense used hearing aids to 50 eligible candidates for years 2016 & 2017. (Courtesy, Canadian Donors at Miracle Ear Canada Clinics)

**Conclusions:** There is a need to create hearing health awareness in developing world and work towards achieving early hearing Detection and professional follow up. Efforts are needed to train local health care workers to perform basic audiometry.