Dear Colleagues,

In this special issue of the "*Journal of Hearing Science*", you will find the abstracts of all the oral presentations, poster presentations, structured sessions, workshops, and keynote lectures of the 13th Congress of the European Federation of Audiology Societies, which takes place in Interlaken, Switzerland. A large variety of research areas, concepts and ideas is covered here by more than 200 contributions. They range from topics which are important today in everyday exams in children and adults, such as tympanometry or hearing screening, to intriguing and promising new concepts, such as hearing with light or brain-computer interfaces in audiology, which might become very relevant in the future.

This meeting of the European Federation of Audiology Societies (EFAS) is an ideal event to exchange ideas and proposals and to discuss audiologic topics in a relaxed atmosphere. Interlaken provides an ideal and stimulating venue for such a meeting. I am sure that you will not only hear interesting talks and see great posters from well-known researchers, but that you will have many stimulating talks with colleagues from many different countries.

The congress is organized by audiology group of the ENT-department of the University Hospital of Bern. The latter is locally better known by the name of "Inselspital" and has been founded in 1354. Personally, what I find most amazing is that today, more than 660 years later, the hospital is not only still running, but attracts more patients and its research is more innovative than ever before. With the work at our hospital and the University of Bern and our contributions to different research areas in hearing bone conduction hearing aids, the development of the implantable hearing system DACS, or robotic cochlear implantation, we hope to contribute to this effort and success and to be part of this local drive for the benefit of our patients. The organization of a large international audiologic congress, such as EFAS 2017 is an important part of our dedication and a way to give back some of the support we have received from various individuals and institutions over the past years.

Welcome to EFAS 2017!

Prof. Dr. med. Dr. sc. techn. Martin Kompis

Congress President, 13th Congress of the European Federation of Audiology Societies in Interlaken, Switzerland

Dear Colleagues,

Warm greetings from EFAS to all with an enthusiasm for ears and hearing. Many European Countries collaborate through EFAS; on *www.EFAS.ws* you can read our Mission statement; find professional Audiology contacts and consider possibilities for cross border research/ staff and student exchanges, or apply for EFAS Congress scholarships to facilitate younger Audiologists to travel and share their work. Climb mountains, both real and theoretical, with us in beautiful Interlaken in June, *www.efas2017.org*

Istanbul in 2015 was where EFAS shared the spirit of East meeting West with their new Audiology degree programme being launched; then in 2016, many European Audiology Academics visited Cork, Ireland and shared progress with e-learning and even kissed the Blarney Stone – vital for scientific communicators! An EFAS grant-funded Israeli project on e-learning has had 'technical hitches'; truthfully, technology changes so rapidly now that technical solutions 'upgrade' every 2 years. Friends & colleagues remain our best resource in the Audiology learning curve.

EFAS, over many years, has encouraged training and professionalism in European Audiology degree programmes, including advocacy. There are many interesting Working Groups with some research in progress in School Screening. In 2019, EFAS are heading to Lisbon for some guaranteed sunshine. And we sincerely hope to meet again, in person as well as 'virtually'.

Dr. Theresa Pitt

Au.D., M.Sc., Chairperson EFAS 2017

13th Congress of the European Federation of Audiology Societies, June 7–10, 2017, Interlaken, Switzerland

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WORKSHOPS

Workshop WS01 | Hearing 4 All

W01

Hearing4All: Developments from the Cluster of Excellence for Audiology in Europe

Speakers: Birger Kollmeier, Oldenburg, DE, Thomas Lenarz, Hannover, DE, Ania Warzybok, Oldenburg, DE, Andreas Büchner, Hannover, DE, Simon Doclo, Oldenburg, DE

Chairs: Birger Kollmeier, Oldenburg, DE, Thomas Lenarz, Hannover, DE

Introduction to the cluster of excellence Hearing4All.

Hear the future with implantable hearing devices: clinical, otological, and technological aspects.

Multilingual speech tests and their application for international field studies and comparison between theory and experiment.

Highlights from Hearing4all for patients with auditory implants.

Highlights from Hearing4all for patients with hearing aids and the subclinical population.

Workshop WS03 | School-age hearing screening and pediatric audiology

W02

Report of the EFAS Working Group on School-Age Hearing Screening

Speakers: Jan Wouters, Leuven, BE, Jan de Laat, Leiden, NL, Sam Denys, Leuven, BE, Tom Francart, Leuven, BE

Chairs: Jan Wouters, Leuven, BE

KU Leuven, Department of Neurosciences, ExpORL, Leuven, Belgium

An overview will be given of the activities of the EFAS Working Group on School-Age Hearing Screening since the last EFAS congress. The outcomes of the working group meetings will be reported and plans presented for a multi-country EFAS initiative of hearing screening in children. In the two following contributions the development and evaluation of a new screening test, which will be used as a common denominator in this collaboration, will be reported.

W03

Hearing loss in children and the development of on-line non-speech hearing screening for school-aged children

Jan de Laat[1], Marya Sheikh Rashid[2], Laura Sels[2], Wouter Dreschler[2], Sam Denys[3], Jan Wouters[3]

(1) Leiden University Medical Centre
(2) Academic Medical Centre
(3) KU Leuven

Neonatal hearing screening programs do not identify all childhood hearing impairment. The prevalence of permanent hearing loss ranges from 1‰ to 2‰ shortly after birth and doubles in the following period until about 8 years of age (Fortnum, 2011). Screening at later ages is imperative, given the detrimental consequences of untreated (acquired) hearing impairment early in life, resulting in speech, language, and cognitive development disorders. Until now hearing screening programs at school show many shortcomings in different European countries. The EFAS European consensus states that children aged 4–7 years are the primary target population for school-age hearing screening. The development of reliable hearing screening methodologies is a major focus in our research. Speech-in-noise tests, such as digit triplet tests, have proven to be reliable self-screening instruments that accurately distinguish between individuals with hearing impairment and normal hearing. Whereas their outcomes are quite comparable across different languages, differences remain due to recordings of different speakers in different languages. A non-speech sound-in-noise test might offer a solution and pave ways for international comparisons, given its language independence. Such a test (the Sound Ear Check) was developed at the Leiden University Medical Centre and the Academic Medical Centre in Amsterdam. This is a 9-AFC test, accessible through internet, in which common sounds are presented in noise (with a fixed level of 65 dB SPL) at adaptively varying signal-to-noise ratios (SNR). The sounds are connected to easily recognizable pictures. Preliminary experiments show reliable test–retest results.

W04

Optimization and evaluation of a language-independent hearing screening test based on sound-perception-in-noise

Sam Denys[1], Jan De Laat[2], Wouter Dreschler[3], Laura Sels[3], Michael Hofmann[1], Jan Wouters[1]

(1) KU Leuven
(2) Leiden University Medical Centre
(3) Academic Medical Centre

The development of reliable hearing screening methodologies is a major focus in our research. Speech-in-noise tests, such as digit triplet tests, have been proven reliable self-screening instruments that accurately distinguish between adults with hearing impairment and normal hearing. However, for young children (at school-entry), such a test might be too challenging as it requires knowledge of the written representation of numbers and loads memory capacity. A sound-in-noise test (the Sound Ear Check), in which sounds are presented in noise at adaptively varying signal-to-noise ratios (SNR), was developed at the Leiden University Medical Centre.

This paper reports on the optimization and evaluation of this test in normal hearing and hearing impaired adults across two investigational sites (KU Leuven and Amsterdam Academic Medical Centre).

From a database of 30 sounds, 9 were selected (albeit low-pass filtered) based on their spectro-temporal characteristics resembling speech. In the optimization phase, the rms-equalized tokens were presented at fixed SNRs of 0 to –18 dB SNR to 20 normal hearing adults, using our software platform APEX. Psychometric curves were fitted to these data. Speech reception thresholds and slopes were comparable across sites and on average –13.2 dB SNR and 14.7%/dB, respectively. Level adjustments needed to obtain perceptually homogeneous tokens and, as such, a steeper psychometric function of the overall test, were all below 2 dB. In the evaluation phase, reference values, training effects, test reliability and validity were quantified. Also, an evaluation of the images representing the different sounds of the test was done in 5–6 year old children. Data collection is still ongoing at the moment of abstract submission and will be presented at the conference.

Should this test have acceptable precision and discriminate reliably between normal hearing and hearing impaired persons, it might be a useful common reference across many countries and allow efficient prevalence estimates of (childhood) hearing impairment based on a large dataset by hearing screening via mobile devices (apps) or the internet.

W05

VIRATO, a simulator and training module for child audiometry

Tom Francart[1], Arjan Bosman[2], Chris Halpin[3], Jeroen Hermans[1], Jan Wouters[1]

(1) KU Leuven, Department of Neurosciences, ExpORL, Leuven, Belgium
(2) Radboud University Medical Centre, Nijmegen, The Netherlands
(3) Department of Audiology Massachusetts Eye and Ear, Harvard Medical School, Boston

Free-field audiometry of young children requires a lot of practice and expertise of the audiologist. To facilitate the training of non-experienced clinicians and students, a simulation program has been developed. VIRATO (VIsual Reinforcement Audiometry Training mOdule) is a simulation program for the training of free-field audiometry of children. The module interactively displays segments of video recordings of real-life audiometric measurements. The software will be presented and demonstrated.

Workshop WS04 | Audiology and intellectual disability

W06

*EFAS Working Group on Audiology and Intellectual Disability (in alphabetical order: Eva Andersson[1], Siobhan Brennan[2], Frans Coninx[3], Melissa Cravo[4], Madalina Georgescu[5], Katrin Neumann[6], Melina Willems[7])**

(1) Dept of Audiology, Gothenburg University, Sweden
(2) University of Manchester and Sheffield Teaching Hospitals, UK
(3) Institut für Audiopädagogik, Solingen, Germany
(4) Centro de Educação e Desenvolvimento Jacob Rodrigues Pereira, Casa Pia de Lisboa, Portugal
(5) Carol Davila University of Medicine and Pharmacy, Bucharest, Romania
(6) Dept of Phoniatrics and Pediatric Audiology, Clinic of Otorhinolaryngology, Head and Neck Surgery, Ruhr-University of Bochum, Germany
(7) University College Arteveldehogeschool Ghent, Belgium

Background: Ear and hearing problems are more common in persons with intellectual disability (ID) than in the general population. Prevalence numbers from a couple of studies range between 10% and 66%, mostly around 25% (Hild et al. 2008), depending on the etiology of the ID; for persons with Down syndrome they range between 28% and 73%. These problems may add a considerable portion to the communication difficulties people with ID face in general. Ear and hearing problems in people with ID are usually not mentioned by themselves and often not known to their caregivers. The EFAS Working Group on Audiology and Intellectual Disability wants to advocate for this underserved and often undertreated population among audiologists and the public.

Material and methods: The Working Group (WG) has collected relevant literature on the topic. Furthermore, the group has developed a questionnaire and distributed it among EFAS' National Representatives in order to gather information on the status of screening and follow-up assessment of ear and hearing problems in persons with ID across European countries. Moreover, guidelines for timeline of ear and hearing screening in people with ID have been developed by the WG and will be presented to the audience.

Results: Audiologists from 22 European countries have replied the questionnaire. Its preliminary outcome confirms that only in a few countries programs focus on the ear and hearing problems of persons with ID. Large-scale programs for screenings and regular checkups are lacking in most countries. The guidelines, which will be discussed with the audience, focus on the implementation of ear and hearing screenings and their timelines – depending on age, etiology, and other factors – on a European level that might be adopted for various national levels.

Conclusions: Ear and hearing problems establish a considerable communicative obstacle for persons with ID and call for regular checkups and intervention by audiologists and medical professionals.

Hild U, Hey C, Baumann U, Montgomery J, Euler HA, Neumann K (2008). High prevalence of hearing disorders at the Special Olympics indicate need to screen persons with intellectual disability. J Intellect Disabil Res 52, 520-528.

* Funded by EFAS.

Workshop WS05 | Cochrane reviews workshop: why should I get involved and what will I need to do?

W07

Deborah A Hall

National Institute for Health Research (NIHR), Nottingham Hearing Biomedical Research Unit, Nottingham, UK

As a busy clinician, it can be challenging to find reliable and up-to-date sources of information to inform your evidence-based practice. Cochrane methods generate the most reliable and up-to-date knowledge of what treatments work in health care. Cochrane reviews can therefore help in clinical decision making.

This workshop will introduce you to the Cochrane, describe what resources are available, and explain the steps of developing a new systematic review, or updating an existing review. As this is the last workshop of the day, I'll take a very informal and interactive style. Please do join me!

KEYNOTE LECTURES AND STRUCTURED SESSIONS

Keynote Lecture 01 | Economic impact of hearing loss and relation with public health

S01

Speaker: Shelly Chadha, WHO

Chair: Theresa Pitta, Wexford, IR

Hearing loss is a public health issue which often remains unnoticed and is commonly disregarded by individuals and policymakers. Unaddressed hearing loss has a significant impact on many aspects of life including language development, cognition, communication, education, employment, psychological wellbeing and social integration. Most of these impacts have economic consequences, for individuals, governments and the society as a whole. However, WHO estimates that 60% of childhood hearing loss can be prevented through public health measures and those who have hearing loss can benefit greatly from early identification and appropriate interventions. Evidence shows that strategies aimed at prevention of hearing loss and screening for early identification are cost effective. The use of hearing devices, including hearing aids and cochlear implants has a positive impact on quality of life and can result in economic benefits to both, the individual and the society. Understanding the economic costs associated with hearing loss as well as the potential costs which may be avoided can be powerful pieces of information that help policymakers allocate resources. The World Health Organization has focussed on hearing loss as a public health problem and works with the aim of making ear and hearing care accessible to all. Its activities focus on advocacy to increase global awareness on this subject as well as technical support to national governments and partners for planning, implementing and monitoring ear and hearing care strategies.

Keynote Lecture 02 | Hearing with light

S02

Speaker: Tobias Moser, Göttingen, DE

Chair: Birger Kollmeier, Oldenburg, DE

When hearing fails, speech comprehension can be restored by auditory prostheses. However, sound coding with current prostheses, based on electrical stimulation of auditory neurons, has limited frequency resolution due to broad current spread. We aim to improve frequency and intensity resolution of cochlear implant coding by establishing spatially confined optical stimulation of spiral ganglion neurons (SGNs). We have established optogenetic stimulation of the auditory pathway in rodents using virus-mediated expression of channelrhodopsins to render SGNs light-sensitive. Optogenetic stimulation of spiral ganglion neurons activated the auditory pathway, as demonstrated by recordings of single neuron and neuronal population responses at various stages of the auditory system. Fast opsins enabled SGN firing at physiological rates (hundreds per second). We approximated the spatial spread of cochlear excitation by recording local field potentials in the inferior colliculus in response to suprathreshold optical and electrical stimuli, which suggested a better frequency resolution for optogenetic than for electrical stimulation. Towards characterizing the percept induced by cochlear optogenetics we studied activation of neurons in primary auditory cortex and performed a behavioral response in virus-injected gerbils. Behavioral thresholds of light amplitude were found to be below physiological thresholds (<3 mW, close to the threshold of the neurons in auditory cortex) and thresholds of light pulse duration were as short as 0.1 ms. This study demonstrates that stimulation of channelrhodopsin-expressing spiral ganglion neurons with blue light creates both a stable physiological response and a robust auditory percept over several weeks. In summary, optogenetic stimulation of the auditory nerve is feasible and bears substantial potential for future application in research and hearing restoration.

Keynote Lecture 03 | Implantable BC aids

S03

Auditory implants for conductive and mixed hearing loss; an objective evaluation of their capacities and limitations

Speaker: Ad Snik, Nijmegen, NL

Chair: Jan Wouters, Leuven, BE

In the field of technical aural rehabilitation, treatment options are expanding caused by, among others, the success of cochlear implants (CIs). Through the years, several different types of auditory implants have been brought to the market like middle ear implants, percutaneous bone conduction implants, passive and active transcutaneous bone conduction implants and devices that directly stimulate the cochlea acoustically. Unfortunately, several introduced devices were not a success, resulting in frustrated patients and investors.

From published systematic reviews it is concluded that results are variable, group size is often small and the evidence level is limited, owing to the study design. Our recent research was aimed at a classification of such auditory implants concerning efficacy, for patients with conductive and mixed hearing loss. We published the data on a website; www.snikimplants.nl, developed for professionals. This makes the data easily accessible and they can be uated if needed.

Next we reviewed published systematic reviews. Most recent systematic reviews concern a specific device without

a proper comparison with alternative devices. Furthermore, a common problem when describing audiological outcomes is the use of the 'functional gain' (unaided versus aided sound-field thresholds). By its definition, this measure is directly related to the width of the air–bone gap. The 'effective gain' is the better choice (aided thresholds minus cochlear thresholds), enabling a direct comparison between devices and a comparison with target gain values as prescribed by e.g. the popular NAL-NL fitting rule.

Manuscripts that were selected by the authors of the recent systematic reviews, presenting audiological outcomes, were re-considered; 43 manuscripts could be included, altogether representing more than 700 patients. The evaluation showed that differences in 'effective gain' between implantable devices was present, however, limited when compared to the high variance between implant centres. Compared to the NAL prescription rule, in mixed hearing loss cases, the 'effective gain' was acceptable at 2 kHz (concerning Codacs, the most powerful Baha/Ponto devices and VSB). For conductive hearing loss the spread in results was the largest and the measured 'effective gain' was negative in all cases what indicates that functionally, the air–bone gap was not closed. All devices showed a rather steep roll off in 'effective gain' at frequencies above 2 kHz and below 1 kHz.

In conclusion, variance between clinics was too large. Realising that technological achievements in this field are impressive despite the limitations of today's implantable devices, a pragmatically adapted NAL fitting rule is proposed. The aim of introducing this rule is to reduce the differences between implant centres. Furthermore, it should be noted that today's acoustic implants are not simple equivalents in terms of efficacy. Application areas in terms of the maximum allowable sensorineural hearing loss component are introduced.

Structured Session 01 | Age-related hearing loss: new knowledge for an aging population

S04

Speakers: Paolo Gasparini, Trieste, IT, Marlies Knipper, Tübingen, DE, Anna Fetoni, Rome, IT

Chairs: Josef Syka, Prague, CZ, Isabel Varela-Nieto, Madrid, ES

Age-related hearing loss, presbycusis, is the most frequently occurring sensory abnormality associated with aging. A steady growth of life expectancy will lead to a rapid increase in the number of older people with expressed presbycusis. The etiology of presbycusis is multifactorial, comprising effects of noise exposure, ototoxic drugs, inflammation, and last but not least, genetic factors. Traditionally presbycusis was described as a complex of pathological changes appearing in the inner ear in the process of aging. At present, we understand presbycusis to be a complex of changes occurring in the whole auditory system (and in the case of speech perception, in the non-auditory part of the brain as well). Modern genetics have contributed significantly to our understanding of several hearing deficits, and recent genome-wide association studies have demonstrated a highly polygenic character of age-related hearing loss. Age-related pathological vulnerability is present in the outer hair cells, inner hair cells and especially in their ribbon synapses that contact auditory nerve fibers, but also in neurons of the central auditory system. From a functional point of view, in addition to increased hearing thresholds, presbycusis is characterized by a decreased quality of the temporal processing of sounds, as well as of decreased space hearing. A poorer performance in suprathreshold speech understanding, and in the temporal processing of sounds with age, has been previously linked with progressing inner hair cell synaptopathy, which precedes the age-dependent elevation of auditory thresholds. The results of many recent studies, show that presbycusis is connected with a decrease in the inhibitory function of neurons in the central auditory system, combined with defects in the function of neurons containing calcium binding proteins. Furthermore, long-term hearing deprivation can impact cognitive performance by decreasing the quality of communication, leading to a social isolation and depression. The aim of this structured session, is to inform about contemporary knowledge on presbycusis, on the basis of results of animal experiments, as well as audiological and psychoacoustical observations, along with the results of imaging studies in humans, and genetic studies, in both animals and in humans.

Structured Session 02 | Cochlear implants and implantable hearing devices in single-sided deafness

S05

Speakers: Ona Bø Wie, Oslo, NO, Liat Kishon-Rabin, Tel-Aviv, IL, Andrej Kral, Hannover, DE, Griet Mertens, Antwerp, BE, Thomas Wesarg, Freiburg, DE, Thomas Keintzel, Wels, AT, Stephanie Rühl, München, DE, Mario Zernotti, Córdoba, AR

Chairs: Susan Arndt, Freiburg i. Br., DE with Rainer Linus Beck Freiburg, DE

Cochlear implantation in unilateral deafness and asymmetric hearing loss is becoming increasingly important as an established therapeutic option for auditory rehabilitation in adults and children. The round table will provide an interdisciplinary view of single-sided deafness. It addresses both the problems caused by unilateral deafness in children and adults as well as the physiological and psychological consequences of single-sided deafness.

In addition, the different therapeutic options and their long-term results will be discussed. The particular requirements for fitting and speech therapy following treatment are also of special interest.

Through this interdisciplinary approach of the round table, the therapy of the single-sided deafness as integrated therapy is presented with regard to the International Classification of Functionality (ICF).

Structured Session 03 | Towards optimal cochlear implants: A session in honor of Prof. Norbert Dillier

S06

Speakers: Martin Kompis, Bern, CH, Norbert Dillier, Zürich, CH, George Tavartkiladze, Moscow, RU, Andreas Büchner, Hannover, DE, Clemens Zierhofer, Innsbruck, AT

Chairs: George Tavartkiladze, Moscow, RU, Martin Kompis, Bern, CH

In the past three decades, the importance of cochlear implants, the number of implantations, and the results obtained have all increased. Cochlear implants have made a difference in the life of a growing number of users. In the last four decades, many scientists have contributed to this development. In this structured session in honor of Norbert Dillier, who was undoubtedly one of the pioneers in the cochlear implant research, selected areas of research to which he has contributed significantly are discussed by leading experts in the field.

Objective measures, such as eCAP and eAEP were unknown in the beginning of cochlear implant era, but meanwhile, have been available for many years and are widely used in clinical routine, helping to improve the fitting process and finally to improve the utility of the cochlear implant systems to the users. Still, there may be more benefit for the users, which remains either untapped or not widely used.

Advances in coding strategies have contributed significantly to the improvement in speech understanding of the users in quiet and in noise. Nevertheless, speech understanding with cochlear implants does still not reach the levels of normal hearing, which might be seen as the ultimate aim of any hearing prosthesis. Work on new and better coding strategies has lost nothing of its importance. Leading experts in the field explain from different points of view what has been reached so far, and how future coding strategies might improve speech understanding in different everyday conditions even further.

S07

Electrically evoked auditory potentials: From auditory nerve compound action potential to cortical responses

George A. Tavartkiladze, Vigen Bakhshinyan, Marina Goykhburg, Tatiana Chugunova

National Research Center forAudiology and Hearing Rehabilitation

Background: The objective measures at the different stages of cochlear implantation are of the primary importance especially in pediatric population. The neural response telemetry (NRT) which is of the primary importance for monitoring of cochlear implant and auditory nerve fibres functioning at the surgery stage and during the rehabilitation process does not provide enough information about functional integrity of the auditory pathway higher levels.

Material and methods: 100 patients with cochlear implants were included in the analysis (63 with Cochlear; 37 with AB). The age of patients varied from 2.7 to 37 years. NRT/NRI was performed in all patients, the combined registration of the eCAP and eABR (in 10 patients) and registration of cortical responses (in 43 patients). For combined eCAP and eABR measurements the Volta software connected to the Interacoustics ECLIPSE system was used. The electrically evoked cortical response registration to speech stimuli was performed with HEARLab device and the software module for Aided Cortical Assessment.

Results: In recovery function investigation the correlation between the auditory nerve refractoriness parameters and patients individual stimulation frequency preferences (for experienced CI users) was obtained. Spread of excitation was significantly narrower in case of perimodiolar electrode placement which could suggest better differentiation (discrimination) with this location. The significant decrease of stimulation threshold level was also obtained. The combination of eCAP and eABR measures resulted in an overall estimate of electrode-to-nerve interface quality and the ability of each contact to deliver focused stimulation. Relevance of these measures as a tool for objective prediction of CI programming parameters was then evaluated by comparison to speech intelligibility scores (in adults) and speech therapist's reports (in children). Special attention was drawn to the dynamics of amplitude/latency parameters of cortical responses after the switch-on of the speech processor and 3 and 6 months after first fitting. The significant increase of the amplitude and decrease in the latency of P1 peak was obtained.

Conclusions: Introduction of different classes of electrically evoked responses from auditory periphery to auditory cortex will provide an objective control of the functional integrity of the auditory pathway and the rehabilitation effectiveness in children after cochlear implantation.

S08

Advances in coding strategies for cochlear implants

Clemens Zierhofer[1], Reinhold Schatzer[2], Michael Staudacher[1], David Lanthaler[1], Michael Kupfner[1], Viktor Steixner[1], Andreas Griessner[1]

(1) Institute of Mechatronics
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Background: Stimulation according to the "Continuous Interleaved Sampling" (CIS) concept is first of all based on the tonotopic principle. Temporal information is reduced to the envelope representation of the individual stimulation channels.

Material and methods: Stimulation based on "Channel Specific Sampling Sequences" (CSSS) represents both envelope- and temporal fine structure information. CSSS

utilizes high rate biphasic pulses which are triggered by zero-crossings of individual stimulation channels and weighted with the instantaneous envelopes. In a typical setting for a "Fine Structure Processing" (FSP) strategy, CSSS channels at lower frequencies (apical electrodes) are combined with CIS channels at higher frequencies (basal electrodes). For a precise representation of temporal cues with stimulation pulses with reasonably long phase durations, supporting concepts such as simultaneous stimulation in combination with "Channel Interaction Compensation" (CIC) and the n-of-m type "Selected Groups" (SG) concept are employed.

Results: Electric-acoustic pitch matching experiments with single-sided deaf implant recipients indicate that the tonotopic representation of information is less pronounced for electrodes with an insertion angle greater than about 360 degrees. However, the poorer tonotopic representation in this region can be compensated by adequate low frequency temporal stimulation. On the other hand, low frequency temporal stimulation does not lead to low pitch perception, if the electrodes are not inserted sufficiently deep. In many patients with sufficiently deep inserted electrodes, switching from CIS to FSP causes a subjective pitch shift towards lower frequencies (up to 5 semitones). In acute comparisons, speech perception with FSP is on a par with standard CIS. However, substantial improvements in speech perception are demonstrated after long-term experience with FSP.

Conclusions: FSP strategies can in fact improve the hearing performance of cochlear implant users. However, some improvements such as an enhanced speech perception are not immediate but appear after a comparatively long learning phase. Advantageous effects for the perception of low-frequency sounds in any case require both sufficiently deeply inserted electrodes and adequately low-frequency temporal cues.

Structured Session 04 | Brain–computer interface and audiology

S09

Speakers: Ed Lalor, New York, US, Søren Fuglsang, Copenhagen, DK, Tom Francart, Leuven, BE, Stefan Debener, Oldenburg, DE

Chairs: Stefan Debener, Oldenburg, DE, Tom Francart, Leuven, BE

People with hearing impairment often have problems understanding speech in noisy situations. This is due to a degraded ability to segregate sound sources. Rehabilitation strategies with auditory prostheses involve either assisting the auditory system to segregate sources by emphasizing the important acoustic cues, or by segregating sources in the device using sophisticated signal processing. In this session, we will focus on the latter, and in particular their interaction with the individual user's preferences.

Current acoustic signal processing algorithms are well on their way to be able to filter out a specific sound source of interest from an auditory scene. However, this poses a new problem: which of the many sound sources in an auditory scene should be enhanced, i.e., which is the source of interest? This information is only available in the user's brain. Therefore new ways are needed to interface with the user. This could be a simple as a control on a smartphone, or as complex as a system that decodes brain responses recorded with EEG to decide with sound source should be enhanced. In this session, a number of techniques will be discussed to do the latter.

Starting from a new method for unobtrusively recording EEG signals (Stefan Debener), which is an important prerequisite for practical application of such techniques, studies will be presented on decoding auditory attention to a specific speaker (Søren Fuglsang), decoding the combined effect of attention and visual input (Ed Lalor), and combining attention decoding with realistic hearing aid noise suppression (Tom Francart).

Structured Session 05 | Spatial listening and new developments in hearing aids

S10

Speakers: Michael Akeroyd, Nottingham, UK, Henrik Gert Hassager, Kongens Lyngby, DK, Tobias Neher, Oldenburg, DE, Michael Stone, Manchester, UK, Benjamin Dieudonné, Leuven, BE, Bill Whitmer, Glasgow, UK

Chairs: Michael Akeroyd, Nottingham, UK, Jan Wouters, Leuven, BE

Accurate spatial hearing is crucial to the perception of the auditory world as "real". However, hearing impairment affects for the worse spatial hearing. A recent comprehensive review (Akeroyd and Whitmer, 2016) demonstrated that hearing-impaired listeners have somewhat poorer left–right discrimination than normal-hearing listeners, although there is considerable variation across listeners and experiments. The current data for the effects of hearing aids show that (with the exception of unilateral fitting, which is very definitely detrimental), their effects are often slightly worse, but certainly not better. There is no hearing aid feature or design that has, so far, unambiguously been shown to give a benefit over some alternative. Further, hearing-impaired listeners are prone to front–back confusions, but current hearing aids do nothing to reduce these and sometimes increase them. However, this somewhat gloomy conclusion is based on past or current hearing aids. Spatial hearing is an important and thriving area of hearing aid research, with much exciting happening now and excellent prospects for new advances in the future. This Special Session will give an overview of what is known now, report some of the latest developments in hearing aids that target spatial hearing, and then conclude with the new domains of bimodal listening and conversational listening.

S11

Binaural effects in speech understanding for bimodal cochlear implant listeners

Benjamin Dieudonné, Tom Francart

KU Leuven

Background: Spatial separation of speech and noise can improve speech intelligibility, due to the use of interaural differences. For normal-hearing listeners, different mechanisms are responsible for spatial release from masking. Firstly, spatial separation increases the signal-to-noise ratio (SNR) in one ear: the "better ear". Secondly, listening with two ears (instead of the better ear only) yields an extra binaural benefit in speech intelligibility: squelch. Mostly, squelch is attributed to binaural decorrelation and/or spatial attention (i.e., binaural mechanisms). Spatial attention is said to be most important for informational maskers. For bimodal cochlear implant listeners, it is not clear which of these mechanisms are responsible for spatial release from masking. We hypothesize that no binaural mechanisms are responsible for spatial release from masking in bimodal listeners. We hypothesize that speech intelligibility in noise is merely determined by the signal-to-noise ratios delivered by the cochlear implant and the hearing aid.

Material and methods: Bimodal hearing was simulated with a noise vocoder at one ear, and a low-pass filter at the other ear. A Flemish matrix sentence test was used to measure speech reception thresholds. We investigated three different maskers, spectrally matched to target speech: speech-weighted noise (SWN), a competing talker and modulated SWN with the same temporal envelope as the competing talker. In a first experiment, we measured spatial release from masking for different spatial setups and compared monaural (cochlear implant only) with binaural (bimodal) situations. Spatial hearing was simulated with head-related transfer functions. In a second experiment, we varied the broadband noise level at both ears independently to investigate their relative importance in speech intelligibility.

Results: Spatial release from masking was mainly determined by the signal-to-noise ratio at the vocoded (cochlear implant) ear; the bimodal benefit was determined by the signal-to-noise ratio at the low-pass filtered ear.

Conclusions: Spatial release from masking for bimodal listeners was merely determined by monaural signal-to-noise ratios. As long as interaural time differences remain unperceptible for bimodal cochlear implant listeners, it is therefore not necessary to take into account binaural mechanisms in sound processing strategies to improve speech understanding; improving monaural signal-to-noise ratios should be the main objective.

Structured Session 06 | Speech audiometry and new developments in electronic-assisted audiology

S12

Speakers: Birger Kollmeier, Oldenburg, DE, Aarno Dietz, Kuopio, FI, Karen Banai, Haifa, IL, Cas Smits, Amsterdam, NL, Stefan Launer, Stäfa, CH

Chairs: Birger Kollmeier, Oldenburg, DE, Josef Attias, Petah Tiqva, IL

Closed-set speech recognition tests like the Digit triplet test ("one-three-eight") or the Matrix test ("Peter buys ten wet shoes") are rapidly gaining importance both for hearing screening and professional audiological diagnostics. One of their key features is the option to input the recognized speech items not by verbally repeating them to the test conductor, but by depressing the appropriate response alternative in a closed-set response format. This makes the tests not only ideal for a multilingual community, where the patient can be tested with her/his own native language which the test conductor does not understand himself, but also makes the tests accessible to smartphone-based or tele-audiological solutions where the patient can perform the tests independently from an instructor. This turns the multilingual closed-set speech recognition tests into key enabling factors for e-audiology.

This session will therefore start with a review talk by B. Kollmeier on the current state of developing and assessing these tests in most major languages (currently, 16 languages are available for the matrix test format). Innovative and accurate, automatic-speech-recognition based prediction methods are meanwhile available that help to perform consistency checks of the obtained test results with the current prediction derived from the audiogram or other available individual test data. To demonstrate a best use case of such a test in clinical audiology, A. Dietz will present the developments performed with the Finnish version of the matrix test and its clinical applications for different patient groups. K. Banai will discuss the adaptive determination of accelerated speech recognition as a way to assess not only peripheral factors, but also central learning effects in speech recognition which might be applicable to e-audiology as well. Finally, C. Smits will discuss the currently most widely used test for e-audiology, i.e., the Digit Triplets Test and its diverse applications ranging from hearing screening tests for telephone or internet applications towards occupational health assessment tools. Finally, the future perspectives of e-audiology in the context of the current research, clinical, regulatory and commercial developments will be reviewed and discussed by S. Launer (Phonak).

Taken together, the session promises to highlight some of the foundations and corner stones of emerging solutions for self-paced methods for multilingual speech audiometry that promise to become future standards in a rehabilitative audiology. Evolving solutions in e-audiology, computer-assisted speech audiometry, and patient-centered modern audiometry will be highlighted as well.

Structured Session 07 | Novel treatment options for chronic tinnitus

S13

Speakers: Tobias Kleinjung, Zürich, CH, Pim van Dijk, Groningen, NL, Griet Mertens, Antwerp, BE, David Baguley, Nottingham, UK, Deborah Hall, Nottingham, UK

Chairs: Tobias Kleinjung, Zürich, CH, Deborah Hall, Nottingham, UK

Tinnitus is the perception of sound in the absence of a corresponding external acoustic stimulus. Many affected subjects habituate to the phantom sound, but in about 1% of all people the experience of tinnitus severely impairs their quality of life. These subjects are seeking for medical support. This session will reflect novel options for tinnitus treatment.

Most widely used treatments for tinnitus involve counselling, and best evidence is available for cognitive behavioural therapy (CBT) with or without accompanying sound therapy. The broad availability of internet access has opened new possibilities of delivering elements of counselling, CBT or sound therapy independent from therapeutic institutions and medical specialists.

D. Baguley will highlight the latest achievements of this technology. Tinnitus has traditionally been regarded as an otological disorder with a majority of tinnitus patients demonstrating a certain degree of hearing loss. A special subgroup is experiencing annoying tinnitus in combination with single sided deafness. After careful selection restoration of hearing in terms of cochlear implantation can reflect an effective treatment modality with a significant tinnitus reduction after activation of the implant. G. Mertens will report on the 10 years' Antwerp experience. Recent neuroimaging data has advanced our knowledge on tinnitus pathophysiology by revealing structural and functional changes of different brain areas. The perception of tinnitus is not only related to neuroplastic changes in the central auditory pathways. Rather synchronized co-activation of frontal, limbic, and parietal areas are important parameters for the tinnitus-related distress and emotional aspects of the tinnitus percept. Furthermore, the extended knowledge on the pathophysiological background delivers the theoretical framework for new treatment modalities for tinnitus. New insights from neuroimaging data will be provided by P. van Dijk. Direct modification of neuronal activity in terms of invasive and non-invasive neuromodulation may result in changes of tinnitus perception and tinnitus distress. Neurofeedback is one of the least invasive techniques of neuromodulation. T. Kleinjung will present a new approach called tomographic neurofeedback which aims at modulating brain activity focally in terms of an EEG analysis technique which allows source localization of the oscillations related to the auditory cortices. Clinical effectiveness of novel treatment approaches for tinnitus is judged according to change in primary outcome measures, but because tinnitus is a subjective condition, the definition of outcomes is challenging and it remains unclear which distinct aspects of tinnitus are most relevant for assessment. D. Hall will demonstrate the effort of a European research network called "TINNET". This action strives towards better understanding the heterogeneity of tinnitus to improve and develop new treatments and is funded by the COST program of the European community. This networking project is working towards creating an international standard for measuring whether a tinnitus treatment has worked.

Structured Session 08 | Tympanometry and stapedial reflexes

S14

Tympanometry, stapedial reflexes, and more: standard techniques and new applications

Speakers: Stefan Stenfelt, Linkoping, SE, Kai Uus, Manchester, UK, Kurt Stephan, Innsbruck, AT, Paulette McDonald, Robert Hong, Michigan, US

Chair: Theresa Pitt, Co Wexford, IR

Both tympanometry and stapedial reflex measures are fundamental to the practice of clinical Audiology, providing a wealth of information in a convenient form and in a short time. They are useful for the vast majority of investigations, not just for otitis media with effusion (OME); for example, for newborns with likely permanent childhood impairment (PCHI) or Auditory Neuropathy Spectrum Disorder (ANSD), adults with Alzheimers or Aphasia who are unable to describe their auditory symptoms or complete audiometry fully, and of course those with early stage Otosclerosis.

As scanning techniques have evolved, and fundamental changes in some surgical and amplification fitting processes have occurred, are we in danger of forgetting the potential of swifter and cheaper methods? Do we incorporate findings as fully as possible? Using them within a surgical context with sedated or anaesthetised Cochlear Implant subjects who might otherwise not be able to give good information is a good example.

The idea of a more general Test Battery idea will be discussed as well as looking at some of the more innovative approaches which are worth reiterating. Short talks by experienced clinicians, followed by round table discussion and question and answer will be the format.

FREE PAPER SESSIONS

Free Paper Session 01| Cochlear implants: Fitting and coding strategies

FP01

The effects of sound coder carrier rate and modulation bandwidth on voice pitch perception in CI users

Damir Kovačić[1], Danijel Nejašmić[2], Chris James[3]

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(3) Cochlear France SAS

We employed the dual filter-bank "STEP" coder to separately control the spectral and temporal modulation resolution of analysis channels. Previously we compared vowel pitch ranking and gender classification with eight subjects using enhanced modulation at F0 – including across-channel synchronised modulation – to the standard clinical ACE coder: using standard moderate carrier rates (900 to 1200 pps/channel) there was no significant improvement using modulation enhanced coding versus ACE across subjects. Neither poorer nor better performers on either task obtained a benefit from enhanced F0 modulation in the range 120 to 210 Hz.

In a follow-up experiment we looked at the effect of stimulation rate on voice pitch perception. Since there are large inter-subject differences in overall temporal pitch acuity we hypothesized that some performance in some subjects' may be more greatly influenced by carrier rate than in others, or that some subjects may find sound quality satisfactory with lower carrier rates than those used in their clinical processors. We used a version of STEP with a very short temporal envelope analysis window of 2 milliseconds which allows a very low latency real-time processing implementation and large maximum modulation bandwidth. Subjects were tested using carrier rates of 1000, 500, and 250 pps/ch with modulation bandwidths controlled via low-pass filtering.

Pilot testing indicated that the new low-latency coder provides very good sound quality compared to clinical ACE using 1000 pps/ch or 500 pps/ch. In addition the modulation bandwidth could be tuned at different carrier rates to optimize voice pitch perception based on temporal cues. This opens the potential for lower stimulation rates to be used in CI sound coding while maintaining optimal temporal resolution.

Acknowledgments: This research was supported by Cochlear, and a part of the work by DK was funded by the European Commission (FP7-CIG-2011-303927).

FP02

Comparative evaluation of a partially automated CI fitting method with the clinically established procedure

Joachim Müller-Deile[1], Andreas Büchner[2], Norbert Dillier[3], Alexander Mewes[4], Wai Kong Lai[3], Mark Schüssler[5], Nicole Neben[6], Friederike Junge[7], Matthias Hey[4]

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(5) Medizinische Hochschule, Hannover
(6) Cochlear GmbH
(7) Cochlear AG

Background: Performance with cochlear implants (CI) partly depends on fitting the sound processor parameters to the individual needs of the patients. This is time-consuming and challenging, especially with children. In an effort to provide more standardization in CI fitting and to enable less experienced audiologists to fit the sound processor more efficiently, a new tool was introduced: NFS (Nucleus Fitting Software). The method is based on automatic measurements of an ECAP threshold profile and behavioral estimates of the overall loudness and sound equalization. This study aimed to evaluate whether NFS provides CI recipients with the same hearing performance compared to the fitting procedures used in clinical routine.

Material and methods: A prospective, randomized, double-blind study was initiated at three CI centers. Two NFS modifications, NFS-5 and NFS-22, where either 5 or 22 postoperatively measured ECAP thresholds were used to estimate a threshold profile were compared with the established clinical routine procedure. 48 newly unilaterally implanted, postlingually deaf adults were enrolled and distributed among six randomization groups. The fitting procedures were permuted within each group in an ABCA sequence. Seven evaluation sessions over a 15-months period per patient allowed at least a 3-month acclimatization to the different maps. Hearing performance was assessed by questionnaires (SSQ), aided thresholds, and speech intelligibility tests in quiet and in noise.

Results: Four participants were excluded from the analysis because of clinic-related protocol deviations. Three patients left the study prematurely for private reasons and in five patients the NFS procedure had to be terminated because of clinical complications. The interim results for speech intelligibility did not reveal a significant treatment effect of the three fitting methods. The NFS-5 method may lead in some cases to inferior results.

Conclusions: For most participants the partially automated CI fitting method yielded hearing outcomes comparable to the clinically established procedures.

FP03

Evaluation of a strategy-based fitting approach

Anja Kurz[1], Griet Mertens[2], Paul van de Heyning[2], Rudolf Hagen[1]

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(2) University Department of Otorhinolaryngology, Head and Neck Surgery, Antwerp University Hospital, Antwerp, Belgium

Background: A Cochlear Implant (CI) is individually adapted using the manufacturers fitting software, in order to provide benefit in sound and speech perception. This routinely performed periodic fitting is a time consuming process which may take up a significant proportion of the relevant staff's working time. The major aim of CI centers worldwide is to achieve an optimal map efficiently with as few fitting sessions as possible. This study aimed to address the question how performance with a flat strategy based fitting (FSBF) map compares to a traditional single channel fitted (SCF) map. In particular, the study explored the feasibility, performance and subjective preference of a flat strategy based fitting map (FSBF) compared to a traditional, time consuming, single channel fitted map (SCF).

Material and methods: A cohort of experienced post lingual cochlear implant users was included in this prospective, acute, randomized multi-center study. Subjects were unilaterally implanted with a MED-EL implant using the OPUS 2 or SONNET audio processor. Maps were programmed using three different approaches: 1. FTC (Fine-tuned clinical map): the map the user had in daily use; 2. SCF (Conventional map based on single-channel beeps): map created during the study according to the MED-EL fitting guideline; 3. FSBF (Strategy-based fitting map): Map created by using a live audio signal (ISTS) at 65 dB SPL and fitting of all 12 channels simultaneously. Objective tests assessed the speech perception using the Oldenburg Matrix Sentence Test (OLSA). The subjective benefit was evaluated using a study specific visual analogue scale (VAS) scale to rate frequency perception (bass and treble) and overall preference.

Results: Preliminary results that speech perception in noise with the FSBF map is comparable to understanding with the SCF map but worse to FTC map. Spectral balance with FSBF and SCF maps, as subjectively evaluated, appears to be better as with FTC maps for low and for high frequencies. The FSBF procedure can be performed in consistently less time and was subjectively judged better in sound quality than the SCF and FTC maps.

Conclusions: The FSBF approach is time-efficient and leads to comparable results in speech perception. First results show no significant negative effects on sound quality when compared to the SCF and FTC maps.

This study was conducted as a multicenter study. Data shown were collected at the university clinics in Würzburg, Germany and Antwerp, Belgium.

FP04

Remote support for first and follow-up fittings of MED-EL cochlear implants

Kelly Schepers[1], Hans-Joachim Steinhoff[2], Karin Bauer[1], Alexander Möltner[3], Stefano Morettini[4], Thomas Stark[5], Rudolf Hagen[6]

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Tele-health is a broad term for the application of information and telecommunication technologies in the delivery of health services in cases where users are separated from healthcare providers by some distance. Cochlear implant audiology is fairly specialized, and is therefore often only available in larger cities or via 'outreach' services, which involve a specialist audiologist travelling to different sites. This can place a real burden (in terms of time and expense) on subjects who live in remote or rural locations, and their families.

MED-EL received the approval for Remote Programming within Europe and in countries recognizing the CE mark in 2009. While prior studies on subjective preference for remote or face-to-face fitting sessions have been performed, this study is the first of its kind to provide a prospective and controlled assessment of the safety and performance of the MED-EL remote programming option in children and adults. Remote programming is currently approved for any type of fitting session (first fitting and follow-up fitting) in all subjects receiving a MED-EL cochlear implant regardless of their age. Accordingly, in this study subjects of any age who are bilaterally deaf or bordering on deafness, receiving or using a MED-EL cochlear implant were recruited. This study aimed to compare the outcomes of electrophysiological testing, fitting parameters, pure tone audiometry and speech intelligibility measures. The subjects were fit via 2 procedures (remote and face-to-face) and electrophysiological parameters, pure tone audiometry and speech intelligibility outcomes were assessed acutely after each session in a standard audiological test setup at the study centers. In addition each fitting session was appraised by the remote expert, local host, and the subject via an ad hoc designed questionnaire.

Initial data gathered on subjects receiving a follow-up fitting, show a general good acceptance and a positive appraisal of the remote setting by the subjects themselves and the professionals involved. Likewise, fitting maps generated with either setting did not differ significantly and initial data on the outcomes of the two set-ups on speech intelligibility show similar performances for what concern subjects receiving follow-up fittings. In addition both the

remote and the local fitting could be performed in a similar amount of time without experiencing major delays or interruptions.

FP05

Home testing of speech recognition for cochlear implant patients: A reliable alternative to testing in the clinic

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VU University Medical Center

Background: The number of CI users, a combination of newly implanted and experienced CI recipients, is increasing annually. This results in a higher workload for the cochlear implant centres and yields a need for new and innovative ways to provide healthcare. Remote testing could be time saving for both the audiologist and the patient. We performed a study to validate newly developed remote speech recognition tests with experienced adult CI users. Currently, a user study is conducted in which newly implanted CI users perform remote speech recognition tests regularly during the first three months of their intensive rehabilitation period.

Material and methods: The standard Dutch speech recognition tests (CVC words in quiet and digits-in-noise) were implemented on a tablet and calibrated stimuli were directly presented to the processor using an audio cable. In the validation study, possible differences between stimulus presentation via a loudspeaker and an audio cable and possible differences between self-assessment (at home) and measurements by a trained clinician (in the clinic) were determined. The user study examines the feasibility and added value of remote testing in the clinical practice.

Results: The validation study showed no significant differences between speech recognition scores measured in the clinic and at home. No significant difference was found between speech recognition in quiet measured with a loudspeaker and with an audio cable. The speech recognition scores in noise obtained with the audio cable, were significantly lower (better) compared to the loudspeaker. The results of the user study will be presented in this presentation as well.

Conclusions: Remote speech recognition testing in quiet and noise is feasible in adult CI recipients. Home testing of speech recognition is a reliable alternative for speech recognition testing in the clinic.

FP06

Excitability Controlled Coding (ECC) strategy for cochlear implants: A real time implementation

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Background: The Excitability Controlled Coding (ECC) strategy for cochlear implants is based on neurophysiological properties of neural excitation, and this is now implemented using Matlab/Simulink. ECC's stimulus selection is determined using a model of the excitability state of the target neural population, and is expected to produce more efficient stimulation as well as less channel interaction. The algorithm estimates the refractory behavior of the stimulated neural populations to compute the excitability state after the presentation of each stimulus, and uses this excitability state in the selection of the next stimulus. ECC also regulates the rate of stimulation on a given channel as a function of the corresponding input stimulus intensity.

Material and methods: The ECC algorithm was implemented as a Simulink xPC model, and executed on a Speedgoat real-time hardware system with analog (microphone) input. The output is configured for real-time streaming to Nucleus implants using a Cochlear StimGen RF encoder hardware. ECC was then compared against an ACE implementation on the same hardware system using a spectral ripple test as well as adaptive sentences (OLSA) in noise. Assessments were made by 4 experienced adult CI listeners.

Results: Initial testing comparing ACE vs. ECC show marginal improvements with ECC for the spectral ripple test as well as for OLSA sentences in noise. However, these may not be the optimal tests for determining the advantages of ECC and further considerations are needed.

Conclusions: ECC is a coding strategy for cochlear implants that attempts to account for the capacity of the neural interface in transmitting encoded information. Initial results are promising, showing marginal improvements over the current ACE strategy even without much optimization and training.

Free Paper Session 02 | Pediatric audiology

FP07

Measuring auditory progress in young children with hearing loss: The validity of the Functional Listening Index

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Background: Communication outcomes from paediatric cochlear implantation are traditionally evaluated using measures of speech perception, speech production, and receptive/expressive language. Measuring a child's listening skills in their real world environments, and their ability to couple developing cognitive skill with auditory acquisition provides an opportunity to predict later language outcomes.

Aim: To investigate validity of the Functional Listening Index (FLI) to measure the listening skill development of children using cochlear implants and hearing loss.

Material and methods: Auditory progress was tracked for over 80 children simultaneously or sequentially implanted in a paediatric cochlear implant and spoken language early intervention program. Focus was on determining the concurrent, convergent and predictive validity of the FLI, in particular with regard to children implanted from 5mths of age; with additional needs; from culturally and linguistically diverse backgrounds; who accessed early intervention services <3 mths after diagnosis; as well as cochlear implantation cases outside traditional hearing loss levels including single sided deafness.

Results: Outcomes continue to be varied for children with hearing loss. Listening skills at age 2 of children who received cochlear implants by 7 months often surpassed children with later age at implant and children with lesser degrees of hearing loss using hearing aids. Results for children with single-sided deafness indicate a range in acquisition of listening skills, often despite language within the normal range. Concurrent validity showed expected differences between groups using the Mann-Whitney U and Mood's median test for the variables of additional needs and early access to intervention. Convergent validity measures indicated a strong correlation coefficient with related measures, however no evidence of a linear relationship with the others. Predictive validity measures show a moderate to strong linear relationship between FLI scores at 42mths and language scores at 5 years of age, with similar results for language scores at 4. Variances in language scores were not explained solely by the FLI indicating an enhanced predictive model requires other factors to be taken into account.

Conclusions: Given the strong convergent, concurrent and predictive validity of the FLI, it can be used with confidence by clinicians and families across a diverse range of client groups considering cochlear implantation.

FP08

Auditory evoked potentials in autistic children with normal behavioral thresholds

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Children with autistic spectrum disorder (ASD) are frequently referred for audiology examination because of delayed speech–language development. Only a small fraction of those children has concomitant peripheral hearing loss, while vast majority of them have hearing thresholds within normal limits.

The goal of our study was to analyze the features of auditory brainstem response (ABR) recordings in a group of toddlers with ASD and normal hearing thresholds.

A group of 217 young children (aged 1.5–3.5 y) with ASD was involved in complete team evaluation because of speech delay. Gender ratio was 4: 1 (173 males and 44 females). ABR examination was a part of test battery. The recordings were obtained using following stimuli: click at 35 and 80 dB as well as 4 kHz tone burst at 40 dB. Overall morphology, stability and symmetry of the recordings were evaluated, as well as some specific features of ABR in this population. Laterality of changes was analyzed as well.

The most prominent feature of ABR recording was robust wave I which was observed in 143 (66%) of subjects. Degradation and instability was present in more than half of the children in this study, 114/217 (52.38%). Bilateral changes were found in 40/217 (18.37%). Single-sided degradation and/or instability were more often seen in the left side (55/217 or 25.17%) and only occasionally in the right side (19/217 or 8.84%). Prolonged absolute latency of wave V and inter peak latency III–V were frequently observed.

Changes found in the ABR recordings of toddlers with ASD and normal hearing could suggest that speech processing is frequently affected on brainstem and subcortical levels. Delayed speech in ASD could be related to those processes as well. Further functional studies using newest imaging techniques are needed in order to explain the connection.

FP09

Attributable and relative risk factors for congenital hearing impairment: Maternal age and low birth weight of the baby

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(3) JNMC

Background: Hearing loss is the most common disability and it is observed that in 50% of the cases the cause is genetic and in the rest 50% it is due to environmental factors. Studies carried out by "Selven and Garnikal" suggested that young mothers (below the age of 20 years) and elderly prime (above the age of 35) showed a tendency to have an increasing proportion of LBW infants which is a risk factor for hearing loss. Low birth weight (LBW) is associated with long term disabilities like cerebral palsy, autism, mental retardation, visual–hearing impairment and other developmental disability. In India consanguineous marriages and early marriages are common which also results in children with congenital hearing impairment and congenital anomalies. Studies on influence of maternal age and LBW on congenital deafness are meager in India.

Objectives: In the present study we report the influence of maternal age and LBW on children with syndromic and non-syndromic deafness.

Material and methods: 743 children with hearing impairment were examined at a tertiary hospital in South India. Information on age, sex, religion, parents' occupation, and literacy, along with birth history, developmental and family history were recorded from the parent or guardian of the children using a standard questionnaire. Audiological evaluation like otoacoustic emission (OAE), Brainstem Evoked Response Audiometry (BERA), and Pure Tone Audiometry (PTA) were done to determine the type and degree of hearing loss besides physical and clinical examination. The age of the mother at delivery and birth weight of the children were recorded to correlate with hearing loss.

Results: 743 children with hearing loss, below 14 years were analyzed, and 138 (18.7%) were found to have syndromic hearing impairment. Of these 138 cases, 43 (31.16%) were found to have gestated during their teenage years, i.e. below 19 years, while 9 (6.52%) were found to be elderly primi, i.e. above 35 years of age.

Conclusions: Mother's age during gestation and LBW of child at birth are found to be important risk factors in the causation of hearing impairment. These risk factors can be prevented with good preconception and pre- and post-natal care. More studies are needed to further confirm this observation,

FP10

(Central) auditory processing disorders in children diagnosed with cleft lip palate

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Objectives: The primary objective of this study was to investigate central auditory processing disorder (CA) in children who had been diagnosed with cleft lip palate (CLP). It is known that CLP can readily cause middle ear disorders and having middle ear disorders is a risk factor for CA in the long term. This study investigated whether having middle ear disorders in the early period of life may cause auditory processing disorder.

Material and methods: 21 CLP diagnosed children and 20 children who had normal craniofacial features and normal development as a control group were included in the study. All participants were between the ages of 8 years and 11 years 11 months. Patients with CLP who were not operated on were excluded. For all participants, tympanometric status, peripheral hearing, and their auditory processing skills with SCAN-C with four subtests were evaluated.

Results: Study and control group tympanometric status, peripheral hearing, and central auditory processing were assessed and it was found that all of the CLP children also had a Type B typanogram in their early life and most of them currently had conductive hearing loss (16 out of 21). The results of SCAN-C assessment showed that the CLP group had significantly lower scores than the control group ($p<0.05$).

Conclusions: Results show that participants who had CLP achieved lower scores than the control group. According to these results it is deduced that being exposed to middle ear disorders in the early term of life may be a risk factor for having central auditory processing disorder. It may be crucial to treat middle ear disorders as soon as possible before they affect the auditory system.

FP11

Effects of degree of hearing loss and early diagnosis and device use on the developmental steps in children with prelingual hearing loss

Yusuf Kemaloglu[1], Işıl Oran[1], Melis Keskin Yıldız[1], Çağıl Gökdoğan[2]

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(2) Gazi University Faculty of Health Sciences

Background: Early diagnosis of the children with prelingual hearing loss (CPHL) is important for maintenance of developmental steps. We previously documented that Gazi Early Childhood Assessment Tool (GEÇDA) which has been developed for the assessment of developmental steps for Turkish children between 1 and 72 months is also practical tool for evaluation of developmental steps in CPHL:

significantly lower language (LD), cognitive (CD) and psychomotor developmental (PMD) scores, but no difference in social–emotional development (SED) were found in CPHL compared to age- and sex-matched hearing peers.

Aim of this study is to evaluate effects of hearing loss level (HLL) and ages of diagnosis, the starting age of using a hearing device, and special education on developmental levels.

Material and methods: Sixty-one children (M: 30, F: 31; mean age: 40.05±15.97, min: 6, max: 68 months of age) with bilateral hearing loss (the better ear was <41 dB) were taken to GEÇDA test to detect their developmental stages as normal, lower, and upper groups in PMD, CD, LD, and SED areas.

Results: It was observed that 85.24%, 75.41%, 52.46%, and 49.18% of subjects were in lower groups according to LD, CD, SED, and PMD, respectively. All developmental scores were positively correlated with durations of hearing device use and special education. It was found that late diagnostic and fitting ages (>6 months) increased the number of subjects in the lower LD group (72% vs. 94% and 57% vs. 88%, respectively). HLL was found to be effective only on CD; rate of the subjects in lower CD group was significantly higher in severe–very severe HLL group (83% vs. 58%).

Conclusions: These data support that early diagnosis and intervention is important to improve developmental steps, particularly language and cognition.

FP12

The role of medial superior olivary system on adaptive speech intelligibility in children with normal hearing

Bünyamin Çildir, Suna Yilmaz

Hacettepe University, Faculty of Health Sciences

Background: Speech stimuli are heard in the presence of environmental noise, such as amplitude, frequency, and intensity of speech, which fluctuate in acoustic and/or psychoacoustic properties over time. We understand what is said by adapting to an extraordinary adaptation to distinguish a special speech signal from the background noise. The disturbance effects, which distinguish speech from speech, depend on speech and noise parameters. In this study, it was determined the role of adaptive speech comprehension on efferent auditory system in the presence of different noise in children with normal hearing function.

Material and methods: Seven subjects aged 13 to 15 years with normal hearing were included in this study. The study was conducted in the department of audiology, Hacettepe University. After the individual audiologic evaluations were made, adaptive speech tests (frozen white noise 65 dB SPL and ICRA 4 65 dB SPL) and distortion-product autoacoustic emission (DPOAE) test (f2=4000 Hz, f1/f2=1.22) and the DPOAE test. Suppressor tones were at three frequencies (2828, 4100, 4300 Hz) with 65 dB contralateral narrowband noise were conducted to the children.

Results and conclusions: There was no significant difference between hearing thresholds and DPOAE amplitudes of right and left ear. A statistically significant difference was found between right ear DPOAE suppression and adaptive speech test ($p<0.05$). We found out that contralateral suppression values were higher when adaptive speech test signal/noise ratio was low. There was no statistically significant difference between the left ear DPOAE suppression and adaptive speech tests ($p>0.05$). This preliminary study found evidence of the role of the medial efferent hearing system on speech discrimination in noise.

FP13

Assessment of the relationship between family functioning, depression levels of parents, and child behavior check-list scores of parents and teachers with hearing-impaired children

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The aim of the study was to (a) evaluate family functioning levels and depression levels of families with hearing impaired children and (b) to determine whether there is a relationship between parents' and teachers' CBCL scores, parents' depression scores, and family functioning levels.

In this study, 50 families with hearing-impaired children were included. Validated Turkish versions of Child Behavior Check List for Ages 4–18 (CBCL) were administered to parents and teachers. In addition Beck Depression Inventory and Family Assessment Device (FAD) were administered to parents.

This study was performed to discover if there is a relationship between family functioning levels, parents' depression levels, and how parents and teachers rate items that describe specific behavioral and emotional problems in CBCL.

Free Paper Session 03 |Tinnitus

FP14

Revisiting the interpretation of a clinically meaningful treatment-related improvement in tinnitus using the Tinnitus Questionnaire (German version)

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Background: Reporting of clinical significance is welcomed because findings can be statistically significant without being relevant to patients. There is little information on which to base estimates of the minimal clinically

important change to aid clinical interpretation. To address this question, we conducted a comprehensive analysis of retrospective clinical data on the German Tinnitus Questionnaire (TQ).

Material and methods: We assessed pre- and post-intervention scores for 202 patients receiving Heidelberg Neuro-Music-Therapy. Multiple statistical estimates were triangulated to determine a minimal clinically important difference. These took into account not only patients' experience of clinical improvement, but also measurement reliability.

Results: Six different anchor- and distribution-based methods estimated the range of minimal clinically important difference between 4.6 and 21 points in global TQ change score from pre- to post-intervention. The size of the measurement error was conspicuous, as was a systematic bias towards a reduction in TQ score even in the absence of any noticeable improvement.

Conclusions: We recommend a change of at least 21 points, especially for interpreting individual patients and in the context of non-randomised or unblinded studies when patients can select or know which intervention they have received. Previous estimates may be too optimistic because they have not accounted for measurement error or bias.

FP15

Analysing the correlation between the duration and severity of tinnitus and cognitive functions

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Background: Subjective tinnitus is a phantom sound or noise perceived in the ear(s) most often described as "buzzing, ringing, crickets, whistling, humming, static, hissing, high pitch tone" which occurs in the absence of a known external stimulus. And depression, anxiety, insomnia, auditory perception problems and weakened general and mental health problems may accompany tinnitus. It is indicated by many studies that individuals with tinnitus also suffer from momentary mental concentration difficulties and experience focusing and attention problems. In addition to selective and divided attention, it is also known that the cognitive processing rate decreases and the reaction times on cognitive tasks reduce. In case of coexistence of tinnitus, hearing loss, and cognitive disorders in a patient, it becomes very hard to detect the interaction.

The objective of this study is to determine the correlation between the duration and the severity of tinnitus and cognitive functions.

Material and methods: A total number of 21 female and 20 male with chronic (>3 months) subjective tinnitus aged between 19 and 75 (49±14.1) were included in this study. After the evaluations for audiology and tinnitus were carried out, the participants were subjected to Tinnitus Handicap Inventory (THI) and Montreal Cognitive Assessment Test (MoCA). While 16 participants were determined to have normal hearing, 25 of the them were determined to have mild and slight hearing loss. The THI distribution is: level 1: 4, level 2: 5, level 3: 15, level 4: 11, and level 5: 6. The MoCA distribution is: 28 individuals normal and 13 individuals abnormal.

Results: The durations of tinnitus are determined as 6–132 months (37±31). The localizations of tinnitus are 22 unilateral (10 right, 12 left) and 19 bilateral. THI is determined in the 6–96 months gap (53.5±23) MoCA score is determined in the 11–29 gap (22.3±4.6). Between the severity of MoCA and tinnitus (Pearson correlation 0.311) and duration of tinnitus (Spearman correlation –0.251) a negative correlation is found.

Conclusions: At the end of the study, it is the determined that as tinnitus duration elongates and as its severity increases, cognitive functions deteriorate. And in addition, the importance of cognitive evaluation and addition of therapy within the therapeutic approaches to tinnitus and monitoring by related disciplines have presented itself.

FP16

Prevalence of misophonia and related factors

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Background: Misophonia, which is defined as significant distress caused by certain soft noises, has recently received an increased interest and several new studies have been published. Data presented in recent studies suggest that misophonia, which has long been known and studied in audiology literature, could be classified as a psychiatric disorder. There is no epidemiological study examining the prevalence and clinical features of misophonia in the general population. Although misophonia is known among psychology and psychiatry professionals, there is a need to learn more on its relationship with age, education, and genetic factors. Our aim was to examine the prevalence of misophonia, and its relationship with clinical and sociodemographic variables. We also wanted to find out if misophonia is best described as a psychiatric disorder, using an interview we developed for this purpose.

Material and methods: We used a random household sample (N=543) of all people over 15 living in 350 homes in Ankara city center. All participants were assessed for sociodemographic variables, sounds that they find distressing, and clinical factors that could be related to misophonia. They were given questionnaires to assess obsessive compulsive disorder, depression, obsessive compulsive personality disorder, and autistic traits.

Results: Number of people reporting a significant level of distress relating to at least one noise was 77.9% (425 people out of 543). Number of distressing noises and level of distress for each noise was higher in women than men. Misophonia total score was higher in women, as well as in younger and more educated participants. The total scores of all clinical scales used in the study positively predicted

misophonia total score. Based on the criteria we developed for this study, rate of misophonia diagnosis was 7.7% (42 people).

Conclusions: Both misophonia diagnosis and misophonic symptoms are common in the general population. The clinical presentation of misophonia in men and women differs significantly. The clinical and demographic characteristics of the misophonia category, based on our proposed criteria, support the suggestion that misophonia should be classified as a distinct psychiatric disorder.

FP17

Predictive factors for the severity of tinnitus

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Background: Tinnitus, an auditory stimulation sound that can be heard in ears or head without any external stimulation, is one of the most prevalent audiological–neuroaudiological symptoms. Age, hearing loss, noise, sex, life conditions, and stress affect its prevalance; personality and socio-economic characteristics are also factors in the annoyance of tinnitus. Hence, but the questionnaires investigating psychosomatic perception of tinnitus and tinnitus measurement parameters (tinnitus frequency and loudness, minimal masking level, and residual inhibition) help evaluation and rehabilitation of tinnitus subjects. This study aims to investigate the relationships between these parameters and identify factors associated with the severity of tinnitus.

Material and methods: A total of 99 tinnitus patients and 70 normal cases were included in the study. In this study, whole cases filled-in the questionnaires (demographic and clinical information, Tinnitus Handicap Inventory (THI), Beck Depression Inventory (BDI), and Short Form-36 (SF-36)) and they were taken under the audiologic evaluations (pure tone average, speech audiometry scores, loudness matching, pitch matching, minimal masking level (MML), and residual inhibition).

Results: At the end of the study, MML was found to be correlated with pure tone average, speech audiometry scores, loudness of tinnitus, tinnitus duration, THI, BDI, and SF-36. Particularly, in the subjects with noise-induced hearing loss, it was documented that residual inhibition rate was lower and decrease in residual inhibition was also found to be associated with tinnitus loudness. Tinnitus frequency, loudness, hearing level, noise exposure, presence of balance problems, and work stress were found to be associated factors affecting perception and complaints about tinnitus. Clear tinnitus-related sleep problems were also observed. According to THI scores, physical functions were found to be affected more than emotional functions.

Conclusions: This study determined that depression and anxiety were seen in tinnitus patients much more than normal cases and tinnitus patients' quality of life parameters were affected badly. In addition, there were apparent relationships among tinnitus measurement parameters and epidemiological, clinical, audiological, and physicosomatic parameters.

FP18

Tinnitus management in Australia: audiologists' perspective

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Tinnitus, defined as a conscious perception of sound in the absence of external sound source, affects about 10–15% of general population. The heterogeneity of tinnitus and lack of consensus over how it should be managed has led to significant variations in the clinical services offered to manage this challenging condition. In Australia, the profession most involved in tinnitus assessment and rehabilitation is audiology. The present study explored the views and practices of Australian audiologists with respect to tinnitus management.

The 36-item questionnaire developed by Hoare et al., (2010) to survey clinicians in the UK was modified to survey audiologists in Australia. This modified questionnaire was distributed to audiologists attending the World Congress of Audiology held in May, 2014 in Brisbane, Australia. The modified questionnaire consisted of two parts. Part one (11 questions) was addressed to all audiologist and asked about their practice and the resources, training and support available to them for managing tinnitus. Part two (18 questions) was addressed only to audiologists providing tinnitus services and asked about tinnitus assessment and treatment, outcome measures and referral pathways.

A total of 162 respondents completed part one of the survey with 117 going on to complete part two of the survey. A majority of participants reported not having specialist training in tinnitus management nor access to specialist resources to provide tinnitus rehabilitation. Of the 117 participants who were actively providing tinnitus services (who completed part two of the survey), 79 provided services for clients whose primary concern was tinnitus, 108 adjusted hearing aid settings when fitting clients with tinnitus, and 108 modified rehabilitation plans when providing auditory rehabilitation to clients who also had tinnitus. The most popular treatment options offered by these 117 respondents to clients reporting tinnitus were: hearing aids (96.4%), directive counselling (85%), and sound generators (59%). Tinnitus Retraining Therapy (33%), and Cognitive Behavioural Therapies (7%) were offered less frequently.

A majority of surveyed audiologists in Australia reported providing services for clients with tinnitus. The services provided varied between clinicians and were tailored to individual clients rather than being standardised across clinics. The need for further training in tinnitus and its management was expressed by the majority of respondents.

FP19

Study of contralateral otoacoustic emissions suppression in tinnitus patients

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Background: Tinnitus is the most frequency disturbance of the auditory system – almost 17% of West Europe's population and 33% of the elderly present tinitus.

Aim: The aim of this paper is to study the role of the efferent auditory system in tinnitus appearance. For this, suppression of otoacoustic emissions with contralateral acoustic stimulation is measured, as value of functioning of the medial olivocochlear bundle.

Material and methods: We made a prospective comparative study on 20 normal hearing and no tinnitus subjects and 15 age and gender matched patients with normal hearing and tinnitus. TEOAE and distorsion product DP OAE otoacoustic emissions were measured in all subjects. Click stimulus at 80dB SPL was used for TE OAE and inner ear response in 1–6kHz domain was measured. For DP OAE we used two frequencies f2/f1=1.22, with constant intensities at 65 and 55 dB SPL respectively and 2f1–f2 DP in 0.5–8kHz domain was measured. In all subjects, suppression of otoacoustic emission with contralateral acoustic stimulation (65 dB click stimulus with contralateral broadband noise at 70 dB SPL) was measured in 1–4kHz frequency domain.

Results: Both TE OAE and DP OAE were present in all tested persons, regardless presence, or absence of tinnitus. It was a difference in DP OAE amplitude between control (20 dB SPL) and patients group (15 dB SPL), but without statistical significance (p=8.23). Considering the literature, contralateral suppression test had normal values in the control group (diminishing with 3–3.5 dB SPL) and pathological values (1.1–1.8 dB SPL) in tinnitus patients.

Conclusions: Suppression of otoacoustic emissions with contralateral acoustic stimulus in tinnitus patients functions less, but without significant difference compared with control group (p=2.21).

FP20

Bibliotherapy as a therapeutic strategy for enhancing the quality of life in patients with tinnitus

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Background: There are several approaches to intervention in individuals with tinnitus, and the benefits gained are little obvious, which may be due to the great heterogeneity of tinnitus and the great difficulty in the therapeutic approach. The approaches to the psychological aspects tend to be carried out through cognitive–behavioral strategies, relying sometimes on small books or manuals, which several authors consider indispensable to the success of therapeutic procedures.

The objectives of this study were: a) develop a manual with information on tinnitus and strategies to deal with them and b) evaluate their effectiveness to decrease depression and anxiety, and promote self-efficacy, coping, optimism, spirituality, satisfaction with social support, and quality of life (QOL) of patients with tinnitus complaints.

Material and methods: For this purpose, two groups were built: the intervention group (IG: N=27), which, in addition to usual care provided at the Military Hospital of Porto (Portugal), was also provided with the previously developed manual and the respective instructions for use, and the comparison group (CG: N=31) who received only the usual care. The pre- and post-intervention assessments were conducted using questionnaires.

Results: The values obtained in relation to the perception of the manual's utility (M=5.81) are moderate such as those found in the literature. The low education level of the sample can be one of the aspects that explain this result. Additionally, the individuals of the IG showed a decrease in the intensity of tinnitus, improvement of QOL, and self-efficacy as well as a slight improvement in optimism, and some decrease in anxiety and depression, compared to CG individuals.

Conclusions: It will be useful to perform further studies to realize and improve the perceived usefulness and effectiveness of these types of intervention also with other samples, for example, with individuals with hearing loss and hyperacusis.

Free Paper Session 04 | Hearing aids

FP21

Binaural hearing benefit with interaural asymmetrical processing delays in participants with normal hearing

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Background: The benefit of listening with two ears compared to listening with only one include improved ability to localize sound sources, spatial perception, spatial release from masking, and relies on time and level differences at the two ears. Consequently, if the timing and/or the magnitude cues of the sound at the two ears are disrupted, for example by interaural differences in hearing aid processing or different types of hearing rehabilitation devices at the two ears, the benefit of binaural hearing is hypothesized to decrease. This hypothesis was tested ears on speech perception in noise by introducing unequal time delays at the two ears.

Material and methods: Seventeen participants with normal air and bone conduction hearing thresholds participated. Tests of binaural speech processing in noise, spatial release from masking (SRM) and binaural intelligibility level difference (BILD), were used to estimate the influence of adding a time delay of 0, 1, 2, and 4 ms to one ear.

Results: The SRM had values between 7.9 and 8.2 dB and for the BILD the benefit were between 6.4 and 6.7 dB. The BILD results were relatively independent whether it was the speech or noise signal that was inverted. Neither test showed any effect of interaural time delay.

Conclusions: The results show that spatial release from masking is independent of an asymmetric time delay of up to 4 ms at one ear. This indicates that for speech perception in noise, different time delays at the two ears is not detrimental and different types of hearing rehabilitation devices does not impair speech perception in noise.

FP22

Hearing aid noise reduction: Opening the black box

Helen Connor

GN Hearing

Background: One of the most common complaints with hearing aids is "my hearing aids are too noisy". In an attempt to improve listening comfort and speech intelligibility in background noise, most modern hearing aids offer single-microphone digital noise reduction (DNR) algorithms. Previous studies have found mixed results in terms of improvement in listener comfort and speech intelligibility. Therefore, it can be quite difficult for the hearing aid dispenser to determine if DNR will be helpful, harmful or neutral for the hearing aid user. Part of the problem for dispensers is that most hearing aid manufacturers provide DNR without specifying how it works.

Material and methods: The current study investigated the regulation speed of hearing aid DNR when applied to speech in noise. Recordings of the output of five premium hearing aids were made in the coupler in an acoustic test chamber. The signals were i) stationary speech-shaped noise, and ii) running speech combined with stationary noise at a positive signal-to-noise ratio. The output of the hearing aids was recorded with the DNR off and the strongest setting available.

Results: Measurements showed that for stationary noise, the different DNR algorithms had quite different attack times varying from less than 5 seconds to up to nearly 30 seconds. For speech in noise the DNR regulation speed had an influence on how much gain reduction was applied during the pauses in speech for the speech-in-noise signal. This can be observed qualitatively by visually comparing the time waveforms at the hearing aid output for DNR on and off. In order to quantify this effect the variation in short-term gain reduction across time was calculated. The fastest-acting DNR algorithms vary the gain the most for a speech-in-noise signal. This seems to have an influence on the degree of modulation in the output signal, which may in turn have an influence on the intelligibility for speech.

Conclusions: Along with previous studies this study highlights the need to have a standardized benchmarking procedure to describe i) the regulation speed of DNR processing, as well as ii) the effect of noise reduction for realistic signals, such as speech combined with noise.

FP23

Clinical assessment of remote fitting of hearing aids: A randomized controlled blinded multicenter cross-over trial

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Background: Development of the Internet and web-based solutions opened the field of teleaudiology. Therefore, remote procedures, such as telefitting of hearing aids can be proposed to patients with limited access to medical care. Even if this procedure is currently used in several countries, studies published so far focused on feasibility and technical aspects, but almost none of them evaluated the impact of the remote procedure on the quality of the fitting.

Hypothesis: The study aims at demonstrating that a remote procedure of fitting of hearing aids allows to achieve speech perception in quiet and noisy environment similar to on-site procedure. We also compared the duration of fitting using both methods as well as real ear insertion gain (REIG).

Material and methods: We designed a randomized controlled blinded multicenter cross-over trial. Sixty experienced hearing aid users were enrolled and benefited from on-site and remote fitting during the first visit. Duration of fitting and REIGs were calculated. Then they were assigned randomly to one group and were discharged with either the remote or the on-site fitting, in a blinded manner. Then, they were evaluated for speech perception (PBK test free field 60 dB) in noise and in quiet (SNR +10 dB) 4 weeks after discharge, and then were fitting with the alternative method (on-site/remote, or remote/on-site). Four weeks after the second fitting, subjects were evaluated using the same battery of tests.

Results: Fifty-three subjects were analyzed. We found no difference in speech understanding in quiet (intra class correlation ICC of 0.92 (95% CI: 0.87–0.95)), or in noise (ICC score of 0.71 (95% CI: 0.55–0.82)) after on-site and remote fitting. The time required to perform the on-site fitting was 10.08 min (±2.97), and 10.06 min (±2.81) (p=0.385).

REIGs were highly correlated for input sound at 50, 65, and 80 dB.

Conclusions: Remote fitting of hearing aids makes it possible to achieve similar auditory improvement to on-site fitting with no increase in time spent on patients' care.

FP24

Hearing aid satisfaction and speech intelligibility after hearing aid use in elderly individuals with mild and moderate sensorineural hearing loss

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Background: Communication is an indispensable tool of everyday life. One of the most common causes of communication disorders in elderly people is hearing loss. In such hearing loss, the communication is also restricted, depending on the type, degree and configuration of the hearing loss, but the most prominent problem is a reduction in the speech intelligibilit in noisy settings. Along with aging, communication skills begin to be lost due to hearing loss. Hearing loss leads not only to auditory problems in daily life, but also to additional non-auditory problems. The performance of hearing aids is an important determinant of the quality of life. In evaluating the performance expected from hearing aids, individual evaluations are made by giving questionnaires besides objective tests. The purpose of this study was to determine their quality of life and the speech intelligibility performance of elderly people using hearing aids.

Material and methods: In this study, 29 subjects (19 males, 10 females) with a mean age of 60.52±15.94 were included. The individual hearing thresholds with hearing aids (500, 1000, 2000 Hz) were at <25 dB HL (ASHA) (up to 60 dB for high frequency losses). The subjects were evaluated before and after using hearing aids. For two evaluation sections, the Turkish Matrix Test and the APHAP hearing aid satisfaction questionnaire was conducted.

Results and conclusions: Among the individuals, speech intelligibility performance with hearing aids was 48.7±14.0%, and speech intelligibility performance before using hearing aids was 37.28±16.9%. There was no statistically significant difference between individuals with hearing aids and speech intelligibility without hearing aids according to age and sex (p>0.05). However, a statistically significant difference was found between hearing instrument satisfaction scores and speech intelligibility scores for pre and post hearing aid usage (p>0.05). These results demonstrated the benefits of hearing aid in individuals' daily life qualities and communication skills.

FP25

Severe to profound hearing loss and frequency lowering

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Background: The objective of this study was to compare the benefit of adaptive frequency lowering with a static frequency lowering algorithm and minimum cut off frequency of 1.5 kHz, in behind-the-ear hearing aids (BTEs) for adults with severe-to-profound high frequency hearing loss.

Material and methods: Twenty-seven adults participated in the study. All had severe-to-profound hearing loss. The average audiograms for all participants indicate moderate sloping to profound hearing loss which is essentially symmetrical.

The study design included single blinded, objective testing of aided thresholds (ATs) and the Phoneme Perception Test (PPT). In addition participants wore hearing aids with frequency lowering at home, during the whole of the test period and between test sessions. The results were analyzed using an analysis of variance (ANOVA) with repeated measures.

Results: The results for participants with 6F AHL >90 dBHL confirm improved high frequency hearing thresholds (2 kHz to 8 kHz) for the adaptive algorithm compared to static frequency lowering. The improvement in that frequency range is in the order of 10 to 20 dB. At the same time the aided thresholds for low and mid frequency warble tones (250 Hz to 1 kHz) are unchanged.

For those with 6F AHL >90 dBHL the Detection Test subtest of the Phoneme Perception test, showed better detection thresholds at a statistically significant level for sh5 and s6 ($p<0.001$) and for s9 ($p=0.01$) for the adaptive algorithm compared to the static one. The reduction in the detection threshold was in the order of 10 to 20 dB.

The Recognition subtest of the Phoneme Perception Test indicated a better recognition threshold for Ascha5 for adaptive frequency lowering, again, only for those with 6F AHL >90 dBHL. The recognition threshold for Asha5 was lower at a statistically significantly level for SoundRecover2 ($p<0.001$).

Conclusions: This study results show that an adaptive frequency lowering algorithm with a cut-off frequency lower than 1.5 kHz improves the detection and recognition of voiceless high frequency phonemes for adults with severe to profound hearing loss. In particular, those with severe to profound hearing loss and audiograms that resulted in a more restricted audible bandwidth in which frequency compression could be applied.

FP26

The impact of educational level and age on a new adaptive version of the "Reading Span Test"

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Background: The link between cognition and hearing has become a very interesting topic throughout research and in professional hearing care. It is well known that working memory and processing speed decline in the older population. Working memory is one of the aspects of the memory that correlates the most with understanding speech in difficult situations and that impacts the selection of signal processing in hearing aids. (Gatehouse 2006, Lunner 2003 and Souza 2014). The Daneman Carpenter Reading Span Test can be used to measure working memory. This test however takes a lot of time and is not very friendly to use. We created a similar test that is more time-efficient and gives us a clear view on the clients working memory. In previous research the Thomas More Reading Span Test was developed. In this part if the research we evaluated if age or educational level would influence the test results.

Material and methods: We evaluated 60 subjects divided in 4 groups. We had two groups of younger subjects (18–30 years), one group with a lower educational level and one group with a higher educational level). We have two groups of older subjects (50–70 years) also one with higher and one with higher educational level. All performed the adaptive reading span test and filled out a questionnaire evaluating auditory performance.

Results: Educational level had a significant impact on the test results, while age did not. Older subjects are very emotionally sensitive to learn more about their working memory memory, so the hearing care professional needs to bring this information in a very tactful way.

Discussion: The impact of educational level on reading span results was also found in a study by Boudreaux (2015) and Murphy et al (2016). In the latter study, the relation between educational level and speech understanding in noise was also found. Anderson (2013) et al. demonstrate that a dynamic auditory–cognitive system is essential to understand in noise and audibility has significantly less impact compared to cognition, central auditory processing, and life experience.

The absence of an age effect is likely due to the fact that we tested younger seniors in comparison with other similar research projects or could be explained by the fact that we controlled for educational level. Therefore we recommend to control for educational level in future audiology research.

FP27

Comparing remote wireless microphone technology and hearing aids in a workplace meeting

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Background: When seated at a conference table, a listener must be able to follow meeting proceedings from a fixed point in a room. This is a demanding listening situation for participants with hearing loss. This study examined whether remote microphone system (Roger Table mic) would result in improved speech intelligibility for hearing impaired participants at various positions around a conference table.

Material and methods: 18 participants with moderate to profound hearing loss participated in the study. All participants wore binaural hearing aids combined with Roger wireless receivers. Using the Hearing in Noise Test (HINT) sentences were presented at a fixed level of 65 dB SPL with background noise presented from multiple speakers around the room. The noise level was varied such that the SNR for 50% correct speech intelligibility was achieved. This measurement was completed at positions around the table which varied from 1.5 to 4.5 m distant from the listener.

Results: The results indicate that the remote microphone outperformed the hearing aid microphones alone for all test conditions. The further away the participant was seated from the speech source the bigger improvement. Compared to hearing aids alone, an average improvement of 33% was measured at a distance of 3 m and 47% at 4.5 m. All participants reported that they were very satisfied with the performance of the remote microphone technology for speech understanding around a conference table.

Free Paper Session 05 | Vestibular disorders, diagnosis and therapy

FP28

Communication and motor functioning in subjects with mild Alzheimer's disease: A preliminary study

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Background: Alzheimer's Disease (AD) is a type of dementia that causes problems with memory, thinking and behavior. It causes decline in cognitive function, impairment in activities of daily living, and is associated with significant behavioural and psychological symptoms among the persons affected. Cognitive impairments limit the neurological ability needed to perform deliberate movements

and impair the body's response to everyday situations. Dementia is known to be an independent risk factor for falls with around 60% of people with cognitive impairment falling each year, at a rate of between 2 and 8 times that of their cognitively intact counterparts.

Material and methods: The present study aimed to examine the communication and motor functioning in subjects with mild Alzheimer's disease. Therefore, 23 subjects, between 65 to 88 years, referred from geriatrics department were examined. 18 of these subjects who diagnosed with mild Alzheimer's disease based on MoCA scores were included in the study. One patient has excluded because of middle ear pathology. After otoscopic and tympanometry impedance tests, pure-tone audiometry and was performed using supra-aural earphones. Therefore, speech recognition thresholds and speech discrimination scores were determined. Each subject completed Hearing Handicap Inventory to establish there is a communication problem or not. The sensory organization test (SOT) results, balance scores, and sensory analysis and strategy analysis results were evaluated by using computerized dynamic posturography.

Results: The mean age of a total of 18 individuals (12 female and 6 male) was 78.3±4.69 (range 65 to 88 years). The audiometric test findings suggest that age related hearing loss (presbyacusis). Hearing Handicap Inventory results of 6 (33.3%) have mild–moderate communication problems. Of all individuals evaluated, the SOT results of 16 (88.88%) were found to be abnormal.

Conclusions: Visual–vestibular and vestibular weakness was found to be frequent among elderly people with cognitive problems. This is an important result in terms of fall prevention, vestibular and balance rehabilitation.

FP29

Effects of cycling on vestibular system in cochlear implant users

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Background: The aim of this study was to observe the effects of cycling on vestibular system of cochlear implanted children with congenital hearing loss.

Material and methods: 18 implanted children (7 M and 11 F, average age 8.2, S.D: 1.2 years) were observed and evaluated. All of the participants attended the cycling training in multiple sessions. Before and after the cycling trainings conducted by the implanted children; vHIT(video Head Impulse Test) and CDP (Computerized Dynamic Posturography) with its subtests namely, i) SOT (Sensory Organisation Test), ii) LOS (Limits of Stability), iii) RWS (Rythmic Weight Shift) were performed.

Results: There were significant differences between the results of asymmetry scores in vHIT, equilibrium and composite scores in SOT, end-point execution parameter (EPE) in LOS and front/back parameter of directional control at different trials (slow and fast) in RWS ($p<0.05$).

Conclusions: Our findings supported that cycling training may help improving the vestibular systems. Therefore, we evaluate that it is valuable and useful method for vestibular rehabilitation. We consider that using cycling training during the vestibular rehabilitation is an interesting and entertaining method for cochlear implanted children. Additionally, cycling training gives an opportunity to cochlear implanted children to increase sporting activity and it supports social life of these children, so we thought that it is a beneficial tool in every aspects. Considering all of these, our study is milestone for children's vestibular rehabilitation.

FP30

Balance control after cochlear implant surgery

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Background: After cochlear implantation (CI) some patients have vertigo symptoms and/or show deficits in vestibulo–ocular tests such as caloric and rotating chair tests, as well as posturography tests (Buchman et al., 2004). The effect of CI surgery on balance control with dynamic stance and gait tests has not been evaluated yet.

Material and methods: In this retrospective cohort study the balance control of 30 CI patients having their first unilateral CI surgery were measured pre and postoperatively. Measurements were taken during 14 different stance and gait tests using a SwayStar (tm) posturography system between 2009 and 2016, resulting in a set of 75 paired variables, e.g. roll angle standing on foam with closed eyes. The mean age of the patients at surgery was 58 years (range 18–82 years). Patients with a second bilateral implant or reimplantation of the CI and/or cerebellar pontine angle tumor(s) were excluded.

Results: Significant changes between pre and postoperative evaluation have been found in 7 variables (Wilcoxon paired tests). Young people (<60 years of age) had a significant worsening of the overall Balance Control Index (BCI) after CI surgery ($p=0.008$). This was also true for patients with normal BCI preoperatively ($p=0.005$). Elderly patients ({≥60 years of age) got better regarding the pitch angle during the eight tandem steps test ($p=0.025$) and patients with a preoperatively pathological BCI results also got better ($p=0.023$).

Conclusions: Comparing all 30 patients pre and postoperatively, there is no significant change after CI surgery ($p=0.245$). Therefore CI surgery can be considered a safe treatment regarding the balance control of the patients. Only in the detailed subanalysis can significant changes

be found. If balance control problems have been preoperatively absent, then there is a higher risk for balance control problems after the CI surgery.

FP31

Changes in acceleration and velocity vHIT gains following an acute unilateral peripheral deficit: insights into neural compensation

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Background and aim: An acute unilateral peripheral vestibular deficit (aUPVD) results in deficient vestibular ocular reflex (VOR) control. It has been suggested that the improvement of VOR deficit side gain and asymmetry that occurs could be due to an increase in more acceleration (phasic) than velocity (tonic) sensitive neural compensatory responses (Minor and Lasker, JVR 2009). We examined this hypothesis using video head impulse tests (vHIT), expecting a rapid improvement of the deficit for angular acceleration gain compared to the velocity gain at onset and also a greater improvement in acceleration gain over time.

Material and methods: The VOR responses of 38 patients were examined at aUPVD onset, 3 and 6 weeks later using vHIT in the yaw plane with mean peak angular velocities of 170°/s (sd 45°/s) and mean peak accelerations of 3660°/s^2 (sd 1300°/s^2). The acceleration gain was computed as the ratio of eye to head acceleration over ±12 ms either side of peak head acceleration without a shift as the lag between the peaks was 1ms on average. The velocity gain was calculated as the ratio of eye to head velocity over ±12 ms around peak head velocity with eye velocity shifted 8 ms to account for its average population lag with respect to head velocity.

Results: The deficit side acceleration gains increased ($p<0.01$) from 0.45 at onset to 0.72 at 3 weeks and at 6 weeks from onset and the contra-deficit (normal) side acceleration gains from 0.86 to 0.99 respectively. The deficit side velocity gains increased ($p<0.01$) from 0.28 to 0.55 at 3 weeks and 0.56 at 6 weeks and the contra-deficit side velocity gains ($p<0.05$) from 0.83, to 0.92 and 0.91, respectively. Deficit side velocity gain was significantly ($p<0.01$) lower than that for acceleration at onset with similar trend at 3 weeks. Normal side gains were approximately 1.0 at 6 weeks for both acceleration and velocity. Improvement for both gains types post onset was similar.

Conclusions: Both velocity and acceleration VOR deficit side gains are affected by an aUPVD and improve most in the first 3 weeks after aUPVD onset Contra-deficit gains are slightly reduced only at onset. Thus a response asymmetry remains at 6 weeks. These results indicate that deficit side velocity gains are lower at onset than acceleration gains following an aUPVD. Thus greater acceleration rather than velocity sensitive compensatory neural mechanisms are maybe active during the very initial compensation for the deficit as predicted, but not thereafter.

FP32

Correlations between multi-plane video head impulse test (vHIT) responses and balance control after an acute unilateral peripheral vestibular deficit

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Background and aim: Clinically, it is assumed that the balance deficits in the pitch and roll planes, observed with onset of an acute unilateral peripheral vestibular deficit (aUPVD) are correlated with deficits in vestibular ocular reflex (VOR) responses in the same canal plane. Previous studies have shown that deficits in lateral canal VOR responses are weakly related to deficits in balance control. However, it could be argued that a relationship should only be expected for anterior and posterior canal responses as these provide indicators of deficits in the roll (lateral) and pitch (anterior–posterior) directions. Therefore, we examined whether balance and vHIT VOR measures in roll and pitch planes are correlated.

Material and methods: 19 patients were examined at onset of aUPVD. To measure VOR function, vHIT was performed bilaterally in each of the canal planes. Vertical canal responses were converted to roll and pitch response asymmetries, assuming the canals are at 45 degs to the roll and pitch planes, and then correlated with balance measures. To measure balance control during stance and gait, body-worn gyroscopes mounted at lumbar 1–3 recorded the angular velocity of the lower trunk in roll and pitch.

Results: vHIT lateral VOR response gain asymmetries (mean 32.3±10.4) were greater than roll VOR asymmetries (mean 14.2±9.9, $p<0.05$) and correlated ($p=0.04$). Pitch gain VOR asymmetries were considerably less (mean 5.6±9.2). No significant correlations between VOR roll and pitch asymmetries and trunk sway were found for stance ($R<0.25$). In contrast several gait roll balance measures were significantly correlated with VOR roll asymmetries: roll amplitude walking 8 tandem steps ($R=0.51$), roll velocity walking while pitching the head up and down ($R=0.59$), roll velocity walking with eyes closed ($R=0.45$). No correlations were found with pitch asymmetries.

Conclusions: This is the first report to directly link deficits in roll balance control with VOR deficits in the roll plane. Similar correlations were not found for the pitch plane. The few previously reported correlations of VOR with pitch velocity during stance and gait have been limited to low acceleration lateral plane VOR responses [Allum & Honegger (2016) J Vest Res]. Thus the deficit in vestibular sensory mechanisms leading to major pitch plane instability with aUVL during stance and gait remains unresolved unless a neural cross-coupling between the lateral and pitch planes is assumed.

FP33

Proposal of infra-red utilization in the treatment of Ménière disease: Preliminary results

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Background: Therapy for Ménière disease is one of the main problems of the otoneurologist. Prevention of vertigo crisis, unpleasant and debilitating for the patient, is an outstanding issue in clinical practice, also considering the variability and unpredictability of the vertigo crisis. Up to now no significant new approach has been produced in therapy or pharmacology, and also from a surgical point of view (except for vestibular neurectomy, which is very invasive surgery and not well accepted by the patient). Starting from the above-mentioned problems, considering that the hypertension of endolynph may be related to an alterate equilibrium with hematic circulation (excess of filtration or incorrect re-absorption), we assumed that the pathogenesis of the hydrops may be related to an incorrect hematic vessel mechanism. And so we tried to improve the hematic circulation by using infra-red ray applied on the vertebral column.

The main goal of this study is to verify the possibility of reducing the number and intensity of vertigo crises by using infra-red rays.

Material and methods: 42 patients suffering from Ménière disease were admitted to this study. The crises frequency ranged between 1 per 2–3 months and 2–3 per week. All patients showed the typical symptomatological triad (vertigo, with severe neurovegetative symptoms, hypoacusia, and tinnitus). The treatment consisted in exposing the vertebral column to a source of IR rays. Time exposure varied between 30 and 45 minutes. The treatment was performed once a week for the full period of 12–15 weeks.

Results: In every case in a first step all patients reported a significant decrease of vertigo intensity and successively, just a dizziness sensation remained that was progressively disappearing with the treatment prosecution. Until the end of the treatment, equilibrium was restored in about 90% of the patients.

FP34

Evalution of the balance system of ice hockey players

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Our study is aimed at observing the balance system of ice hockey players, which was done by use of computerized dynamic posturography device as well as a variety of test methods. Our study aims at stressing the significance of the vestibular system for ice hockey players, meanwhile focusing on the relation between the vestibular system and ice hockey for which balance is a significant factor.

Participants had been subject to sensor organization test, adaptation test, weight bearing/squat, unilateral stance, rhythmic weight shifting tests of computerized dynamic posturography device.

Results: Overall results indicate no significant difference between the control group and ice hockey players; which is considered to be caused by control group's comprising adolescents with amateur sport involvement. The number of cases can be increased to obtain statistical information with higher accuracy.

FP35

Effectiveness of vestibular rehabilitation on life quality of the elderly with chronic dizziness

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Background: Dizziness which limits the mobility and activities of the elderly is quite common. Among the elderly, symptoms such as fear of falling, feeling of imbalance or emotional states, cause them to feel dizzy even more severely. The role of vestibular rehabilitation with these patients is rather controversial. Vestibular rehabilitation therapy (VRT) is an important therapeutic option for the audiologist in treating patients with chronic dizziness. The purpose of this study was to assess the effects of vestibular rehabilitation on dizziness in elderly patients with chronic vestibular dysfunction and to determine the quality of life and their emotional and functional states.

Material and methods: In this study a total of 7 individuals (4 male, 3 female) with a mean age of 68.57±3.04 years were included. Objective and subjective vestibular evaluation was performed after ENT examination. EQ-5D-3L General Quality of Life Scale and Dizziness Handicap Inventory were filled for individuals with dizziness complaint before vestibular rehabilitation, during the 4{th week and 8{th week (short term) VRT follow-ups and at the 4{th month (long-term) evaluation. The initial assessment and VRT follow-ups were conducted using CDP. According to results of the evaluation and to the needs of the patient, VRT programs are prepared as individualized home-based exercises.

Results and conclusions: The decrease of the Dizziness Handicap Inventory scores is interpreted as an improvement within their emotional and functional states. When the outputs of the short-term and long-term follow-ups are compared with each other, the improvement of the life quality in the long-term is much more noticeable. Therefore the Vestibular Rehabilitation Therapy program for the elderly should be prepared in a multidisciplinary and multifactorial manner.

FP36

Posturography findings in children with vertigo complaints: A retrospective analysis

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Objectives: Children with vestibular problems often do not complain of vestibular-related symptoms. Vestibular problems can be seen in childhood but different balance strategies are adopted by children. Because of this mechanism, several methods such as Sensory Organization Test (SOT) were used to evaluate the children. SOT is one of the tests of Computerized Dynamic Posturography (CDP) which measures the sway in six different conditions and examines visual, somatosensory, and vestibular systems coordination to maintain balance.

The purpose of this study was to evaluate the SOT results on paediatric patients who complained of vertigo or dizziness.

Material and methods: The sensory organization test (SOT) results, sensory analysis, and strategy analysis results were evaluated by using computerized dynamic posturography between February 2005 and February 2017. In our study we evaluated a total number of 143 patients between 4 and 18 years of age. Patients were divided into two groups according to age: one group of age {≤10 (38.4%) and the other group >10 (61.6%). All of the subjects were evaluated with SOT.

Results: All children with an average age of 10.1 with vestibular complaints tested with SOT are compared to 33 healthy ones. Some 10 (7%) of the patients did not complete the test and were excluded from the study. Of the 133 paediatric patients evaluated with SOT, results of 8 subjects (24.2%) from the group of age {≤10 and the results of 25 subjects (75.7%) from the group of age >10 were found to be abnormal. The sensory analysis results revealed visual, vestibular, and visual vestibular weakness in abnormal subjects.

Conclusions: In our study, it was concluded that a large proportion of children with vestibular disorders have SOT results as good as their healthy peers. It can be explained that children had very efficient compensatory mechanisms and most of them can recover until they see a specialist. Unfortunately we concluded that the compensation effect might decrease after middle childhood (9–11 years). Finally, Sensory Organization Test would be useful when evaluating the balance performance in paediatric population and determining strategies to decide the best rehabilitation/intervention options.

Free Paper Session 06 | Rehabilitation

FP37

Auditory perception of Voice Onset Time contrasts of speech sounds in children with hearing aids and cochlear implants: A comparison with typically developing children

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Background: Voice onset time (VOT) is an auditory based acoustic feature that helps to differentiate from one speech sound to another. Particularly, voiced and voiceless stops are primarily differentiated by VOT. Hence, VOT has been considered as an important temporal–acoustic measure for distinguishing stop consonants for variety of languages. However, voiced and voiceless discrimination confusion is seen in hearing impairment (HI) leading to poor articulation abilities. The studies have reported that cochlear implantation has resulted in improved articulation ability & speech intelligibility in children with HI. But, the role of this auditory based ability has been very poorly reported in cochlear implant recipient. Therefore the current study was undertaken.

Objectives: To compare the perception of VOT contrast of voiced and voiceless speech sounds among Cochlear Implant (CI), Hearing Aid (HA) recipient and Normal Hearing (NH).

Material and methods: Total 60 subjects in age range between 6 to 12 years of both genders divided into three NH, HA and CI groups, each containing 20 children were selected. A total 180 tokens consisting of consonant-vowel-consonant combination of nonsense Hindi stop phonemes of equal time length differing at initial position were created as test stimuli. These stimuli were presented in auditory and visual mode simultaneously in ABX paradigm to subjects and identification scores from each group was obtained.

Results: The statistical analysis indicated significant difference in the distributions of VOT scores across all groups. Further, there was no overlap in distributions of identification scores of between the NH & CI group, and HA & CI group. However, the CI children scored more but were far behind the NH but had better identification score than the HA group. These finding are similar to reports of Nittrouer and Burton (2003) and Guillot and Ohde (2009).

Conclusions: The results indicated that there was significant difference in scores of NH and both HA & CI groups. The HA and CI also differed significantly in identification scores. However, the study observed that identification score for CI group was better than the HA group which indicates that the cochlear implant provide more accessibility to acoustic information than the hearing aids. Thus, it can be concluded that CI improves degraded auditory information to children with hearing impairment which may improve speech perception and acquisition in children with HI.

FP38

Evaluation of different phone solutions in CI and hearing aid users and bimodal recipients

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Background: Communication on the telephone is challenging for people with hearing loss. Various products have been developed to improve speech intelligibility during phone calls. One example is the binaural algorithm DuoPhone by means of which the phone signal received on one ear is streamed to the contralateral ear. Furthermore, Phonak DECT phone or EasyCall for mobile phones stream the signal into both ears simultaneously. Improvement for speech intelligibility for HA and bimodal users have already been shown with this wireless hearing assistance technology. However, no formal studies involving this technology have been carried out with CI users.

Material and methods: Both HA, CI and bimodal users participated in the study. The following phone solutions were used:
- Phonak DECT CP1 V2 (for CI and bimodal users);
- Phonak DECT CP2 (for HA users);
- Phonak EasyCall (for CI and bimodal users);
- Phonak EasyCall II (for HA users);
- Phonak DuoPhone (for all above named users);
- Standard (mobile) phone (for all above named users).

Speech intelligibility was measured with the adaptive Oldenburg Sentence Test (Wagner et al. 2006) during a phone call to determine the speech reception threshold (SRT) for two different background noises. Subjective ratings about speech intelligibility, noise suppression, and usability were assessed for all phone solutions.

Results: Previous research has shown that the DuoPhone algorithm improved speech intelligibility for HA users by 3.1 dB SNR (Nyffeler, 2010). Speech intelligibility measurements for Phonak DECT phone or Easy Call for mobile phones also showed improved SRTs compared to a standard telephone (Appleton-Huber and Latzel, 2013). Wolfe et al. (2016) demonstrated a benefit for bimodal participants in word recognition of 25% in quiet and 23% in noise when streaming was enabled. Results of the current investigation will be presented and discussed in relation to the earlier findings.

Conclusions: A bilaterally provided phone signal can improve speech intelligibility compared to a standard telephone solution. Differences and preferences between HA, CI, and bimodal users will be discussed.

FP39

Intellectual disability and auditory skills via the Orff musical education method

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The definition of Intellectual disability balances limitations with an equal emphasis on skills. Associated health conditions with a higher prevalence in individuals with Intellectual disability are auditory processing disorder. This intellectual disability manifests by causing the person to have difficulty in processing the things they hear and see. They may lack the ability to tell the difference between certain sounds. Depending on the severity of impairment, this can profoundly affect learning. Music training offers a promising auditory learning strategy by directing attention to meaningful acoustic elements of the sounds cape. In light of evidence that music training improves auditory skills and their neural substrates, there are increasing efforts to enact Orff musical education in special care units to children who has intellectual disability.

The present study investigated whether music training via the Orff method fosters children's auditory skills such as listening, auditory discrimination, and perception. Five children were assigned to participate in a 6-week training program in the Orff musical education method. Before and after training, children's listening profile, word discrimination skills were assessed. Improvement after training was observed on the listening profile measure, but the children with music training improved significantly more than the untrained children on the auditory discrimination measure. Music training appears to benefit certain skills necessary for children who have intellectual disability.

FP40

Communication abilities of adult CI patient with aphasia

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Background: The benefits of cochlear implants (CI) on spoken language of adult users have been shown in numerous studies. Cochlear implant users with additional communication disorders are not very common. In this case study, the auditory perception and communication results of an adult CI user with aphasia was determined, and rehabilitation options are discussed.

Material and methods: The patient was 49 years old, male, CI user. In his post op one month, the patient had a stroke, and acquired aphasia. His communication abilities due to aphasia was evaluated with Turkish Aphasia Test. Auditory perception performances were assessed with closed set word identification test and sentence recognition test. His mental condition assessed with mini mental test. Also his short term memory performance was evaluated with VADS.

Results: The results indicated that aphasia affected the patient's life severely. Although he started to identify environmental sounds, his word identification score was 6/24. His sentence recognition score was 0% in auditory only condition and 20% in auditory verbal condition. His VADS score was below the norm. Multidisciplinary evaluations were conducted and a rehabilitation program was developed with other professionals.

Conclusions: In complex communication disorders, communication performances should be evaluated under different conditions. Not only auditory perception, but also memory and visual perception must be included in the process.

Free Paper Session 07 | Cochlear implants: Surgery and electrophysiology

FP41

Assessment of cochlear function during cochlear implantation by extra- and intracochlear electrocochleography

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Objectives: The aims of this study were: 1) To investigate the correlation between electrophysiological changes during cochlear implantation and postoperative hearing loss, and 2) to detect the time points that electrophysiological changes occur during cochlear implantation.

Material and methods: Extra- and intracochlear electrocochleography (ECoG) were used to detect electrophysiological changes during cochlear implantation. Extracochlear ECoG recordings were conducted through a needle electrode placed on the promontory; for intracochlear ECoG recordings, the most apical contact of the cochlear implant (CI) electrode itself was used as the recording electrode. Tone bursts at 250, 500, 750, and 1000 Hz were used as low-frequency acoustic stimuli and clicks as high-frequency acoustic stimuli. Changes of extracochlear ECoG recordings after full insertion of the CI electrode were correlated with pure-tone audiometric findings 4 weeks after surgery.

Results: Sixty-one subjects were included. Of these, extracochlear ECoG recordings were performed in 58 and intracochlear ECoG recordings in 3 subjects. Mean hearing loss in subjects without decrease or loss of extracochlear ECoG signals was 12 dB, compared to a mean hearing loss of 22 dB in subjects with a detectable decrease or loss of ECoG signals (p=0.0058). In extracochlear ECoG recordings, a mean increase of the ECoG signal of 4.4 dB occurred after opening the cochlea. If a decrease of ECoG signals occurred during insertion of the CI electrode, the decrease was detectable during the second half of the insertion in extra- as well as intracochlear recordings.

Conclusions: Extra- and intracochlear ECoG recordings allow detection of electrophysiological changes in the cochlea during cochlear implantation. Decrease of extracochlear ECoG recordings during surgery has a significant correlation with hearing loss 4 weeks after surgery. Baseline recordings for extracochlear ECoG recordings should be conducted after opening the cochlea. Extra- and intracochlear ECoG recordings suggest that trauma to cochlear structures occurs during the final phase of the electrode insertion.

FP42

Intraoperative cochlear implant position monitoring with spread of excitation measurements

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Background: The correct placement of the electrode array of a cochlear implant (CI) is essential for successful rehabilitation. Insertion depth and position may affect speech comprehension. Upcoming electrode arrays are thinner and thus even more delicate concerning insertion and correct positioning. The electrode position may be demonstrated by means of high resolution computer tomography, yet this technology is usually not available intraoperatively and involves radiation exposure. However, certain measurements of evoked compound action potentials (ECAP), so-called spread of excitation (SOE) measurements, are sensitive to electrode position. The main goal of this study was to evaluate SOE measurements intraoperatively in order to evaluate problematic electrode array positioning, especially potential tip foldovers.

Material and methods: In 195 implanted ears (CI512 and CI532, Cochlear Ltd.), NRT thresholds and SOE measurements were recorded intraoperatively with CustomSound EP. Probe electrode 15 was stimulated with 210 current level (CL) or different levels if 210 CL were not in the range of 25 to 45 CL above NRT threshold of electrode 15. Data was evaluated regarding the N1–P1 amplitude, SOE width, and NRT thresholds and set in relation to two detected tip foldover cases confirmed by X-ray imaging.

Results: Best results of descriptive SOE data were obtained for measurements in between 30CL and 45CL above NRT threshold. All tip foldover cases could be identified correctly and exhibited typically elevated N1–P1 amplitudes at the most apical electrode. ECAP threshold measurements should be performed beforehand in order to measure the SOE in a suitable range of stimulation level.

Conclusions: SOE measurements provide a useful tool for the evaluation of the array position within the cochlear intraoperatively. However, the variance of neural responses often require a specific adjustment of the SOE stimulation levels in order to observe the decay of the masker amplitudes in basal and especially in apical direction. In order to confirm a tip foldover, intraoperative imaging is still inevitable. However, SOE measurements allow confining intraoperative imaging to conspicuous SOE findings.

FP43

Feasibility and early results of electrocochleographic recordings via the Advanced Bionics cochlear implant system

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Background: Electrocochleography (ECochG) is a well-established method to record the inner ear response to an acoustic stimulus. Work originally conducted with the University of North Carolina has demonstrated the ability to record ECochG also via the intra-cochlear electrode array for an acoustically delivered low-frequency sinusoidal stimulus. Even though the telemetric system of the Advanced Bionics cochlear implant system was developed to record impedances as well as the compound action potential to electrical pulses, it is also suitable for ECochG recordings. This may allow to record ECochG on a regular basis to monitor residual hearing, both during the insertion process in the surgery as well as long-term postoperatively.

Material and methods: In this study, ECochG was recorded from 30 adult subjects during and following implantation of the Advanced Bionics HiRes90K implant. During insertion of the array, recordings were virtually always made for 50 ms tone burst of 500Hz. Following insertion, recordings were made, where possible, for 125, 250 and 500 Hz tone bursts. Typically 64 averages were used for each individual measurement. Subtraction of recordings, time-locked to phase-reversed stimuli, allowed extraction of the cochlear microphonic (CM) signal. Comparisons were made between the CM and behaviourally measured hearing thresholds. Analysis was also made of CM amplitude during insertion of the electrode array and correlated with the surgical reports.

Results: It was possible to record ECochG in all cases for at least one stimulus frequency. The average electrode insertion took approximately 25 seconds and returned 12 CM data points. Preliminary data indicate a highly significant correlation (r^2=0.81) between ECochG and behavioural estimates of low-frequency hearing threshold.

Conclusions: Results show the feasibility of ECochG recordings, both intra- and post-operatively using the standard Advanced Bionics cochlear implant system hardware with research software. Recording speed is sufficient to give surgical feedback during electrode array insertion. A strong correlation exists between objective and behavioural estimates of low-frequency hearing thresholds.

FP44

Correlation between hearing preservation after cochlear implantation and speech understanding in the electric-only condition

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Background: There are several reasons why hearing preservation and minimization of cochlear trauma is aimed for cochlear implantation. However, it has not yet been completely clarified if hearing preservation after cochlear implantation with full-length electrodes has an effect on word recognition in the electric-only condition. While Carlson et al. [1] reported significantly better word perception scores in in the electric-only condition with preserved residual hearing, Balkany et al. [2], D'Elia et al. [3], and Cosetti et al. [4] could not demonstrate such an effect. In this study, we investigate if the degree of hearing preservation in CI recipients with full-length CI electrodes correlates with speech understanding scores in the electric-only condition.

Material and methods: 105 CI recipients who had measurable residual acoustic hearing before surgery were included in this retrospective study. We evaluated pre- and postoperative pure tone average (PTA) and postoperative monosyllabic word perception scores after 6 months, 12 months, and after 18 months.

Results: Commplete or partial hearing preservation was achieved in >50%. After 6 and 12 months, no significant difference in word perception was found between subjects with and without hearing preservation. After 18 or more months, subjects with hearing preservation had significantly better word perception scores. No significant difference in word perception was found between subjects with and without hearing preservation after 6 and 12 months. However, after 18 or more months, subjects with hearing preservation had significantly better word perception scores.

Conclusions: Preservation of residual hearing leads to better word perception in the electric-only condition over the long-term. CI recipients with hearing preservation continue to make progress after more than 12 months of CI experience whereas those without plateau at 12 months. The findings further support the necessity of conservation of residual acoustic hearing in all CI recipients.

References:

1. Carlson ML et al. Implications of minimizing trauma during conventional cochlear implantation. Otol Neurotol, 2011.
2. Balkany et al. Conservation of residual acoustic hearing after cochlear implantation. Otol Neurotol, 2006.
3. D'Elia A et al. The role of hearing preservation on electrical thresholds. Otol Neurotol, 2012.
4. Cosetti MK et al. The effects of residual hearing in traditional cochlear implant candidates. Otol Neurotol, 2013.

FP45

A combination device delivering therapeutics to the inner ear via a cochlear implant

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Background: Elution of active pharmaceutical ingredients (APIs) from the silicone matrix of a cochlear implant (CI) electrode array may provide a simple, effective and reliable method for delivering dexamethasone (DXB) to the inner ear over an extended period postoperatively. Such treatment may be effective in mediating tissue response to insertion, and potentially assist in preserving remaining acoustic hearing in CI recipients.

Objectives: To investigate the clinical feasibility of integrating a drug therapy into a commercial cochlear implant electrode array, and to assess the effect on electrode impedance measures.

Material and methods: Surgical insertion studies were undertaken to ensure insertion characteristics with the experimental device were not compromised. Pharmcokinetic profiling were conducted both before and after both normal and accelerated ageing. Non-clinical safety studies in animal models were conducted to evaluate potential primary patient risks. Subsequently, ten adult subjects were implanted in two centres with the investigational device augmented with regions loaded with dexamethasone (DXB; Sanofi). Standard electrode impedance measures were compared with a control group of 29 recipients receiving standard electrode arrays. Comparison of 4-point electrode impedance measures were also made between the investigational and a control group of implanted subjects to more directly examine the effect of the drug therapy on impedance measures associated with local tissue response.

Results: Non-clinical results in the animal model did not identify any safety issue associated with inclusion of high loadings (50% w/w) of DXB. Surgical reports showed no decrement in electrode insertion characteristics with this design nor any safety issue for the patients postoperatively, as compared with control patients receiving standard devices recruited from the same clinics. In comparison to data from 29 control recipients, the investigation group demonstrated significantly lower impedances ($p < 0.001$) in both common ground (CG) and monopolar (MP1+2) stimulation modes at all time-points.

Conclusions: A combination CI delivering APIs is a feasible strategy for delivering a targeted drug therapy to CI recipients. An ad hoc analysis of data from this FTIH study has demonstrated that such a device delivering DXB provided sustained, reduced impedances, which could be a biomarker of reduced fibrosis.

FP46

Robotic cochlear implantation: First clinical results

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Background: Robotic cochlear implantation is a novel minimally invasive approach for CI surgery. The procedure is currently being evaluated in a clinical trial at the Inselspital in Bern, Switzerland. The aim of this presentation is to report preliminary clinical results of the first cases of robotic cochlear implantation.

Material and methods: The clinical study was approved by the local IRB and regulatory body. Preoperative assessments included morphological evaluation using CT, taste examination and facial nerve neurography. During surgery, four bone fiducial screws were inserted behind the ear and CT (0.2 mm resolution) was performed to plan a drill trajectory from the mastoid surface, passing through the facial recess to the center of the round window. Access to the middle ear was drilled using a previously developed task specific image-guided robotic system. Sufficient clearance of the drill trajectory from the facial nerve was confirmed using intraoperative cone beam CT imaging. Upon completion of drilling and screw removal, a tympanomeatal flap was created and the round window membrane was exposed. An implant bed was prepared and the electrode array was manually inserted using a specifically manufactured insertion tube. Correct placement and nominal function of the implant was verified by telemetry and postoperative CT imaging. Postoperative facial nerve neurography and taste examination took place two weeks postoperatively. Audiological assessment was performed as part of routine clinical care.

Results: Robotic middle ear access was completed in 2 patients, with successful electrode insertion according to the preoperatively defined plan. Audiological results for all patients are currently being collected.

Conclusions: We have demonstrated in 2 patients that a CI electrode can be successfully inserted into the cochlea through a 1.8 mm keyhole access created by a surgical robot. The workflow with the robotic setup requires additional setup time and extensive teamwork.

Free Paper Session 08 | Age-related hearing loss (1)

FP47

Brain plasticity in the elderly: Evidence from auditory training of sentences in noise

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One of the negative consequences of aging is the decline in communication abilities. This has been found to contribute to social isolation and to cognitive and general health decline. This problem has been most commonly addressed by fitting hearing aids and/or cochlear implants. The results, however, were only partially successful, especially when listening in noise. The purpose of the present study was to attempt to address the difficulties of listening in noise in older adults via single- and multi-session auditory training. Twenty-one older adults aged 65–78 years (M=70 years) were trained in a single session on a sentence perception in noise test (Hebrew Matrix test). For each participant, 6 speech reception thresholds in noise (SRTn) were obtained using an adaptive procedure. Seven of the participants continued to train for seven more sessions, 1–3 days apart and with 6 SRTn/session. Retention of learning was assessed one month after training was completed. Single session performance were compared to data of 51 young adults (21–28 years of age). The results showed that during a single session training, older adults improved performance by 1 dB and 38% had comparable performance to that of young adults. By the end of multi-session training, 6/7 older adults improved SRTn by additional 2–4 dB regardless of their initial performance. More than 50% of the variance in performance was explained by cognitive abilities. Learning was partially retained at the 1-month follow up session. These data provide important evidence of auditory plasticity in older adults and the benefit they can obtain from auditory training.

FP48

The audiologist's perspective of their role in the hearing rehabilitation process among the elderly: A qualitative study

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Hearing aid (HA) fitting is a significant element of the continuous, complex hearing rehabilitation process (HRP) that includes counseling, training, listening strategies, and requires patient–audiologist cooperation. First-time HA users preliminary expectations regarding the HA advantages, disadvantages and use are part of the factors that can influence the success of the HRP. There is limited information indicating the audiologist's role in the HRP. The next decades will be characterized with accelerated technological advances of HA and increasing aging population. In light of these changes and the lack of information regarding the audiologist contribution to the HRP, one can wonder if the audiologists will still be a relevant part of this important process.

This qualitative study was conducted using Grounded Theory. Its main purpose was to assess the process of matching expectations of first time HA users during the HRP. Ten Israeli audiologists, specialized in HA fitting, from different professional backgrounds were interviewed. Data from this maximum variation sampling of audiologists was analyzed – parallel to data collection – by coding and categorization using ATLAS ti 7 software.

Four main themes were found: 1) the audiologists' holistic perception; 2) audiologist–patient relationship and partnership; 3) EM and HRP as an intertwined process and 4) the audiologists' professional backbone. These four themes reflect the audiologists' understanding of the importance of their role in the HRP and the significance of their relationship with the patients and their significant others. Beyond these four themes, "the technology vs. the audiologist" was found as a major category, relevant to this paper presentation.

Study findings revealed that although hearing rehabilitation is only one of the audiologists' professional fields of practice, it serves as a prism for their professional perception, helps in dealing with professional and ethical dilemmas, shapes their relationship with patients and their surroundings, and also shapes the ways in which they cope with technology and regulatory changes affecting their work.

This presentation will focus on the audiologist' role in the HRP as reflected from the interviews and will discuss the added value that audiologists bring to the process in light of developments and changes in the HA market.

FP49

Changes in the central auditory system associated with presbycusis and tinnitus

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Background: Presbycusis and tinnitus are two of the most common hearing related pathologies. Both of these disorders share few common signs. Although it is believed that they originate from the inner ear, there are several reports about their central components. The onset of presbycusis coincides with the highest appearance of the tinnitus (between 60–70 years of age). The aim of our study

was to investigate changes occurring due to tinnitus and presbycusis in the central auditory system.

Material and methods: Twenty-seven patients with presbycusis and tinnitus and twenty healthy volunteers were examined by audiological and MRI methods. Following audiological examinations were used: pure tone high frequency audiometry, otoacoustic emissions, speech and speech in babble noise audiometry, speech audiometry with signal drop-outs – „chopper", gap detection threshold, laterogram (time–intensity trade off). MRI examination used: resting state fMRI and event-related fMRI with various combination of acoustic (speech, speech like noise, speech in babble noise) and visual and acoustic stimulation (congruent and discongruent).

Results: Auditory tests showed clear differences between control group and tinnitus/presbycusis group that are due both to ageing and tinnitus. Resting state fMRI showed preferred connectivity between the auditory cortices in tinnitus/presbycusis group. The activation of the visual cortex depended on the relationship between acoustical and visual stimuli.

Conclusions: The results of the examinations demonstrate that presbycusis and tinnitus alter function of the auditory cortices compared to healthy individuals. The complex of selected audiological tests together with MRI methods offer new approaches how to understand pathological basis of presbycusis and tinnitus.

FP50

Improved hearing in Swedish 70-year olds: Evidence from cohort comparisons of unscreened populations

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Background: Populations worldwide are rapidly aging. The number of people aged 65 and above is projected to double by 2030 – a change which will undoubtedly put upward pressure on societal and health care costs. In light of these demographic changes, it is vital to generate up-to-date prevalence figures, in order to accurately estimate aural rehabilitation needs of the population. The aims of this study were to examine hearing acuity and hearing loss prevalence in a new cohort of older adults in Gothenburg, Sweden, and to investigate whether hearing in this age-group has changed over the last 5 decades.

Material and methods: This was a prospective population-based study of unscreened populations. As part of a geriatric population-based study (H70), a new birth cohort consisting of 70-year olds (n=1135) was tested with computerized automated audiometry. A random subgroup (n=251) was tested more extensively with an audiological test battery, including clinical pure-tone audiometry. The hearing thresholds were compared to three previous cohorts of 70-year olds, born in 1901–02, 1906–07, and in 1922.

Results: Significant improvements ($p<0.01$) in median pure tone thresholds were seen at most frequencies in the men (range: 5–20 dB) and at some frequencies in the women (range: 5–10 dB). The prevalence of hearing loss decreased significantly in the study period (1971–2014), from 53–28% for men and 37–23% for women ($p<0.01$). Rates of mild and moderate hearing loss also decreased, whereas severe hearing loss remained stable.

Conclusions: These results support that hearing in Swedish 70-year olds has improved. The largest improvements were seen at 4–6 kHz in men, possibly reflecting a decrease in occupational noise exposure.

FP51

Cognitive computing for hearing healthcare: An eHealth solution for the clinical management of aged people with hearing disabilities

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Background: A successful hearing rehabilitation plan for older people shall consider the technological factors (e.g. the type of HA or CI used) and also other aspects related to auditory disability, e.g., the perceived hearing difficulties in real life, the impact of subject's hearing disability on the quality of life, speech perception abilities in real environments. Many valuable clinical instruments exist to measure all the diverse aspects of hearing disability. Unfortunately, most physicians cannot make profit of this wealth of ever increasing information as it is dispersed in different medical documents. Also, about 80% of health data, e.g. that in medical notes, is invisible to systems because it is unstructured. Our work is the first attempt in the hearing healthcare domain, to design and develop an easy-to-use, multi-source clinical system for extracting and collating audiological information from the diversified documents of the patient health record.

Material and methods: This first pilot evaluation of our system is done on a sample of medical records of elderly with CIs. The records included all the medical documents and test results generated during the time (including all the follow-up visits). The system applies eHealth technologies (cognitive computing) and leverages an *ad hoc* lexicon developed for the hearing healthcare.

Results: Our system extracts textual narrative information (e.g. from the past medical history, current complaints, etiology, audiological diagnosis, risk factors, surgical procedure to implant the hearing devices) and numerical information (e.g. audiometric tests, technical setup of CIs, questionnaires scores, etc.). The system analyses medical

notes written in plain language, understands which information is critical to the treatment pathway, and puts the extracted information into the proper textual and temporal contexts. The extracted information is then made available through a central platform to be analyzed in a tuned approach by the clinician. All these processes are directly performed on the original medical documents, as they are generated by the clinician using plain language.

Conclusions: The proposed system provides clinicians with a multi-source and multi-dimensional view of patient's hearing disability. It helps clinicians to improve the ongoing treatment of chronic conditions and the proactive and preventive interventions.

Grant: PNRCNR Aging Program 2012-18.

FP52

Are changes in sensory function associated with cognitive decline? Longitudinal analysis in European older population

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Background: The prevalence of hearing and/or vision loss and cognitive impairment increases sharply in old age. Hence, the explanations for relationships between sensory and cognitive function remain unclear. The purpose of this study was to assess in an older European population: (1) any independent association between single and dual sensory impairment (hearing and/or vision) and cognitive decline; (2) cognitive trajectories according to the pattern of sensory impairment.

Material and methods: We used two surveys on older individuals in Europe: the Survey of Health, Ageing and Retirement in Europe (SHARE) for 10 Continental European countries and English Longitudinal Study of Ageing (ELSA). Growth curve analysis with time–variant variables of sensory impairment was performed to predict cognitive function measured by episodic memory score (range 0–20). Vision and hearing function in SHARE and ELSA were each coded on a scale from 1 (excellent) to 5 (poor). We recoded the scores of hearing and vision function into two categories by combining the responses excellent, very good and good into good sensory function and collapsing fair and poor vision into poor sensory function. We defined sensory impairment as having poor sensory function and categorised it into three: no impairment, single impairment (vision or hearing), and dual impairment (vision and hearing).

Results: Older adults in England with single (β=–0.154, ρ<0.001) and dual impairments (β=–0.369, ρ<0.001) performed less well than those with no impairment in final model, where the potential confounders, including sociodemographic, health behaviour and health status characteristics, were included. Similarly, older adults with single (β=–0.289, ρ<0.001) and dual impairments (β=–0.727, ρ<0.001) were able to recall fewer words than those with no sensory impairment in other ten European countries included in SHARE. In both surveys, the cognitive trajectories of older adults with no sensory impairment followed curvilinear shapes, while those of older adults with single and dual sensory impairments showed more precipitous pattern trajectory of cognitive decline after the age of 50 in both surveys.

Conclusions: These findings suggest that sensory impairment was independently associated with cognitive decline among older adults in Europe. Further investigations should shed light on causal connections among them.

FP121

Computerized Duration Pattern Test and Computerized Frequency Pattern Test results in the elderly

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Background: The aim of this study was to evaluate the performance of Computerized Frequency Pattern Test (CFPT) and Computerized Duration Pattern Test (CDPT) in elderly with normal hearing.

Material and methods: This study was conducted at Hacettepe University, in Otorhinolarnygology Department, Audiology and Speech Pathology Unit. 30 elderly subjects (60 ears) were evaluated. CFPT and CDPT were carried out for all elderly subjects. The correct answer percentages of CFPT and CDPT were analyzed.

Results: Subjects were aged between 65–77 years, and the mean age was 70.26±3.45 years. The average percentage of correct answers of CFPT were 56.2% for right ears and 55.2% for the left ear. The average percentage of correct answers of CDPT were 65.03% and 63.80% for the right and left ears respectively. There was no statistically difference between right and left ear for CT and CFPT (p>0.05).

Conclusions: The performance of CFPT and CDPT were evaluated for elderly subjects in this study. These results may provide useful information about auditory processing performance in elderly subjects.

Free Paper Session 09 | Objective measurements

FP53

The effectiveness of bone conduction (BC) chirp stimulation in evaluating auditory brainstem

response (ABR) compared to air conduction (AC) chirp and to click ABR

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Background: Chirp is a frequency time-varying stimulation that compensates for the temporal dispersion in the cochlea by delaying high frequencies of stimulation, so that both low and high frequencies will transmit simultaneously to the cochlea. Most studies examined the effectiveness of chirp stimulus in AC ABR, while only little research is done with BC stimulus, which is important for detecting mixed and sensorineural hearing losses.

Objectives: The main purpose of this study is to create, investigate and to implement a chirp stimulus in ABR, both in AC and BC. This procedure is meant to improve the efficacy of measuring ABR threshold, by obtaining ABR thresholds closer to psychoacoustic thresholds, and larger wave V amplitudes. Therefore, this study constructs a chirp stimulus with frequency range of 0.1 to 4 kHz to fit the frequency response of the bone vibrator B71. This stimulus was also compared to the commonly used BC click. In addition, a comparison was made between click and chirps with different frequency content.

Material and methods: The study involved 25 healthy students with normal hearing at University of Haifa, aged 19–30. Responses were examined in 31 ears. All stimuli were calibrated according to the psychophysical threshold of each subject and stimulation intensity level was determined according it. ABRs were evoked using AC and BC chirp and click presented at 60, 40, 20 dB sensation level, and at threshold level, with stimuli rate of 27.1/s. The various chirps were modified using MATLAB-R2013b, referring the original that was provided by Natus.

Results: Chirps were found to have closer ABR threshold to the psychoacoustic threshold than click, both in AC and BC. In addition, greater wave V amplitudes with chirp stimulus, in the intensities of 20, 40, 60 dB SL were observed.

Conclusions: For the first time, BC chirp was found to have important and direct clinical implications to improve predicting thresholds in BC ABR.

FP54

Test–retest study of multi-feature mismatch negativities to speech sounds

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Background: Mismatch negativity (MMN), a change-specific component of the auditory event-related potential (ERP), is elicited by any discriminable change in auditory stimulation irrespective of the subject or patient's attention or behavioural task. It provides an objective index for sound-discrimination accuracy at the cortical level and represents a neural plasticity. With traditional recording sessions tend to be long and it provides cortical discrimination of 1–2 sound features. Recently new multi-feature MMN paradigms have been developed to provide very fast assessement of auditory discrimination profiles (Pakarinen S., et al., 2009).

Material and methods: The present study aimed to evaluate the test retest reliability of MMN elicited by multi-feature paradigm which was developed in Hacettepe University. Thirty healthy volunteer subjects, all above the age 18, were taken the MMN test in Hacettepe University Audiology Department, electrophysiology laboratory. The stimuli were synthetic consonant–vowel syllables. The standard stimuli were /te/ and /pi/. Syllable duration was 170 ms. The deviant stimuli differed from the standarts either in syllable frequency (F0: 9%), syllable intensity (±7%), vowel duration (100 ms), consonant (/pe/ and /ti/) or vowel (/ti/ and /pe/). Duration of test–retest was one week.

Results: The data obtained indicate high level replicability of multi-feature MMNs to acoustic change.

Conclusions: The test–retest reliability of multi-feature MMN found in this study promotes the usefulness of the MMN in audiology and speech pathology fields.

FP55

Enhancements in auditory steady state responses (ASSR)

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An auditory steady-state response (ASSR) is an electrophysiological response that follows the envelope of a periodically repeated narrow band stimulus. The stimuli may consist of pure tones modulated in amplitude and/or frequency, repeated filtered clicks or repeated band-limited chirp signals. ASSR is mainly used in audiological diagnosis. It is a powerful method to provide frequency

specific estimation of the behavioural pure-tone thresholds in the entire audiometric frequency and level range. Our case study was developed to demonstrate the use of a variable modulation rate between 37 to 163 Hz to improve the correlation between the pure tone audiogram and the ASSR response on both ears. The cochlea acts, among other things, as a real-time spectrum analyzer. A consequence of cochlea mechanics is a frequency-dependent latency between acoustic stimulus and neural activity. Optimized stimuli for AEP recording can partly compensate this delay to generate stronger AEP responses. Moreover, cochlea response is much slower for low stimulus frequencies and much faster at high frequencies. This results in the use of varied repetition rates to be optimal for different stimulus frequencies and bandwidths. This improves stability of responses and results in improved correlation to pure tone audiometry.

FP56

Frequency modulated DPOAEs improve robustness and speed of DPOAE recordings

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When measuring DPOAEs for screening or diagnostic purposes, usually only a handful of fixed frequencies are tested, to keep the procedure short in time. However, a feature of DPOAE known as fine structure can interfere with such testing, if one of the test frequencies happens to hit a fine structure minimum. Typically, fine structure dips can be in the order of 10 dB deep, which means test time would extend by a factor of 10 to record a stable response. Using a suppressor tone in the neighborhood of the DPOAE frequency has been proposed to damp the "second source", which is thought to be responsible for the fine structure. A different way of overcoming the DPOAE fine structure is presented here, using frequency modulated (FM) primary tones, resulting in a frequency modulated DPOAE response. The method will be referred to as FMDPOAE. Standard recording methods for DPOAE, usually based on Fourier transform or similar techniques, do not allow frequency modulation. Therefore, a different approach has been designed, making use of heterodyne filtering techniques. Modulation widths in the order of 100 Hz at modulations rates in the order of 1 to 2 Hz can be applied, while still recording a phase-stable DPOAE signal.

Comparison tests with and without FM indicate that the fine structure is suppressed quite effectively without the need of any additional stimuli and without extending test time on average. Measurements have also shown that DPOAE fine structure is level-dependent. This can – by chance – lead to higher DPOAE amplitude being recorded at lower stimulus levels and vice versa. This fact can have a serious impact on DPOAE threshold estimation methods, based on so-called DPOAE growth functions. On average, FMDPOAE are more robust in this aspect and can therefore improve threshold estimation accuracy significantly.

Free Paper Session 10 | Music and noise

FP57

Relationship between music perception impairment and auditory processing in normal hearing children

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Background: Tone deafness is a neurodevelopmental disorder of the musical processing that affects the subtle aspects of speech processing. Temporal function disorder, who individuals may experience a disorder in the perception of temporal pattern (arrhythmia). The normal auditory system can maintain speech intelligibility in the background noise environment. The perception of the music of the individuals with the problem of speech discrimination in noise can be degraded. The aim of this study is to investigate the relationship between auditory processing abilities in normal hearing children with low tone perception disorder scores.

Material and methods: Twelve individuals between the ages of 12 and 18 years were included in this study. Individuals split into two groups (first group with tone perception scores low, second group with tone perception scores high). The study was conducted in the department of audiology, Hacettepe University. Individuals were assessed for speech in noise test (+5, –5 SNR), tone perception impairment test, frequency pattern test (880 Hz and 1122 Hz) with interstimulus interval of 150 ms and a 10-ms rise/fall time.

Results and conclusions: A statistically significant difference was found between tone perception scores 42.70 (SD±10.2) and speech in noise test ($p<0.05$) in first group. But there was no statistically significant difference between the tone perception scores 60.2 (SD±12.65) and speech in noise test ($p>0.05$) of second group. No statistically significant difference was found between the tone perception scores and the frequency pattern test measurements among the groups.

Conclusions: These findings showed that musical perception skills of individuals with the problem of speech discrimination in noise were low. It is necessary to work with more individuals in order to show the relationship between auditory processing with normal hearing and low tone perception scores.

FP58

Symphony orchestra musicians: Reduction of sound exposure by physical measures

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Measurements by many researchers have shown that musicians in symphony orchestras are regularly exposed to equivalent sound levels above 85 dB(A). Professional symphony orchestras are therefore obligated to take measures to reduce sound levels. Since most musicians are reluctant to wear hearing protection devices physical measures are used in an attempt to control exposure levels. Examples of such measures are increased space between musicians, positioning brass instruments on risers, putting screens between musicians and adding sound absorption. However, it is unknown to what extent such measures are effective. It is difficult to exactly reproduce the music played by an orchestra under different conditions to determine the effect of measures. A solution to this problem is to simulate the effectivity of control measures using a prediction model. In the current study, a model is used to calculate the equivalent sound levels for a performance of the first 2 minutes of the 4th movement of Mahler's 1st symphony, representative for loud orchestral music. The model outcome shows good agreement with measurements of the same excerpt. Next, the model's geometrical and acoustical input is varied to study the possible effect of control measures. Calculated results indicate that risers, available space and screens at typical positions do not significantly influence sound exposure. Hypothetical screens that would fully surround each musician have the largest calculated effect for loud instrument players surrounded by loud sections. In contrast, changing room acoustic conditions has the largest impact on sound exposure of soft players. Our calculated results confirm measured results from other researchers who found similar limited reduction in sound exposure after introducing physical measures. It seems impossible for physical measures to be effective enough to replace hearing protection devices such as ear plugs. Besides, given the fact that often higher equivalent sound levels occur during individual rehearsal compared to group rehearsal, most musicians are better off playing in the orchestra than rehearsing at home. Still, many musicians only focus on taking measures when playing in the orchestra or even blame the orchestra for bad working conditions. It seems that musicians, playing current modern powerful instruments have no other choice than to protect their ears with ear plugs under all circumstances if they wish to avoid the risk of developing hearing damage.

FP59

Music-induced hearing loss in youngsters 12–19 years of age: A longitudinal survey

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This study describes research on the hearing of youngsters 12–19 years of age who are exposed regularly to music noise. The study involves behavioural determinants and long-term effects with respect to hearing capacity.

Subjects: 477 young people, 12–14 years of age, participated in the initial measurements, 289 of them have completed the detailed behaviour questionnaire, and 149 of them participated in the final measurements, 5 years after the initial measurements.

Results: A. Results in terms of behaviour: 1) Young people often use personal music players at high noise levels and they regularly attend school discos and parties with loud music. 2) The awareness of the risk of exposure to loud music noise seems to increase in young people. However, this does not reflect in changes in lifestyle: young people know of the existence of personal hearing protection but the application takes it only very slowly. 3) The lower level of education seems to be correlated significantly to other factors, such as encouraging each other to find loud music nice, long listening to loud music, and alcohol consumption. B. Results in terms of long-term impact: the average audiogram shows an average hearing loss of 5 dB for the high frequencies, 1 kHz to 4 kHz, after 5 years of exposure to noise music. This effect is significant. In addition, almost 50% of all young people complains about tinnitus after exposure to noise music. In this study, 8% of the participants suffer from a permanent beep in the ears.

Recommendations from this study:
1) requirement of adequate information on this topic at the primary school;
2) focus on hearing during contact by a paediatrician at elementary and secondary schools;
3) enforcement actions in discos, etc. with regard to noise level, provision of personal hearing protection, chill-out rooms, etc.

FP60

Therapeutict effect of Metformin for noise-induced hearing loss

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Metformin is known it has antioxidant property. In this study our aim is research curative effect of Metformin for noise-induced hearing loss.

32 Sprague-Dawley female rats, separated into 4 groups, were included in our study. At the begining of the study electrophysiological measurements (DPOAE and ABR) were measured from all rats. During 8 h at 100 dB SPL wide-band noise was exposed to Group 1 and Group 2 after basal measurements. After basal measurements, from 1st day to 14th day, Metformin was given to Group 2 and Group 3 (group 3 was not exposed to noise). Group 4 was never exposed to noise and/or Metformin. All of the groups had been DPOAE and ABR tested after noise exposed 1st, 7th, and 14th day. Intelligent Hearing System (IHS) had been used for DPOAE and ABR measurements. DPOAE measurement had been done 358, 498, 701, 997, 1401, 1977, 2834, 4002, 5636, 7988, 11.288, 15.991, 22.608 kHz. ABR measurements han been done click stimulus and 8 kHz, 16 kHz, 20 kHz and 32 kHz toneburst stimulus. After 14th day, intracardiac blood sample had been taken all of the rats and cochlear excision had been done for biochemical and histological research.

Results: DPOAE and ABR value of group 2 (Metformin had given) after noise exposed, hearing threashold statistically better than group 1 (Metformin had not been given). Both of the groups which exposed to 8 h 100 dB SPL wide-band noise, first day after noise exposed, damage of DNA elevated than the other groups. At group 2 which Metformin had been given, damage of DNA was fewer than group 1 which Metformin had not been given at last 14{th day. At group 2 total antioxidant status was higher than group 1 (Metformin had not been given). At group 1 oxidative stress index was higher than the other groups. In our study, there was no different morphological aspect in light microscopic evaluation at spiral ganglion, stria vascularis, and organ of Corti cells all of the groups. But if we had electron microscopic evaluation, we thought that we could find some variation between groups.

Conclusions: Our results show that noise exposure causes DNA damage and Metformin has antioxidant property and it has therapeutic effect of NIHL.

Free Paper Session 11 | Speech audiometry

FP61

An English smartphone digits-in-noise hearing test: Effect of age, hearing loss, and language competence

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Background: This study determined the effect of age, hearing loss, and language competency on the South African English digits-in-noise hearing test to evaluate its suitability for use across native and non-native speakers.

Material and methods: A prospective cross-sectional cohort study of native and non-native English South African adults with and without sensorineural hearing loss compared pure-tone air conduction audiometry to the speech reception threshold (SRT) recorded with the smartphone digits-in-noise hearing test. A rating scale was used for non-native English listeners' self-reported competence in speaking English. This study consisted of 454 adult subjects (164 male, 290 female; range 16–90 years), of which 337 subjects had the best ear pure-tone average threshold (PTA)(500, 1000, 2000, and 4000 Hz) of ≤25 dB HL.

Results: A linear regression model identified three predictors of the digits-in-noise SRT namely PTA (best ear >25 dB HL), age, and self-reported English-speaking competence. The non-native group with a poor self-reported English competence rating (≤5/10) performed significantly ($p<0.01$) poorer than the native (N) and non-native (NN) (≥6/10) group on the digits-in-noise test. Screening characteristics of the test improve with separate cut-off values for the N and NN (≥6/10) group and NN (≤5/10) groups. Logistic regression models, that include age in the analysis, showed a further improvement for both groups (area under the ROC curve 0.962 and 0.903 respectively).

Conclusions: Self-reported English competence had a significant influence on the SRT obtained with the smartphone digits-in-noise test. A logistic regression approach considering SRT, self-reported English competence and age as predictors of best ear PTA >25 dB HL provides an accurate screening tool for native and non-native English speakers. The smartphone digits-in-noise test, therefore, allows testing in a multilingual population familiar with English digits using dynamic cut-off values adjusted according to self-reported English competence and age.

FP62

Comparison of Spanish speech audiometry tests used with cochlear implant listeners

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Background: The present study aimed at (1) assessing speech-in-noise recognition thresholds for cochlear implant (CI) users with different speech audiometry tests available for the Spanish language and (2) comparing results on an international basis.

Material and methods: Speech recognition threshold were measured for 24 CI users using three speech-in-noise tests: the Spanish matrix sentence test (MT), the Spanish hearing-in-noise test (HINT), and the Spanish digit triplet test (DTT). Results were compared across the different tests and with results for a disyllabic word test in quiet, a common clinical reference test in Spain. As a control, tests were applied to a group of six normally hearing listeners.

Results: Moderate to high correlations were found across scores in all the speech in noise tests. The highest correlation was between the Spanish MT and the Spanish DTT. Almost no correlations were observed between scores for the word test in quiet and scores in noise. Thresholds were comparatively higher for the present participants than for CI users with similar characteristics (age, CI experience) tested in other languages. Results of the normally hearing control group were comparable to the reference data. The number of CI users capable of performing the tests decreased with increasing the linguistic complexity of the test: one-fourth of the CI listeners failed to complete the Spanish HINT (the most complex test); three CI listeners were not able to complete the first of two training lists of the Spanish MT but were able to complete the second training list and the actual test. All CI users were able to complete the Spanish DTT, the least complex test.

Conclusions: When comparing the practical feasibility and efficiency, closed-set tests with international comparability are preferable, i.e. the MT for clinical purposes and the DTT for a quick, but less balanced first assessment.

FP63

Recognition performance for the Hebrew words-in-noise test (WIN-H) in 6- to 12-year-old children

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Background: The Words-in-Noise (WIN) Test (Wilson, 2003), is used to quantify the ability of English speaking adults to understand speech in a background of multitalker babble, and can be used with children as young as 6 years of age (Wilson et al., 2010). The purpose of the current study was to establish normative data for Hebrew speaking children on the Hebrew version of the WIN Test (WIN-H) and to describe the developmental course of monosyllabic words identification in the presence of energetic (6-talker babble noise) and informational (2-talker babble noise) masking.

Material and methods: 272 normal hearing children in 7 age groups, ranging in age from 6 to 12 years participated. The Hebrew WIN test consists of two lists of 35 common CVC words mixed with 2 or 6 talkers babble noise, at 7 SNRs from 24- to 0-dB SNR in 4-dB decrements. Each child listened to two lists, for open-set identification: one list was delivered with 2 talker masker, and the other with 6 talker masker. The WIN-H results were quantified in terms of the 50% point calculated with the Spearman–Kärber equation. Additionally, standardized Hebrew vocabulary test (the Shemesh naming test, Biran and Friedman, 2005) and the Wechsler digit span sub-tests were administered.

Results: Recognition performance improved with age resulting in 5–6 dB SNR difference in the 50% point between the youngest and the oldest age groups. The biggest improvement occurred between the ages of 6 and 9 years. For all age groups, recognition performance was better for six-talker masker than for two-talker masker. In addition to the age effect, WIN-H performance was correlated both to vocabulary score and to backward digit span score.

Conclusions: The Hebrew version of the WIN Test (WIN-H) can be used to test speech in noise recognition performance in 6–12 years old children. Identification of CVC in noise was affected by age and masker type, and was related to expressive vocabulary and to short term memory measures.

FP64

Evaluation of internationally compatible speech test in noise for the pediatric population

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Background: Reliable and internationally compatible speech audiometry in noise for adults as well as for children is of great importance for hearing diagnostics and rehabilitation. This contribution reports evaluations of the simplified Matrix sentence test (shortMatrix) in German, Italian, and Russian for internationally comparable and accurate speech audiometry in children.

Material and methods: The shortMatrix test consists of a 21-word base matrix from which speech phrases of a fixed structure are generated (e.g., 'eight red windows'). For all languages, 7 out of 10 numerals, adjectives, and nouns were selected from the standard version of the Matrix test taking into account words the children are familiar with. Furthermore, the phoneme distribution of the base matrix was compared to the language-specific phoneme distribution. Each of the 10 test lists consists of 14 speech phrases and each word is represented exactly two times in a list. First, speech recognition measurements were conducted with 50 young, normal-hearing adults (20 in Italy and Russia, and 10 in Germany) to prove the equivalency of the test lists and to obtain reference data for adults. Then, the test was evaluated with 204 normal-hearing children (96 in Italy, 63 in Russia, and 45 in Germany) in order to establish reference data for children from 5 to 10 years old and to assess test–retest reliability of the test.

Results: In all three languages, the test lists are equivalent in intelligibility with a standard deviation in speech reception threshold of 0.2 dB across the test lists. The training session requires presentation of 1 list only. The slope of the test-specific intelligibility function for children is slightly lower than for adults and ranges from 9%/dB for German to 12.7%/dB for Russian. Children require about 2-dB better signal-to-noise ratio than adults to correctly recognize 50% of presented speech material. Test–retest reliability is comparable across different age groups of children and between children and adults.

Conclusions: The shortMatrix test was shown to be a reliable test for speech intelligibility measurements in noise for children.

FP65

Pediatric speech audiometry in noise: validation of the Italian simplified matrix test with children

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Background: Speech audiometric sentence tests are crucial for high-quality diagnostics of hearing impairment and rehabilitation purposes,. The simplified Matrix test was proposed as internationally compatible and accurate tool for assessment of speech intelligibility in noise. This contribution reports validation of the simplified Italian Matrix test for accurate diagnostics of hearing deficits in children.

Material and methods: Speech material of the simplified Matrix test consists of 21-word base matrix (7 numerals, 7 adjectives, and 7 nouns) used to generate semantically unpredictable speech phrases of a fixed grammatical structure (e.g., eight red tables). Speech intelligibility measurements in noise were conducted with children aged from 5 to 10 years divided in 3 age groups. In each age group children with different hearing status (normal-hearing, hearing-impaired with mild, moderate and severe hearing loss) were involved. After one training list of 14 speech phases presented at a fixed signal-to-ratio, speech intelligibility was measured adaptively at 80% speech reception threshold (SRT80). In all measurement speech-shaped noise was used as a masker. In addition to the speech audiometry in noise, all hearing-impaired children underwent otomicroscopy, pure tone, and immitance audiometry.

Results: Considering normal-hearing children, no statistical differences in SRT80 were found between children in age of 7 to 10 years old. The youngest group showed significantly higher (worse) thresholds than older groups. High test–retest reliability of about 1.0 dB was observed for all age groups. Hearing-impaired children performed worse than the children with normal hearing. Test sensitivity and specificity will be reported as well as correlation between pure tone audiometry and speech in noise thresholds.

Conclusions: The simplified Italian Matrix test was shown to be an accurate and sensitive tool for diagnostics of hearing impairment in children. The Italian test is also compatible with the tests in other languages what increases the comparability of speech audiometry in children across different countries.

FP66

Validation of the Turkish matrix sentence test in noise

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Background: Listeners with hearing impairment first notice problems in complex listening environments like conversations in noisy backgrounds. Those difficulties are not well reflected by pure tone audiogram findings. The matrix test constitutes a speech audiometric tool to assess information in addition to pure-tone audiogram, i.e., possible supra-threshold distortions in the auditory system due to hearing impairment. Its syntactically equal, but semantically unpredictable sentences (e.g., "Steven prefers three large windows") are generated from a closed set of 5×10 words in a seemingly random fashion. Using an adaptive procedure, the test determines the patient's speech reception threshold (SRT), i.e., the signal-to-noise ratio (SNR) or signal level yielding 50% speech intelligibility. This contribution presents validation results for the Turkish matrix test (TURMatrix) in noise and quiet.

Material and methods: In total, 120 native listeners of Turkish (aged between 18 and 80) participated in this study. 40 of them had normal hearing (pure-tone thresholds below 20 dB HL at octave frequencies between 0.25 and 8 kHz), 80 a hearing loss (pure tone average, PTA 0.5, 1, 2, 4 kHz ≤60 dB HL; 10 dB maximum air–bone gap). SRTs in quiet and noise were obtained by presenting lists of 20 sentences each either 1) monaurally via headphones, or 2) in free field (S0, S0N0, S0N90, or S0N270). For SRT in noise, the test-specific noise was used and for monaural headphone measurements also the fluctuating ICRA5_250 noise. Noise level was fixed at either 65 dB SPL or, for listeners with PTA >55 dB HL at 80 dB SPL. Responses were counted in the open-set response format by word scoring. To observe test–retest reliability, all subjects completed two test sessions, approx. 3–5 days apart. SRTs were correlated to the hearing abilities. For comparison purposes, similar data were collected for the Turkish monosyllabic and trisyllabic test in the same listeners.

Results and conclusions: The TURMatrix was found to provide reliable **Results:** for most of the conditions, mean pair-wise differences between test and retest were about ±1 dB, test–retest reliabilities were between about 1 and 2 dB. The two extremes were found for monaural headphone measurements in test-specific (1 dB), and modulated noise (2 dB), respectively. It can be concluded that the TURMatrix is a sensitive diagnostic tool.

FP67

Preliminary results of Turkish stationary speech in noise test for adults

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Background: Evaluating speech in noise performance has a key role to determine functional hearing performance in enviromental conditions especially for patients with hearing loss and hearing amplification users. Our objective was to develop valid and reliable Turkish stationary speech in noise test and determine normative values for young and middle age adults. The goal was to design a fast, automated, easy to use test to identify difficulties in speech communication especially for people with hearing loss and hearing amplification users.

Material and methods: All participants underwent hearing test. Normal pure tone results and speech in noise scores more than 92% were included the current study. A total of 52 (37 F, 15 M) healthy subjects with no complaints of hearing understanding in noise, active middle ear infection, or history of middle ear pathology were evaluated. Participants aged betwen 20–39 as young adults group (mean age: 28.45 SD=6.26) and 40–65 as middle-aged adults group (mean age: 49.30 SD=5.48). Turkish multitalker babble noise and phonetically balanced monosyllabic word list was mixed and presented at +10 dB, +6 dB, 0 dB, and –6 dB HL speech in noise ratio via calibrated earphones.

Results: The reference range for the Turkish stationary speech in noise test for young adults was established at 88.76% for +10 sin, 85.12% for +6 sin, 76.96% for 0 sin, 31.52% for –6 sin or more of correct answers, while for the middle-aged adults it stood at 85.04% for +10 sin, 68.00% for +6 sin, 68.00% for 0 sin, 24% for –6 sin or more of correct answers. There were no significant associations between the results at all speech in noise ratios and gender.

Conclusions: Evaluation of pure tone thresholds is insufficient in evaluating functional hearing ability. Since there were no reference values available for the Turkish population, in this study we have estimated the results of four different stationary speech in noise ratios.

FP68

Evalution of Turkish matrix test in free-field sound chamber at different signal/noise ratios

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Background: The aim of this study is to measure the performance of the young adults with normal hearing in understanding speech in noise using Turkish matrix test and establish a normalization data to use in free-field tests. The results of this study could be used in the assessment of hearing ability of cochlear implant and hearing aid users.

Material and methods: 77 volunteers with normal hearing, 22 male and 55 female, participated in this study. The age range of the volunteers is 18–30 (mean 22.25±2.7). The signal-to-noise ratio, which the participants achieve a speech intelligibility performance of 20%, 50%, and 80% was determined using the adaptive method. Furthermore, speech intelligibility scores were determined for all participants by applying a different signal-to-noise ratio with non-adaptive method and by changing the direction of the noise.

Results: The mean and standard deviation of the PTA values are 3.73±2.8 dB HL. The mean and standard deviation values of the Adaptive Matrix SRT in Quiet for 20%, 50%, and 80% are found as 18.48±2.6, 22.69±3, and 26.64±3.6 dB SPL respectively. The intelligibility scores obtained at −10 dB, −5 dB, 0 dB, and +5 dB SNR when noise was presented from the rear were found significantly different from the values when noise was presented from the front direction ($p<0.05$). Adaptive Matrix SRT in Noise values were also obtained different for front and rear noise presentation conditions and this difference was also found statistically significant ($p<0.05$).

Discussion: It can be found in the literature that the number of participants is limited when the normalization studies are examined. Since the number of participants in our study is higher, it is considered that more accurate statistical results are obtained. Another limitation of the studies in the literature is to evaluate participants with headphones. So, the results do not refer to the evaluation of patients using cochlear implants and hearing aids in free field. For this reason, in our study measurements were made in free-field.

Conclusions: Findings in our study show that CI users need better SNR values to provide 50% speech intelligibility when compared to the results of matrix test studies with CI users in the literature. As a result, normalization values are thought to be a reference value, especially for patients using cochlear implants and hearing aids.

FP69

The effect of acoustic, phonetic, and lexical variables on recognition of Hebrew monosyllabic words presented in noise

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Background: Measuring recognition performance of monosyllabic words presented in noise helps to demonstrate the communication disability that people with hearing loss are experiencing, elucidating the deficient bottom-up processes. In order to build equivalent and balanced word lists in Hebrew for speech-in-noise testing, it is necessary to characterize the factors that affect auditory decoding. The purpose of the present study was therefor to examine the acoustic, phonetic and lexical variables that may predict recognition performance for Hebrew CVC words presented in babble noise.

Material and methods: 30 young, normal hearing Hebrew speakers listened to 275 CVC words presented with eight talkers babble noise at four signal-to-noise ratios (−7, −2, +3, +8 dB SNR). The 50% point in dBSNR was calculated for each word. Regression and variance analysis examined which lexical, phonetic and acoustic factors affected the 50% point. In addition, for each SNR and for each phoneme, error analysis was conducted.

Results: The selected variables explained 50.6% of the variance in the 50% point [predicting variables ($p<0.05$) by order: final consonant voicing, word familiarity, initial consonant sonority, word duration, initial consonant voicing, initial consonant manner]. Significant negative correlations were found between 50% point and word duration and word familiarity, indicating that longer and more familiar words were easier to recognize. Significant main effects were found for vowel identity, consonant voicing and for consonant sonority. Initial and final phonemes were affected differently by these last phonetic factors: in final position, voiceless consonants were easier to identify compared with voiced consonants, whereas in initial position sonorants were easier to identify compared with obstruents. Error analysis also enabled to scale Hebrew phonemes according to the ease of identification in noise.

Conclusions: When building monosyllabic speech-in-noise test, it is important to balance the phonemic distribution separately for initial and final consonants and to take into account the familiarity of the words. The 50% point for each word can be used to create word lists that will elicit equivalent performance in noise. In addition, error analysis results may aid in building hierarchical intervention programs for improving speech-in-noise understanding.

FP70

Properties of the "Oldenburger Satztest" matrix test: Short-term and long-term learning, age dependency, test–retest accuracy, effect of procedure

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Background: The "Oldenburger Satztest" matrix test (OlSa) is in widespread use in audiology in German-speaking countries. Short-term learning effects have been reported, however more knowledge about long-term effects, age dependency, test–retest accuracy and the influence of the method of conduction is necessary. We therefore performed four experiments to investigate these possible influences. Monte Carlo simulations were used to investigate the effect of limited speech understanding.

Material and methods: Test subjects were normal hearing listeners. Experiment 1 was about short-term learning, experiment 2 about long-term learning. In experiment 3, the effect of the age of the subjects was investigated. Experiment 4 was about the effect of the test procedure: 1) noise level constant, speech level adaptive, 2) speech level constant, noise level adaptive, 3) no noise, speech level adaptive. In Monte Carlo simulations, the 50 different words of the test were used with their individual psychometric function as collected from experiment 1. ANOVAs and Tukey HSD tests were used for statistical analysis.

Results: Subject's gender is of no influence. Short-term as well as long-term effects are statistically significant. Open and closed set conduction yield different results and in both short-term effects exist. Age is of significant influence. Monte Carlo simulations suggest that the simulated subjects' maximum performance in quiet influences results even when far above 50%.

Conclusions: The effects of short-term learning can be reduced by preceding the actual tests by additional training test runs. However, it appears as if it is not possible to reduce the effects of age nor long-term learning effects with additional test runs. For scientific questions with a large number of test runs as e.g. in parametric studies, the OlSa appears to be very well suited. However, this kind of questions does rarely occur in everyday clinical practice. Here, reliable results also with test repetitions in greater intervals are indispensable for reliable diagnosis.

Free Paper Session 12 | Hearing screening

FP71

Newborn hearing screening and factors influencing its Results: our experience

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Before leaving the hospital the transitory evoked otoacoustic emissions (TEOAE) are measured (1.5% had no response). In all these cases newborns are referred to our centre. If the child is hospitalised in newborn intensive care unit (NICU), the auditory brainstem responses are measured. After the full audiology workup, only 31% of children remain with the unresponsive TEOAE.

Material and methods: In our retrospective study 129 children with unresponsive TEOAE after birth and referred to our Centre from the June 2014 to June 2015, were included. We have analysed the medical charts and the questionnaires taken by parents on their first visit. The questionnaire encompasses the sociological, perinatal, postnatal factors and family history all of which could have influenced the child's hearing. Every child was examined by the otorhinolaryngologist, had the tympanometry, TEOAE and behavioural audiometry done. In the case of bilateral unresponsive TOAE, the ASSR (auditory steady state responses) and the auditory brainstem responses (ABR) have been measured.

Results: We have analyzed the relationship between parental age, family history of hearing loss or deafness, maternal infections (toxoplasmosis and CMV), hospitalization in NICU, ear status (cerumen, narrow ear canals), birth weight, term of delivery and subjective hearing evaluation (made by parents) regarding the results of Universal newborn hearing screening.

Conclusions: We found no strong correlation between tested factors and the hearing screening results. We think that one of the reasons could be the small number of participants, but then some larger studies had a similar problem. We think there could be a set of not uniformly defined factors that could influence the unresponsiveness of TEOAE after birth. We find that recognition of such factors could help better define the group of children who need our special attention for a longer period of time. Our own study implied we should have a central database of children with unresponsive TEOAE.

FP72

Follow-up at the diagnostics level in the Polish universal neonatal hearing screening program

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Background: Polish Universal Neonatal Hearing Screening Program (PUNHSP) consists of three levels: first, neonatology – the otoacoustic emission test and collecting data about risk factors for hearing loss; second, ENT and audiology – diagnosis of hearing loss; and third, intervention – treatment of children with a diagnosed hearing loss. On average 8.9% children from the first level are referred to the second level.

Material and methods: The analysis and the study were performed in a group of children born between June 1, 2014 and November 30, 2014, registered in the PUNHSP Central Data Base (CDB) (n=182,978) at the hearing screening level. Among children requiring further diagnosis, 3,239 children without visit on diagnostic level were selected to the telephone survey in order to analyze the reasons for not reporting to the control visit.

Results: The telephone survey showed that only 5.9% of newborn infants required further diagnosis at the second level. Remaining children had mistakenly entered at the first level as requiring diagnostic visit or come up to the diagnostic visit but were not marked in the CDB. The main reason for not coming to the second PUNHSP level included a long waiting time for the visit at the diagnostic level (36.09%), lack of referral to visit (25.9%), conscious parental decision not to come for a visit due to a lack of noticeable signs of hearing loss (16.35%), child's illness at the time of the arranged visit (7.43%), no need for the visit as determined by a GP (4.88%), parents forgetting about the visit (2.76%), parents lack of time (1.27%), too large distance to the second level (0.63%), and child's death (0.21%).

Conclusions: The actual percentage of children diagnosed at the second PUNHSP level was established to be 83.6%. This result is comparable to countries which have similar programs implemented.

FP73

14 years of the Polish universal neonatal hearing screening program

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Background: Polish Universal Neonatal Hearing Screening Program (PUNHSP) has been running in Poland since 2003. The aim of the program is to perform hearing screening in 2–3 day of newborn's life with an analysis of risk factors that predispose to hearing loss. The program involved 501 centers based on three references levels: early detection of hearing loss, audiological diagnosis, and intervention.

Material and methods: From 1 January 2003 to 9 February 2017 there were 5,251,012 children registered in the Central Database of Polish Universal Neonatal Hearing Screening Program. It represents 97% of the newborn population born at that time in Poland. In this period various degrees of hearing loss were recorded in 13,797 children.

Results: 8.9% (464,832) children who had been screened on the first level were sent for further diagnosis. The median age of the diagnosis during the analyzed period was 82.3 days. According to the Central Database of the Program and telephone survey, 83.6% of children who had been targeted for further diagnosis were recorded and diagnosed in laryngological and audiological centers. Bilateral sensorineural hearing loss was diagnosed in 46.0% children, conductive in 17.0% children, and mixed in 9.3% children. In contrast, single-sided sensorineural hearing loss was diagnosed in 13.5% children; conductive in 10.6% children; and mixed in 3.7% children. All children that were diagnosed with hearing loss were referred to third-level centers in order to apply the appropriate treatment: hearing aids, 59.0% of children; rehabilitation, 32.6%; surgical treatment, 8.4%.

Conclusions: PUNHSP is the biggest preventive health Program in Poland which has been successfully conducted for more than 14 years. It was created as a citizens' initiative together with The Great Orchestra of Christmas Charity Foundation with cooperation of neonatologists, otolaryngologists, and audiologists. It is estimated that any hearing loss greater than 20 dB occurs in about 2–3 per 1000 children born in Poland.

FP74

Auditory processing screening in children of school age (11 to 13 years)

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Background: This study aimed to verify the prevalence of auditory processing disorders in school-age children and to correlate the results of screening tests with the results of the P-CHAPPS scale.

Material and methods in this study we used an anamnesis that asked questions about the child's school development, history of hearing loss, hearing difficulties and the dominant hand. Then we did the following tests to detect hearing dysfunctions: Otoscopy, tympanogram, and hearing screening. Then there was some central auditory processing (CAP) tests like sound localization, sequential memory for verbal sounds and nonverbal sounds and the SSW test. For this study we used a joint definition of the various theories for central auditory processing disturbances (CA): all study participants with abnormal results in at least one ear and at least two CAP tests (and at least one of those tests being non-verbal). Participants with only

one out-of-normal test in one or both ears were classified depending on their anamnesis on specific questions. Two positive answers on any of these questions, along with an altered test, classified the child as having CA.

Results: The sample consisted of 40 children. With the definition used in this study we found 11 children (27.5%) who have criteria to be considered as having a CA; Using the ASHA definition, we have only 3 children (7.5%) who can be considered as possessors of a CA; Regarding the correlation between CHAPPS and the prevalence of CA, we noticed that there is no significance between any of the items, however, the correlation between the subscale "CHAPPS attention" and presence of CA is marginally significant. Using the ASHA definition the same happened, no significance noted. Regarding the CAP tests there was significance between the total of the scale and the nonverbal memory test errors. In the case of the 11 children classified as having CA there were correlations of the nonverbal memory test with the memory subscale of CHAPPS and also with the total of scale. We also have correlation of the bilateral SSW test with the memory subscale.

Conclusions: We conclude that: there is correlation between the P-CHAPPS scale and only one auditory processing test; according to the theory used to define CA, prevalence increases or decreases, and there should be more studies in order to universalize theories and to build a general protocol for defining and testing auditory processing, especially in screening.

FP75

Congenital cytomegalovirus infections require a screening and a follow-up program for sensorineural hearing loss and other sequelae

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Purpose: Congenital CMV infection is the most common non-genetic cause of a sensorineural hearing loss in developed countries and an important reason of microcephaly, neurodevelopmental delay, seizure disorders, and cerebral palsy. Only 10% of congenital CMV (cCMV) infections lead to symptoms after birth, however about 6–23% of the infected neonates develop a sensorineural hearing loss at later ages (Fowler & Boppana 2006). Screening programs for cCMV infections are under evaluation. Antiviral therapy of symptomatic children and timely treatment of the symptoms has been shown to effectively reducing the risk of long-term impairments. The CMV virus may cumulate in the cochlea and can be detected during a cochlear implantation of a cCMV infected child.

Material and methods: In an international project running in Germany and Qatar 12,000 neonates undergo a CMV screening by real-time PCR-based testing of liquid saliva specimens. If a congenital CMV infection is confirmed, babies are enrolled in a 6-year follow-up program. If a cochlear implantation of a cCMV-deafened child becomes necessary, the perilymph is examined for CMV by PCR.

Results: By the end of 2016, CMV screenings (specificity 99.7%, sensitivity 100%) of 3242 neonates from Germany and 1687 neonates from Qatar identified cCMV infections of 14 babies in Germany and of 4 babies in Qatar, corresponding to a prevalence of 0.4 and 0.2%, respectively. Babies were enrolled in treatment and follow-up programs. Four of the initially asymptomatic children developed symptoms during their first year of life. Of five CMV-infected children who underwent cochlear implantation, virus DNA has been detected in the perilymph in two cases, in one of them under antiviral medication.

Conclusions: The high prevalence of congenital CMV infections and their lifelong sequelae call for action with respect to the implementation of screening, follow-up, prevention, and intervention programs which seem to be feasible and effective. In case that a cCMV infection is suspected, virus diagnostics of the perilymph during cochlear implantation may provide valuable diagnostic and prognostic hints (Ramirez Inscoe & Nikolopoulos 2004).

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FP76

Optimization of the Flemish digit triplet test for school-age hearing screening

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In Flanders, systematic school-age hearing screenings in 5th grade elementary (5E) and 3rd grade secondary (3S) school children are performed with the Flemish Digit Triplet Test via school health services. This adaptive speech-in-noise self-test is performed using a portable tablet platform.

Based on the results of 14,058 screened ears, normative speech reception thresholds (SRTs) were determined for children aged 9 to 16 years old. Also, optimal referral criteria (SRTs) were determined to minimize false positive and maximize true negative rates with respect to a diagnostic pure-tone audiometry, thereby referring 1.1% (5E) and 2.0% (3S) of children to ENT. A test reliability of 0.6 dB was obtained, which makes the test extremely suitable for accurate longitudinal follow-up of slight deteriorations in hearing (for instance, due to noise exposure). Test durations were around 6 (5E) and 7 (3S) minutes on average for both ears.

To further reduce the duration, and based on the data we obtained from the study described above, we investigated retrospectively the effect of presenting) less triplets (as if we were shortening the test) on the SRT, the referral rate and test reliability. Furthermore, we explored the

homogeneity of the individual speech tokens of the test, by comparing their psychometric functions.

Reduction from 27 triplets (the default) to 11 has no effect on the reference SRT. However, with referral criteria of –6.5 (5E) and –8 (3S) dB SNR, referral rates rapidly increase. Also, test reliability falls. Our results suggest that only 2 triplets can be skipped in order to maintain the reliability of the default test, gaining an estimated 1 min in testing time. The analyses of the psychometric functions show that some speech tokens might need a second wave of level adjustment.

To conclude, test reliability and test duration are inversely proportional. Whereas shortening the test does not affect its normative value, it can drastically increase referral rates. Current work is focusing on another scoring method (i.e. digit scoring instead of triplet scoring), since it has been shown in adults to result in increased test reliability.

FP77

Enhanced strategies in screening, tracking, and follow-up: Different approaches from Germany, Iran, Uzbekistan, and Georgia

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A universal and quality controlled newborn hearing screening program requires a number of prerequisites for a long term, efficient and reliable outcome. New technical standards enable new approaches in screening strategies. Enhanced screening procedures avoid high loss to follow-up rate as well as unnecessary appointments in diagnostic centers. Re-tests can be performed in combination with multi-level ABR, targeted ASSR, or DPOAE frequencies in a few minutes without the need for a higher audiological knowledge. Data will be transferred for central assessment. Especially for regions with limited medical infrastructure this approach reduces appointments and travelling to remote follow-up centers. It enables audiological expertise in areas with insufficient facilities. Approximately 80% of follow up appointments will end up without pathological findings for the patient. Approximately 50% of "lost to follow-up cases" are caused due to the long distances required to travel for the patient in order to be seen by the referral expert.

This approach of telemedicine in screening, tracking, follow-up requires a direct data transfer between instruments and tracking server. Data transfer via wireless radio technology represents an "out of the box" solution, which is independent from any hospital IT infrastructure. Data is encrypted and transferred directly from instruments to a central database in the tracking center and vice versa. Mobile data networks are available worldwide at any time at any location, even in areas with limited infrastructure.

A nationwide or region-wide screening program requires uniform prerequisites. With bi-directional communication all settings for the instruments can be made in the tracking center, generating substantial saving in resources. The independent wireless data transfer can be connected to all existing tracking systems. In combination with pathTrack software it is available in different screening approaches, e.g. in preschool, newborn hearing screening, or telemedicine.

The presentation illustrates the feasibility and effectiveness of data exchange and tracking systems with respect to the varying demands in a number of screening and follow-up approaches in different countries such as Iran, Georgia, Uzbekistan, and Germany.

FP78

Comparison of the reliability of mobile equipment and a standard automatic hearing screening equipment

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Background: Otoacoustic emission is an objective test that has been widely used in recent years, especially in the hearing screening program. The duration of the test, the reliability and the practicality of the device are important while performing the test. Tele-audiology has been used in many fields of audiology since the 1990s and especially in hearing screenings in America. In our study, it was aimed to compare the reliability of the results, test duration, and ergonomics of the hearing screening equipment.

Material and methods: 126 subjects (59 male, 67 female) were included in the study. The age of the cases ranged from 0 to 299 days and an average of 20.67 ± 45.38. All subjects were tested with the otoacoustic emission test at the same time using Neuro-Audio-Screen (Neurosoft, Ivanovo, Russia) and Neuro-Audio-aScreen software and a probe mounted in Huawei p800 mobile phone (Neurosoft, Ivanovo, Russia). The measurement times of two tests and the test results were compared with each other.

Results: There was no statistically significant difference between Neuro-Audio-Screen and Neuro-Audio-aScreen mobile device about measurement times ($p > 0.05$) and the results of the otoacoustic emission test ($p > 0.05$).

Conclusions: It was considered that the use of both devices is reliable because there was no significant difference between Neuro-Audio-Screen and Neuro-Audio-aScreen mobile devices in detecting hearing loss, time of measurement, and reliability. In addition, mobile devices could be preferred because they are cheaper, more portable, and more suitable to tele-audiology.

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FP79

Audiology and intellectual disability: Preliminary results of EFAS WG

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Background: Hearing impairment has negative important consequences without appropriate treatment. Its high incidence (5% in general population, WHO report) is increased in intellectual disability (ID) persons (ranging from 21% to 70%) (H. Evenhuis et al., 2004; Hild et al. 2008). Due to limited self-report of this sensorial handicap, active detection of hearing loss should be implemented and hearing screening is the most effective method.

Material and methods: EFAS Working Group on Audiology & Intellectual Disability review literature in the field and developed a questionnaire to determine the actual level of health/audiological services available among European countries. Additionally, the WG developed guidelines for timeline of hearing screening in people with ID based on specific etiology of ID (especially Down syndrome) and hearing loss incidence in ID population.

Results: Preliminary results from questionnaires, gathered from 22 European countries, revealed low level of audiological services at national level in Europe. Few exceptions exist, where dedicated programs for ear and hearing screening in ID persons are implemented, mainly for Down syndrome population. Recommended timeline of hearing screening will be presented as guidelines developed by the EFAS WG.

Conclusions: High incidence of hearing impairment at different age-group of ID persons, more rapid progression than in non-ID population, and low self-reported hearing problems are strong arguments for health policy changes in favor of hearing screening in ID population.

References:

1. Evenhuis H et al. Prevalence of visual and hearing impairment in a Dutch institutionalized population with intellectual disability. J Intellect Disabil Res, 2001; 45(5): 457–64.
2. Hild U et al. High prevalence of hearing disorders at the Special Olympics indicate need to screen persons with intellectual disability. J Intellect Disabil Res, 2008; 52, 520–28.

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FP80

European collaboration through EFAS to improve early childhood hearing and communication screening programmes: Irish pilot study

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Background: EFAS guided the adoption of an EU Consensus document in 2011 (European Consensus Statement. Int. J. Paed. Otorhinolaryngology Jan;76(1): 120–1) to promote the aspiration of Hearing and Communication Screening for all children at school entry age. Research is being developed through the EFAS Working Group on Early Childhood Hearing Screening into both methodology and outcomes; some new Irish data will be described.

Material and methods: Database analysis of over 500 child health records from several Irish school cohorts, relating especially to hearing and vision screening, and including the impact of specialist schools nurses being appointed.

Results: Coverage, efficiency, and effectiveness of existing Irish school entry screening programmes will be presented; additional data on the use of preschool therapy services attended, with some initial information on outcomes, will be described.

Conclusions: School entry screening methodology and comparative European data may be more feasible to examine with information from Irish study. Participants can then evaluate the potential challenges, costs, and benefits of childhood hearing screens at both pre-school and school entry level.

Free Paper Session 13 | Electrical and acoustical auditory stimulation

FP81

Interaural timing and sound localization in single-sided deaf cochlear implant users

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Background: The performance of binaural hearing is severely degraded in patients suffering from single sided deafness. One particular problem for this group of patients is the limited localization ability for sounds originating from different directions. Rehabilitation of the deaf ear with a cochlear implant (CI) aims to recover binaural hearing performance and should also result in an improvement of localization abilities. However, even with CI the performance of normal hearing listeners cannot

be reached. One reason might be the different timing of electrical stimulation via CI and natural hearing in the normal hearing ear as the processing of information is not synchronized. Evidence for frequency specific time differences in the range of a few milliseconds were found in auditory brainstem response measurements. Hence it is hypothesized that changing the timing of the cochlear implant might have an effect on sound source localization in single sided deaf cochlear implant users.

Material and methods: The sample consisted of 12 single sided deaf cochlear implant users at ages of 53±12 years. All patients participated in sound localization tests in an anechoic chamber. During these tests the microphone signal picked up by the patients' audio processor was delayed by 0.5, 1, 2, and 4 ms in a pre-processing step to vary the synchronization between the cochlear implant and the normal hearing ear.

Results: In all patients delaying the signal of the cochlear implant had a significant impact on sound localization. Particularly at signal delays of 1 and 2 ms sound localization performance improved compared to conditions "not delayed" (as in daily use). Repeated measures ANOVA revealed significance for the factor "time delay" and corresponding post hoc comparisons proved significant differences for signal delays of 1 and 2 ms. This compensation of timing is in agreement with auditory brainstem response measurements, which show a desynchronization of the cochlea implant and the normal hearing ear by about 1 ms in the same CI systems at frequencies above 1.5 kHz.

Conclusions: Improvement of binaural hearing performance may be achieved by compensating different temporal processing of CI and the normal hearing ear in single-sided deaf cochlear implant users.

FP82

How close can we get to a real CI with acoustic simulation?

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Hilkhusyen and Macherey (2014) have recently proposed pulse spreading harmonic complexes (PSHCs) as an alternative acoustic carrier in noise-excited vocoders. PSHCs have less intrinsic modulation with the aim to be closer to CI stimulation. Mesnildrey and al (2016) showed that speech in noise scores in normal-hearing listeners were better with PSHC-vocoder than noise-vocoding and worse than with sine-vocoding. In the quest for a closer match to real CI we compare stimulation with CIs versus three different carriers in CI users with single-sided deafness (SSD). We also investigated the mismatch between analysis and carrier frequency that may result due to the specific position of CI electrode contacts by varying carrier bandwidth.

Six single-sided deafness patients performed a forced-choice comparison task embedded in 4 blocks of 36 trials. On each trial, subjects heard two intervals, each containing the same recorded sentence. In the first interval they were first presented with speech processed via the CI sound (via the auxiliary input of the clinical sound processor) followed by speech processed via an eight-channel vocoder simulation (presented via a single earphone Etymotic ER1). In the second interval, the CI-processed sound was followed by a different vocoder simulation. The latter differed in the two intervals by carrier type (PSHC, sine or noise) and/or carrier bandwidth (1: no mismatch – carrier bandwidth the same as input bandwidth, 2: shifted up by 1/2 octave, 3: shifted up by 1 octave). Subjects were then asked to state on in which of the two intervals the sounds were most similar. The sentence and the speaker were the same for 4 blocks with a training session every 2 blocks. The blocks were repeated twice.

For three of the six subjects tested so far, PSHC-carriers were judged more similar than sinusoidal carriers, one subject judged PSHC more similar than noise carriers, and three out of six subjects judged noise carriers more similar than sinusoidal carriers. Notwithstanding the variability in the results, we suggest for now that the PSHC-carrier might produce auditory sensations somewhat closer to a real cochlear implant than conventional sinusoidal and noise carriers. Also, no mismatch in vocoder bandwidth was judged more similar to CI processing significantly more often than the 1/2 and 1 octave up-shifted bandwidths. These data will be interpreted with respect to electrode contact positions determined from post-operative CT scans.

FP83

Speech perception in bimodally listening cochlear implant users

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The typical listening situation for most cochlear implant (CI) listeners is the bimodal binaural situation, i.e. combining the electric CI input on the one side with acoustic input of a contralateral hearing aid (HA). When sufficient residual hearing is present, bimodal listeners perform significantly better than those who receive stimulation from a CI only. At the Cochlear Implant Center Erlangen about two-thirds of the adult patients use both the CI and the contralateral HA. The aim of the current investigation was to identify the audiologic parameters determining the bimodal speech perception benefit.

Audiometric measurements of 151 patients (age: 61±16 years) provided with a CI and a HA were retrospectively analyzed. In particular, the puretone audiograms of the HA side, sentence perception (Göttinger Sentence Test) in quiet at 65 dB and in noise (speech reception thresholds, SRT) were investigated. For all subjects, results for the HA

side, the CI side, and the binaural situation were available. SRT measurements were performed in the S0N0 situation.

Puretone thresholds on the HA side (4 frequency average at 0.5, 1.0, 2.0, and 4 kHz) ranged from 13 dB to complete deafness (i.e. 130 dB). Mean puretone loss was 88±27 dB HL. Speech perception scores in quiet were determined as 79±21%, 69±30%, and 90±14% for the CI only, HA only and bimodal, respectively. Speech recognition thresholds in noise were 6.9±6.3 dB, 7.1±6.9 dB, and 3.4±6.8 dB for CI, HA, and CI+HG, respectively. For both situations, in quiet and in noise significant binaural benefits were found on average. However, the benefit showed a large variation. Neither age, nor duration of CI use, nor puretone loss could explain the individual differences sufficiently.

In summary, bimodal hearing is beneficial for most CI users. Bimodal speech perception scores in quiet and in noise are typically better than the HA alone or the CI alone condition.

FP84

Benefit of bimodal stimulation with cochlear implant and hearing aid in the elderly

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Background: Postlingual deafness in adults can be effectively treated with cochlear implants (CI). Residual hearing in the non-implanted ear is usually treated with a hearing aid (HA). Data on bimodal stimulation in elderly patients is still limited. In our study we compared the audiological and subjective outcome of bimodal stimulation in a population of elderly CI users.

Material and methods: 22 patients aged >70 years were implanted with unilateral CI between 2002 and 2014. 17 patients used bimodal stimulation with HA and CI. We analyzed the audiological benefit of CI, HA, and bimodal stimulation (pure tone average, speech recognition) retrospectively in a chart review. Time to follow-up was 6 months to 12 years. For assessment of the subjective benefit we used a structured questionnaire.

Results: Speech recognition was better in the bimodal situation than with CI alone (word recognition score of 61% *vs.* 53% in monosyllabic word testing in quiet @ 65 dB SPL; p=0.35). Residual hearing in the lower frequencies was not significantly correlated with bimodal benefit.

Conclusions: Bimodal stimulation is beneficial in most elderly patients with better word recognition scores and subjective benefit. Regular control of hearing aid fitting is recommended to further optimize the benefit.

This data is published in Laryngo-Rhino-Otology.

Free Paper Session 14 | Cochlear implants in different populations

FP85

The relationship between speech perception measures and language scores among Arabic-speaking toddlers using cochlear implants and the language acquisition gap between them and hearing toddlers

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The contribution of this study is the linking between speech perception measures and language outcomes as part of assessment and intervention protocols. In general clinical practice, when audiologist verify the outcomes of cochlear implant (CI) mapping, they use speech perception tasks not language task. This might lead to misunderstanding the full developmental stage of the child. Thus, understanding the links between speech perception and language acquisition is critical.

Twenty Arabic speaking toddlers who were implanted between the ages 10–36 months participated in this study. Their hearing age was 1: 6–3: 0 years (chronological age 2: 8–6: 1 years). The control group included 41 hearing toddlers matched to the CI group in hearing age (thus, their chronological age was 1: 6–3: 0 years). The CI group was evaluated using three open-set speech perception tests: at a phoneme level (vowel–consonant–vowel), at a word level (two-syllabic and one-syllabic), and at a sentence level. In addition, the parents filled in a hearing function questionnaire (PEACH). Language level was evaluated both in the CI and in the hearing groups using two language measures: a vocabulary task (Hebrew Communicative Development Inventory) and a sentence repetition task exploring different syntactic structures for children in this age range.

Results showed positive correlations between speech perception scores at a sentence level and the hearing function score as well as between all three speech perception scores and the language measures (Ps<.001). These findings support the validity of these measures, specifically the validity of the hearing function questionnaire as a communication assessment tool. Surprisingly, no correlations were found between hearing age and chronological age and the two language measures (Ps>.05). In addition, when comparing the CI group with hearing group, the former performed significantly lower than the latter on syntax task (Ps<.05), although performed equally on the vocabulary task.

The current findings support the sensitivity of speech perception tasks as predictors of language outcomes in toddlers using CI. The language gap between the CI group and hearing group raises the question of when do these

toddlers close the language gap? Importantly, there is a need to develop sensitive diagnostic tools that can be used routinely in daily practice to identify those children who need further intervention.

FP86

Benefits of cochlear implantation in the Roma population: Do we really know?

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The cochlear implantation program points on the early identification of hearing loss and its adequate rehabilitation. The main aim is to give every child the tools needed to understand the language and to communicate effectively. The benefit of cochlear implantation is evaluated by using various speech discrimination tests.

Based on the last census the citizens in Roma nationality make up 2.4% of the Slovak population (the second largest national minority in Slovakia). Although living in Slovakia, the Roma population uses its own language and has its own lifestyle influenced by specific Roma culture, resulting in the poor understanding of Slovak as official language in the majority of Roma children. This fact leads to difficulties in knowing the real benefit of cochlear implantation.

From 2010 to 2016, 125 cochlear implantation (68 children, 57 adults) were performed in University Hospital in Košice, Slovakia. Of 68 child patients, 40 (59%) were of Slovak nationality and 28 (41%) were Roma children. 66 adult patients (100%) were of Slovak nationality, and there was no Roma patient. Each patient received Oticon Saphyr SP devices and were started on the rehabilitation program after implantation in our center.

The presentation is focused not only on difficulties in the rehabilitation process in this specific ethnic group, but also on both our support and future goal.

FP87

Auditory performance and electrical hearing in cochlear implant recipients with auditory neuropathy compared to severe-to-profound sensorineural hearing loss

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Background: The aim of the study was to compare auditory and speech outcomes and electrical parameters on average 8 years after cochlear implantation between children with isolated auditory neuropathy (AN) and children with sensorineural hearing loss (SNHL).

Material and methods: Sixteen patients with isolated AN with current age of 5–12.2 years who had been using a cochlear implant for at least 3.4 years and 16 control patients with SNHL matched for duration of deafness, age at implantation, type of implant, and unilateral/bilateral implant placement. All participants had had extensive auditory rehabilitation before and after implantation, including the use of conventional hearing aids. Unaided pure-tone audiograms were evaluated before and after implantation. Main outcome measures were between-group differences in the following parameters: 1. Auditory and speech tests. 2. Residual hearing. 3. Electrical hearing. 4. Correlations of residual hearing at low frequencies with electrical thresholds at the basal, middle, and apical electrodes.

Results: The children with AN performed equally well to the children with SNHL on auditory and speech recognition tests in both quiet and noise. More children in the AN group than the SNHL group were attending mainstream educational settings at school age. Significant between-group differences were noted in electrical measurements: the AN group was characterized by a lower current charge to reach subjective electrical thresholds, lower comfortable level and dynamic range, and lower telemetric neural response threshold. Based on pure-tone audiograms, the children with AN also had more residual hearing before and after implantation. Highly positive coefficients were found on correlation analysis between T-levels across the basal and mid-cochlear electrodes and low-frequency acoustic thresholds.

Conclusions: Children with isolated AN do at least as well as children with SNHL on auditory performance tests after cochlear implantation. The lower current charge required to evoke subjective and objective electrical hearing thresholds in children with AN compared to children with SNHL may be attributed to the contribution to electrophonic hearing from the remaining neurons and hair cells. In addition, it is also possible that mechanical stimulation of the basilar membrane, as in acoustic stimulation, is added to the electrical stimulation of the cochlear implant.

FP88

Spectral and temporal cues to voice pitch perception in cochlear implant users

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An important aspect of speech perception is voice pitch, or fundamental frequency F0, which is a strong cue to speaker identity and emotional state, and clarifies meaning via prosody in Western languages and tone identity in

Oriental languages. We describe two studies of voice pitch perception undertaken in our centre. In the first we used a novel experimental sound coder "STEP" that allowed separate control of spectral and temporal resolution. In the second we studied voice pitch perception in a cohort of 61 cochlear implant subjects using clinical processors.

Voice pitch perception varied widely across CI subjects in both studies. The conventional approach to improving voice pitch perception by enhancing temporal envelope modulation at F0 appeared ineffective. However improvements were seen in prosody perception for poorer performing subjects by doubling spectral resolution below 1000 Hz. In the large cohort study Nucleus subjects with perimodiolar electrodes performed significantly better than those with straight electrodes. Thus both studies indicate that better spectral resolution may be the key to improving voice pitch perception by cochlear implant users.

FP124

Speech understanding in noise and over distance for cochlear implant recipients with single-sided deafness using the Roger digital wireless remote microphone system

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In previous studies, the effectiveness of wireless remote microphone systems has been demonstrated for wearers of bilateral hearing aids as well as unilateral and bilateral cochlear implant (CI) recipients with bilateral hearing loss. It was shown that a remote microphone system together with a hearing aid and/or CI allowed for significant improvements in speech understanding over distance and in noise at various noise levels (Lützen, 2014; Thibodeau, 2014; Wolfe et al., 2013).

The objective of the current study is to assess if using a remote microphone system (Roger digital wireless system) leads to an improvement in speech understanding for CI recipients with unilateral or single-sided deafness (SSD) when listening at a distance and in different levels of background noise.

Ten adult single-sided deaf CI recipients participated in the study. Speech understanding was measured using the Oldenburg sentence test (OlSa) presented in multi-channel noise at three presentation levels for different hearing conditions. In these tests the SSD CI recipients used the Roger digital wireless remote microphone system with their normal hearing ear, their CI processor, and bilaterally.

Preliminary results indicate that SSD CI recipients obtained best speech understanding in noise when receiving the Roger signal bilaterally.

FP90

Parent perspectives of pre-lingually deafened children using a cochlear implant

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Background: With recent advances and upcoming technology, cochlear implants(CI) have become choice of intervention for pre-lingually deafened children. Use of CIs has greatly benefited society as they help in increasing communication skills, social well-being, and autonomy. After CI, the main role of family and speech-therapist is to bring out effective results. Thus, it is of utmost importance to assess how parents perceive their children after they undergo CI.

Material and methods: This study is a prospective cross-sectional questionnaire-based study. For analysing the parental perspective of the pre-lingually deafened children with cochlear implant, we used the questionnaire "Children with cochlear implants: parental perspectives". It consists of 74 non-grouped affirmative and negative phrases, divided into subscales regarding the child and their family. Subscales were made from these questions and were categorised into communication, functionality, parental perspectives of children with communication, functionality, autonomy, well-being, social relations, and education. The questionnaire consists of a total of 74 questions; out of these 48 were quantitative and 26 were qualitative. Each question has five options scored from 1 to 5. Questionnaires were given to 98 parents whose children were pre-lingually deafened and less than 10 years of age. Correlations amongst these variables were made using Spearman's rank correlation method. To determine the normality of different variables, a Kolmogorov–Smirnov test was applied.

Results: After analysing the questionnaire it was found that there were 36 boys (36.2%) and 62 girls (63.8%). Subscales of education showed highest mean of 25.61, followed by functionality 24.75, social 24.66, communication 23.29, support 22.04, effects of cochlear implant 20.21, well being 19.64, and autonomy 15.11. It was seen that functionality, autonomy, well-being, and effects of cochlear implant showed significance ($p<0.05$).

Conclusions: It can be concluded that parents perceive advantage of CI for communication, functionality, well being, and education of the child. It is also seen that the questionnaire is effective in an Indian population for pre-lingually deafened children who have undergone a cochlear implant.

FP91

A program of vestibular system stimulation and its significance for speech development in children with a cochlear implant

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There is a documented bibliography on the benefits of cochlear implants (CIs) in the area of speech perception as well as linguistic competence, which means the ability to use language in an effective and suitable way in accordance with the situation. This competence depends on biological skills (perception and completion processes) and communicative brain actions (intellectual abilities). The neurophysiological analysis of development processes in children (hearing or hearing impaired) clearly indicates links between the level of language development and motor functions within the scope of motor skills. It is an indisputable fact that speech production is a physical act connected with motor activity. The majority of researchers about the functioning and abilities of the vestibular system of people with CI, focus on neuromuscular control represented by the ability to keep balance. However, data about the influence of CI on psychophysical functions aren't clear.

Our paper shows the results of conducted research about intensive training during rehabilitation camps. Our purpose was to check if the improvement of motor skills has any connection with the speech development of children with CI. 17 children with profound hearing loss with CI aged from 4.2 to 10.1 (M=6.7±1.7), with their parents and therapists, were the participants of a camp organized by the Association of Parents and Friends of Deaf Children in Krosno, Poland. The children were tested by pre- and post-test: body control, spirometry, balance skills. The level of linguistic competence was assessed as well as birth potential (Apgar). Every day, for 2 weeks, apart from all the planned speech therapy, there was a set of general movement exercises (directed at the vestibular system). The results of the post-test showed the increase in correlation between static, dynamic equilibrium and the results of test that assess linguistic competence, Apgar scale, and age (R=04 does 0.9). It has been proven that there is a significant presence of relevant neurophysiological bonds in the scope of development of balance and language skills. The results of this pilot research indicate the necessity of further continuous research in the field of coordination motor abilities (CMA) as well as in terms of the development of linguistic and communicative competencies. Practical implication is to recommend for young hearing-impaired children speech therapy combined with movement activities.

Free Paper Session 15 | Bone conduction devices

FP92

ADHEAR, the adhesive bone conduction system: Principles and applications

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Otorix

Background: The development of the adhesive bone conduction system was driven by a vision to offer an acceptable non-invasive bone conduction solution for all those who are reluctant to or who cannot have implant surgery. There is a significant need for a well-functioning non-surgical bone conduction device for bilateral and unilateral conductive hearing losses, especially in paediatrics. The new concept is based on a unique small disposable adhesive adapter attached to the skin behind the pinna. An ear level audio processor can be connected and disconnected to the adhesive adapter.

Material and methods: The fundamental physics and principles behind the adhesive bone conduction system will be discussed. In collaboration with clinics and universities the audiometric performance and clinical outcome have been investigated. Audiometric evaluation of the concept was performed by measuring hearing thresholds with the adhesive bone conduction system compared with the established softband solution for bone anchored hearing aids. The clinical experience included both audiometric evaluation and subjective evaluation with for example Glasgow Children's Benefit Inventory.

Results and conclusions: The adhesive bone conductor offered similar hearing stimulation as the established solution. The new system offers significant advantages in terms of wearing comfort and aesthetics since it does not include any pressure against the skin and no bulky headband arrangement is required. The Glasgow Children's Benefit Inventory, shows that the adhesive bone conduction system is a user friendly and efficient device with high scores on benefits and user satisfaction. The patients are now using it on a regular basis and the first patients that were fitted have now used the concept for more than three years. As for any ear level bone conduction concept where the vibrations are damped when being transmitted through the skin, this type of ear level concept is primarily intended for bilateral and unilateral conductive hearing losses and not for more severe mixed hearing losses.

FP93

User satisfaction and clinical efficacy of a new non-invasive bone conduction hearing system in single-sided deafness

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Background: Recently, the ADHEAR hearing system has been developed as a novel bone conduction (BC) concept. The system comprises two parts: an adhesive adapter and an audio processor that are worn together behind the ear. This solution is introduced as a non-surgical treatment for conductive hearing loss (CHL) and single-sided deafness (SSD). In SSD cases, this device may be a good solution for patients who are unsuitable for, or who do not wish to undergo, bone conduction device (BCD) or cochlear implant (CI) surgery.

Objectives: The aim of the study is to investigate the user satisfaction and clinical efficacy of the ADHEAR hearing system in SSD. A randomized cross-over study design will be conducted, using the CROS hearing aid as a control.

Material and methods: In order to define the user satisfaction and clinical efficacy of the ADHEAR hearing system the following outcome measurements will be administered after a two-week trial: 1) speech perception in noise (SSSDNAH, S0NSSD, S0NNH, and S0N0), 2) sound localization, 3) the Speech, Spatial and Qualities of Hearing scale (12-item version) (SSQ12), the Audio Processor Satisfaction Questionnaire (APSQ), and the ADHEAR Adhesive Adapter questionnaire. Using a randomized cross-over study design, the study compares the user satisfaction and clinical efficacy of the ADHEAR hearing system and a CROS hearing aid in the same group.

Results and conclusions: The first results with the novel non-surgical ADHEAR hearing system of 10 SSD subjects will be presented at EFAS2017 in Interlaken.

FP94

Performance evaluation of a novel transcutaneous bone conduction hearing aid

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Background: Bone conduction hearing aids are indicated in patients who can not wear traditional hearing aids because of chronic infections or atresia of the external auditory canal, and in patients with single sided deafness. A newly developed transcutaneous bone conduction hearing aid (OSI) is evaluated with regard to the transfer function efficiency and acoustic feedback.

Material and methods: Experiments were conducted on five Thiel embalmed whole head cadaver specimens. A transcutaneous bone conduction hearing aid device (OSI) is sequentially implanted on three positions: 1) traditional BAHA position 5 cm posterior of the tragus in the temporal line, 2) superior to the external auditory canal as close to the cochlea as possible, 3) a posterior position 7 cm behind the tragus in the temporal line. For each stimulation location three types of measurements were performed: 1) acoustical feedback, from OSI to the modified sound processor, was measured; 2) motions of the cochlear promontory were measured on the ipsilateral and contralateral side, at a single point using a 1-dimensional laser Doppler vibrometer (LDV) system, and measurements were repeated after mastoidectomy on the ipsilateral side; 3) 3-dimensional (3D) motions of the bone surrounding the OSI were quantified at 70–90 points, covering an area of approximately 8×8 cm, using a single point 3D LDV system, supported on an automated robotic arm. All measurements at stimulation position 1 were done with both OSI (piezoelectric transducer) and BAHA Cordelle II (electromagnetic transducer), sequentially, for comparison purposes.

Results: Surface wave patterns of the skull surface, for stimulation with OSI and BAHA Cordelle II, are comparable for both the magnitude and phase of motion. The magnitude of motion at the promontory, normalized by the driving voltage, is higher for stimulation with BAHA Cordelle II compared to OSI, at low frequencies (i.e. <0.6 kHz), and vice versa at mid and high frequencies (i.e., 1.5–10 kHz).

Conclusions: The sound transfer function efficacy and acoustic feedback of a novel transcutaneous bone conduction device have been quantified, and the influence of stimulation position and the state of the mastoid have been analyzed.

FP95

BAHA treatment with various acquired and congenital ear malformations in children

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Background: Children with conductive and mixed hearing loss in cases of congenital ear malformations (bilateral microtia with external auditory canal atresia), after chronic otitis media, or in single-sided deafness (SSD) can be treated applying bone anchored hearing aids (BAHAs). Our aim was to assess the results of application of BAHA in children and to compare hearing obtained with typical bone conduction hearing aids (head-band hearing aid, bone conduction glasses, or cross system in SSD to hearing in Baha system.

Material and methods: Our treatment method of hearing impairments in the presented group of various defects of the ear included implantation of titanium fixture to the temporal bone with or without removal of subcutaneous tissue around it. In most of the cases it was a one-stage procedure. After implantation the titanium screw was not used for about 6 weeks to 4 months, to provide good healing and proper osseo-integration. Then a hearing aid was

selected. Audiological examinations were performed 1 and 6 months after hearing aid fitting. Our material consists of 117 patients of age 3 y.o. to 18 y.o.

Results: Audiological results are good and sustainable. Thresholds measured in free field audiometry wearing BAHA hearing aids are on average 8.8 dB lower in comparison to previously used hearing aids. Our patients comment that the new hearing aids provide better sound quality, speech understanding, are comfortable and are more aesthetic comparing to typical bone conduction hearing aids.

Conclusions: Application of BAHA in children with various hearing loss in ear malformations is good from an audiological perspective, safe, and comfortable for the user.

FP96

Binaural hearing ability with bilateral bone conduction hearing aids: Effect of hearing status

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Background: The interaural separation of bone conducted sound is low, and there is a general assumption that binaural hearing is inefficient with bilateral bone conduction hearing aids. Bone conduction hearing aids are therefore most often fitted unilaterally. Sparse data in the literature indicates that binaural hearing can be efficient in subjects fitted bilaterally with bone conduction hearing aids. Therefore, to the current study aimed to evaluate the ability to use binaural cues with bilateral bone conduction stimulation and evaluate the influence from symmetrical and asymmetrical hearing loss.

Material and methods: Eighty persons were included in the study. Thirty had bilateral normal hearing thresholds, 20 had moderate symmetrical hearing loss, 20 had moderate asymmetrical hearing loss, and 10 had unilateral deafness. They were tested with release from masking and binaural intelligibility level difference using the matrix sentence test, and just noticeable differences for interaural level and time differences using brief tonal stimulation. The stimulation was applied bilaterally in two modalities, air conduction stimulation using earphones and bone conduction stimulation using vibration transducers at the mastoids.

Results: All groups except the unilateral deaf group showed binaural hearing ability. The results were generally better with air conduction stimulation than with bone conduction stimulation. The result were worse with symmetrical hearing loss compared to normal hearing, and worse with asymmetrical hearing loss compared to symmetrical hearing loss. The testing of just noticeable differences for interaural time and level differences indicated that temporal separation at low frequencies was significantly worse for bone conduction than for air conduction stimulation, but sensitivity to level differences were similar for the two stimulation modalities.

Conclusions: Bilateral bone conduction stimulation provides binaural hearing in subjects with normal hearing, sensorineural hearing loss, and asymmetrical hearing loss. These results suggest that bilateral fitting in subjects using bone conduction hearing aids is justified for all types of hearing status. The results also suggest that binaural hearing with bilateral bone conduction stimulation is primarily driven by interaural level differences.

FP97

The benefit of a 2nd bone-anchored hearing implant can only partially be estimated by using a speech processor on a test band

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Background: Unilateral users of one bone anchored hearing implant (BAHI) who could benefit from a 2nd BAHI on the other ear usually test the new device preoperatively in a trial with a test band. The objective of this prospective study was to investigate, how well tests with a 2nd BAHI on a test band approach its benefit of the same device after implantation.

Material and methods: 16 adults, ages 27–79, average 65 years, thereof 8 unilaterally implanted BAHI users (group A) and 8 bilaterally implanted users (group B) participated in the study. Aided sound field measurements with Cochlear Baha 4 devices. Speech-in-noise tests with speech from the front and noise either from the left, right, or from and front in 2 conditions for group A (with 1 BAHI, and with 2 BAHIs, 2nd device worn on test bands) and in 3 conditions for group B (same 2 conditions as group A, and additionally measurements with both BAHIs snapped on the abutments). Improvement of speech understanding in noise with 2 BAHIs, compared to only 1 BAHI were analyzed.

Results: Speech understanding in noise was improved with the 2nd Baha for noise on the side of the 1st BAHI (+0.7 to +2.0 dB) and was decreased for noise from the other side (–1.7 dB to –2.8 dB). The improvement was highest (+2.0 dB, p=0.02) and the disadvantage was smallest (–1.7 dB, N.S.) with both BAHIs mounted on the implants. Using the testband yielded smaller advantages and higher disadvantages of the 2nd BAHI.

Conclusions: Based on our data, using a BAHI on test band to preoperatively test the potential advantage of a second BAHI underestimates the advantage with two BAHIs placed on two implants.

Free Paper Session 16 | Cochlear implants in children

FP98

Speech recognition in silence and noise of children after bilateral cochlear implantation: A retrospective study

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Background: The aim of this study is to evaluate the benefits of paediatric bilateral cochlear implants (BiCIs) in speech recognition in silence and with background noise and to analyse the predicitive factors.

Material and methods: A retrospective study from 2005 to 2016 was conducted in our tertiary CI centre, the Medical University of Montpellier and Saint Pierre Institut of Palavas. The data of congenitally deaf, bilaterally-implanted children with no cognition impairment or particular family surroundings was analysed. Recognition of open set monosyllabic words of Phonetically Balanced Kindergarten (PBK) list and sentences of Marginal Benefits from Acoustic Amplification (MBAA) list was recorded in silence and noise with 5 dB S/N ratio at one, two and three years post second implantation, with the first and with both cochlear implants. Inter–implant interval between BiCIs was analysed. Student's t-tests were performed.

Results: The cohort of the 27 children received BiCIS between the age of 0.9 years and 16.4 years (average 7.0 years). The inter-implant interval was 0 to 13.6 years (average 4.4 years). Sentence recognition in noise was statistically and significantly better with both implants after two and three years: 85.9% with first implant versus 88.5% ($p<0.10$) with both at one year, 73.8% versus 84.6% ($p<0.05$) at two years, 69.6% versus 85.4% ($p<0.001$) at three years. Results were not significantly different with words and sentences in silence. The results suggest that speech recognition was better for children who received their second cochlear implant within two years.

Conclusions: BiCIs provide significant perceptual benefits for children. These benefits were demonstrated in speech perception in noise. As already reported in the literature the inter-implant interval seems to be an important predictive factor. Other factors to be considered are age of the first cochlear implantation, deafness aetiology, rehabilitation, family support, and educational setting.

FP99

Foreign language education at school in children, adolescents, and young adults (10–25 years old) with cochlear implant in the Swiss German population: Chance or burden?

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Background: Most children with a cochlear implant acquire a spoken language, even in a bilingual environment. However, how many of them participate in foreign language education at school, and how they perform, has not been studied before.

Material and methods: Patient-specific data from all patients aged 10–25 years was extracted from the Lucerne CI database. CI non-users and mentally retarded patients were excluded. By use of questionnaires, additional data (type of schooling, foreign language learning, and bilingualism) were obtained. German-speaking children with foreign language (English and/or French) at school were enrolled to a further evaluation by use of both a subjective (self-assessment) and an objective test (Lingualevel) to obtain the level of hearing and reading. We compared the results with the target school level.

Results: Thirty-seven out of 43 questionnaires (86%) were completed. Sixteen (43%) were in mainstream. Twenty-seven patients (73%) have foreign language learning at school. Of the mainstream patients, all but one participated in foreign language learning (15/16=94%), as did 12 out 21 patients (57%) in special schools. Eleven German-speaking patients were further tested in English and six additionally in French. For reading skills, the school objectives for English were reached in 7/11 patients (64%) and for French in 3/6 patients (50%). For listening skills, 3/11 patients (27%) reached the school norm in English and none in French. Overall, there was a positive correlation between the self-assessment and the objective test results. Patients judged themselves to be at a 0.4–1.8 (average 1.4) higher language level.

Conclusions: Almost 75% of our CI children learn foreign language(s) at school. Participation in foreign language education was not only limited to mainstream schoolers, as in special schools about half of the CI patients had foreign language learning. A small majority of the tested patients reached the current school norm in English and French in reading skills, whereas for hearing skills most of them were not able to reach the norm.

FP100

Speech and language acquisition of prelingual deaf children with cochlear implants: Long-term results from 6 to 10 years of age

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Background: There still is high variability in language development during childhood, especially in children born with hearing loss. Despite optimal conditions, language performance within the normal range is not possible for all. Different factors influence the long-term result of speech and language acquisition. It is important to understand the achievements in order to provide informed advice to parents and caregivers.

Material and methods: In a longitudinal study we examined prospectively enrolled 27 children (8 females, 19 males). All participating children had been deafened prelingually and had no language perception with hearing aids. The age at implantation was 20 months (range 8–49 months). 85% of patients had bilateral implantation. The hearing level with the implant was in all patients 10–35 dB HL. Measures included the evaluation by standardized speech tests at age 6 and 10 years.

Results: In a subjective evaluation, we observed normal communication skills in 68% of patients (age 6 years) and 47% (age 10 years). The phonological working memory was in a normal range in 53% of patients (age 6 years) and 41% (age 10 years). Speech perception increased in a normal range in 42% of children (age 6 years) to 59% (age 10 years). Normal speech production in different subtests increased also in 53–63% of patients (age 6 years) to 65–76% (age 10 years). 33% of children had multilingualism in the family. Most children were in a regular school setting, 53% full time, 12% partial time. 35% of patients went to a special school with education for the deaf at age 10 years. In the study population, we observed a significant effect of multilingualism on the outcome of speech acquisition. There was no significant effect for age of implantation younger than age 2 years.

Conclusions: The weak point in speech and language development of children at the age of 10 years remained their auditory capability, whether the speech perception and production approached in more than 50% the normal range of children at the age 6 to 10 years. There was nevertheless a surprisingly strong variance in language development in all children with cochlear implants.

FP101

Cochlear Implants in single-sided deaf children: The Würzburg experience

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Background: Cochlear implantation (CI) in singled-sided deafness (SSD) is an established treatment method for adult patients and has become an option of children in the last few years. The benefits of speech understanding and improved localization are, especially for children, variable. Since 2010, an interdisciplinary follow up program for all hearing-impaired children aiming to systematically collect follow-up data for evaluation of interventions and therapies has been developed and applied at the Comprehensive Hearing Center in Würzburg. Within this program, children with single-sided deafness were implanted with a cochlear implant and regularly observed.

Material and methods: Seven SSD children were implanted with cochlear implants at different age levels (3.5–16 years). Two children were congenital deaf, 4 post-lingual (>4 years), and one perilingual (2–4 years) deafened. The etiology of deafness varied, but the evidence of a cochlear nerve was confirmed. According to the follow-up program, audiological data were collected at time intervals of 3, 6, 12, 18, 24, 36, and 48 months after implantation. Speech perception in quiet and in noise as well as sound localization ability was tested using age-appropriate material at every interval appointment. All conditions were tested unaided and with the CI activated.

Results: Audiological data reveal that speech understanding in quiet and in noise could be measured in all children in the NH+CI condition. Speech perception was improved in noisy conditions with the CI. Furthermore, better localization abilities with the CI were developed within the first 12 months. All children wear their CI every day.

Conclusions: The implanted SSD children show improved speech perception and benefit in spatial hearing and localization.

FP102

Fitting information and outcomes for paediatric auditory brainstem implant users

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Background: Six congenitally deaf children with significant inner ear or 8th nerve anomalies were implanted with an auditory brainstem implant (ABI). ABI implantation involves intradural surgery, which can carry higher risks than other hearing implant surgeries. Furthermore, programming the audio processor is challenging and rehabilitation

arduous. The number of paediatric ABI users and length of usage worldwide is limited, as are reported outcomes. Here, information is provided on the benefits of ABI usage to justify paediatric intervention with an ABI.

Material and methods: Data was retrospectively extracted from six unilateral paediatric ABI user files. All users had MED-EL ABIs. The mean age at switch on was 36 months (range 21–72), with a mean length of ABI use of 46 months (range 22–72). Program thresholds were set using play or visual reinforcement audiometry techniques. Maximum comfort levels (MCL) were set based on loudness, observation of user's behaviour, measuring electrically elicited stapedius reflexes, reaching maximum output of the implant, and by modifying programming parameters according to results of aided cortical assessment (ACA). Post fitting, sound field thresholds (SFT) were measured and ACA carried out. Following interviews with parents and observation of parent–child interactions, the category of auditory performance and a Manchester Spoken Language Development Scale level were awarded. Closed set word recognition tests were also carried out.

Results: By assessing results from each user, the mean MCL charge was recorded at 140 qu, with a mean rate of 521 pps. The mean number of active electrodes was 8. MCL could not be increased further for three of the users due to adverse effects on some electrodes. One user's MCL was limited due to reaching maximum available charge. The mean SFT of these ABI users was 42 dB HL (range 30–55). Five ABI users had a CAP of 5, and one a CAP of 4, with MSLDS levels ranging from 5 to 7. All users had aided cortical P1 responses to /m/, /g/, and /t/, and closed-set word recognition (set size 6–12) through audition only.

Conclusions: All users in this cohort benefited significantly from their ABIs. Access to sound provided by their implant devices allowed them to develop their speech language skills. Therefore, it can be concluded that ABI's are an effective solution for the paediatric population with severe inner ear or 8th nerve anomalies.

FP103

Predicting outcomes of children with cochlear implants: Findings from the LOCHI study

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Purpose: To identify factors that influence 5-year language and speech outcomes of children with congenital hearing loss who received cochlear implants.

Material and methods: Participants were enrolled in the Longitudinal Outcomes of Children with Hearing Impairment (LOCHI) study, a population-based study of some 475 children that is investigating the outcomes of children with congenital hearing loss in a prospective manner. Children were evaluated at 3 and 5 years of age, using a battery of standardised tests and custom-designed tests. Parent reports on functional and psychosocial outcomes were solicited. Using regression analyses, this study examined the influence of a range of child-, family-, and intervention-related factors on the language and speech outcomes of children at 5 years of age.

Results: Age at implantation and nonverbal cognitive ability accounted for 58% of the variance in language performance. In addition, the absence of additional disabilities and the use of oral communication were significant factors influencing outcomes. The effect of delays in age at implantation on language outcomes was also quantified.

Conclusions: Findings highlight the effectiveness of early treatment for improving child outcomes, and the necessity to monitor early outcomes to ensure that children who require cochlear implantation receive the intervention early, preferably before 12 months of age.

FP104

Speech perception in children with a cochlear implant

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Background: Children with cochlear implant tend to develop speech abilities similar to their normal hearing peers. Obviously age of implantation plays significant role. Brain plasticity decreases with age so early implantation is mandatory. We studied difference in speech development in different times of implantation in ages up to 5.

Material and methods: We analyzed results of closed and open-set words in quiet and noise as well as sentence perception in 31 cochlear implanted children. They were divided into two groups; 12 were implanted before 2 years of age and 19 were implanted between 3 and 5 years of age. We used four tests: 1. Closed set for monosyllabic words in quiet and noise 12 months after switched on implants. 2. Open set for monosyllabic and polysyllabic words in quiet 12, 24, and 36 months after we switched on the implants. 3. open set for polysyllabic words in noise, 24 and 36 months after we switched on the implants. 4. open set sentence perception 36 months after switch on of the implants.

Results: The results of our study indicate a significant influence of duration of implant use on speech perception and intelligibility. Listening in demanding situations, like in background noise, is significantly better if the implantation was made before 2 years of age.

Conclusions: Duration of implant use significantly improve speech abilities in children implanted up to 5 years of age. Age at the implantation has a positive effect on speech abilities development especially if the listening is in demanding situations like in terms of background noise. Children implanted before 2 years of age have gradual, continuous, and more natural improvement in speech abilities Those who are implanted between 3 and 5 years of age

expressed delay in listening skills 2 years postoperatively and significant improvement after this time.

Free Paper Session 17 | Diagnostic methods in audiology

FP105

Validation of the Italian version of the Acceptable Noise Level Test

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Background: The Acceptable Noise Level (ANL) test was developed by Nabelek A. et al in the early 1990s; it is a measure of noise tolerance and has been proposed as a predictor for successful hearing aid use. Aim of this work is to validate the Italian version of ANL test in adults.

Material and methods: ANL was determined in normal hearing subjects and in hearing aid (HA) users, affected by mild to severe bilateral cochlear hearing loss. All subjects underwent otomicroscopy, pure-tone and speech audiometry with and without HA and immitance audiometry. Test–retest has been performed after 15 days in normal hearing and hearing impaired subjects. Ninety subjects with HA has been tested and divided in two groups according to the outcome at International Outcome Inventory for hearing aids. In a subgroup of 10 of "unsatisfied" subjects, ANL was also tested with optimization of fitting with new HA.

Results: Test–retest reliability was high (intraclass correlation coefficient was 0.95; interval of confidence: 0.88–0.98). ANL values were higher in hearing impaired subject (with and without HA) compared to normal hearing subjects. ($p<0.001$) The use of HA significantly varies the ANL values of each subject, independent by the grade of hearing loss ($p<0.001$). In accordance with literature, no significant correlation was found between IOI_HA and ANL values.

Conclusions: The Italian version of ANL was shown to be an accurate and sensitive tool in rehabilitation with HA and proved to give comparable results to data from other languages reported in the literature.

FP106

Could manipulation style of the tuning forks produce so much different results leading to misinterpretation of audiological test outcomes?

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Background: Tuning forks (TFs) still have a priority for physicians to evaluate hearing of subjects before referring to audiology. Besides, many surgeons consider that negative Rinne test by 512-Hz TF is a selection criterion for otosclerosis surgery. There has been controversial data about accuracy of Rinne test in relation to gap by PTA. Further although the textbooks recommend that TFs should be vibrated by psiform strike (PS) and then let the subject listen to its tuning through the vibrating axis of forks (TVA), various modalities are common in practice. Aim of this study is to compare i) striking styles (PS with pinching the forks between the fingers (FP)) to tune TFs and ii) replacing modes (TVA with perpendicular to its vibrating axis (PVA)).

Material and methods: C2 and C3 TFs were tuned by 15 physicians by both PS and FP. After being struck, the TFs were replaced to a distance, which was 3 cm away from the microphone in TVA and PVA modes. Fundamental frequency (FF) and first and second overtones and their decay times (DTs) were analysed in the Praat sound analysis program.

Results: It was observed that although FF was not statistically different between PS and FP (518.48 and 518.84 Hz for C2-TF and 1031.37 and 1037.2 Hz for C3-TF), DT of C2-FF was significantly longer by FP (70.94 seconds) than PS (67.42 seconds). Further, it was found that FFs of the recordings via TVA mode were higher than those of PVA (518.48 vs. 512.57 Hz for C2 and 1031.37 vs. 1025.66 Hz for C3-TF). The difference for C2-TF was statistically significant. No difference was found in FF-DTs of C2-TF between two recording modes, while FF-DT of C3-TF was statistically longer in the recordings through the vibration axes of the TFs (37.62 vs. 30.81 seconds).

Conclusions: Even if it is significant, small frequency shifts between striking and recording modes does not appear to be important regarding PTA. However, DT could be important particularly when Rinne test with threshold comparison method was used to find out the gap. This study clearly shows that replacing the TFs against the ear in TVA mode makes sound-duration shorter. That could turn to "negative" Rinne test, even if gap in audiogram is not much higher. On the other hand, FP provides longer duration. If use of Rinne test for corroboration of PTA for case selection for stapes surgery is still kept as a recommended clue, following the classical recommendations (PS-TVA) for TF use appears to be important.

FP107

Alternative representation of wide-band tympanometry for daily clinical practice

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Background: Wide-band tympanometry from 200–8000 Hz was clinically introduced in our institution in 2014 using a commercial device (Titan, Interacoustics, Denmark).

Material and methods: For our standard clinical procedure, we perform a conventional tympanogram followed by a wide-band tympanometry and an absorbance measurement at 0 daPa. Then stapedial reflex measurements are performed. For the reviewing ENT specialist a 3D diagram with the three axes absorbance, pressure, and frequency is provided. A second plot shows the absorbance at 0 daPa with examples of different pathologies such as otosclerosis and ossicular dislocation. Despite informative presentations, the clinical value of this novel diagnostic instrument is still considered low by medical staff. One reason for this might be that the additional value of the absorbance measurements at different pressures is not clear. Another explanation could be that the data representation is too complicated. Nakajima [1] described a simplified two dimensional representation with the mean absorbance on one axis and the mean air bone gap on the other axis. With such a plot, stapes fixation, ossicular discontinuity, or dehiscence of the semicircular canals could have been detected in a single plot. However the data includes only the absorbance at 0 daPa.

Results: We aimed to design a 2D plot similar as shown by Sun [2] including all frequencies and pressures. Based on 50 normal ears we present normative date and investigated the use of multi-dimensional pattern recognition to differentiate between different pathologies.

Conclusions: Wide-band tympanometry is technically easy to perform but further investigations of the representation seem to be needed to provide an additional value in daily clinical practice.

References:

1. Nakajima HH et al. Assessment of ear disorders using power reflectance. Ear Hear, 2013; 34(Suppl 1): 48S–53S.
2. Sun XM. Wideband acoustic immittance: normative study and test–retest reliability of tympanometric measurements in adults. J Speech Lang Hear Res, 2016; 59: 819–34.

FP108

Comparison of absorbance values before and after ventilation tube insertion

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Objectives: Ventilation tube insertion, also known as tympanostomy tube insertion, is the placement of a pressure equalizer tube into the tympanic membrane. This surgical procedure treats middle ear fluid, which, when it persists in the middle ear space, can cause otitis media (acute or chronic) in addition to hearing loss. The ability to measure absorbance shows the acoustic energy absorbed into the middle ear as a function of frequency 226–8000 Hz. The aim of this study is to compare the absorbance values of before and after the ventilation tube insertion for children who has serosis otitis media.

Material and methods: 15 children between the ages of 1 and 8 years were included this study. The study was conducted in the department of audiology, Hacettepe University. Individuals were assessed for without pressure absorbance measures before ventilation tube insertion and one week later from ventilation tube insertion. 6 frequencies (226, 500, 1000, 2000, 4000, and 8000 Hz) were selected from absorbance graph and results were compared between pre-op and post-op measures.

Results: A statistically significant difference values were found between pre-op and post-op measures with all six selected frequencies (for 226 Hz p=.023, for 500 Hz p=.005, for 1000 Hz p=.001, for 2000 Hz p=.001, for 2000 Hz p=.001, for 4000 Hz p=.001, for 8000 Hz p=.001).

Conclusions: These findings show that wideband absorbance is sensitive to treatment. It is neccesary to work with more patients and different age groups in order to show effectiveness of wideband absorbance for monitoring ventilation tube insertion.

FP109

Reliability of the Adaptive Categorical Listening Effort Scaling (ACALES) procedure: How training and number of presented sentences influence subjective listening effort ratings

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Background: ACALES is a new tool to evaluate the subjective listening effort (LE) in a handy way in the laboratory. In a first phase ACALES estimates the SNR range in which LE can be rated between the edges "no effort" and "extreme effort". In the next steps the stimuli at SNRs

between these edges are presented and rated. Here we evaluate whether the first phase can also be used for training. Another question is whether two or three sentences have to be presented before a reliable rating can be made. Currently, the participants have to listen to at least three sentences and two sentences would reduce the overall measurement time.

Material and methods: 16 young normal hearing subjects (mean age 22.7 years, PTA4 below 10 dB HL) participated. As speech material the sentences of the Oldenburg sentence test were used in two different maskers: the olnoise and the modulated International Fluctuating Female Masker (IFFM). Overall 4 conditions were tested: 2 sentences presented prior rating in Olnoise (olnoise2) or in IFFM (IFFM2), and 3 sentences presented prior rating in Olnoise (olnoise3) or in IFFM (IFFM3). All subjects performed one run which consisted of phase 1 of ACALES only and 3 complete runs in one block per condition.

Results: Mean duration per run was: olnoise2: 222s; IFFM2: 262s; olnoise3: 320s; IFFM3: 367s. Duration of the 2 sentence conditions were significantly lower as the 3 sentence conditions. Using IFFM as masker yielded to significantly longer durations compared to olnoise. No differences between the mean response latencies were found. Also no significant training effects on LE were found but small differences in median LE values for the rating of extreme effort between run1 and run2. The mean gof was for run1: 0.93; run2: 0.90; run3: 0.92; run4: 0.90. The ratings of LE did not differ between olnoise2 and olnoise3. However, the ratings of IFFM2 were significantly below the ratings of IFFM3.

Conclusions: The small differences in gof and response latencies indicate stable ratings by subjects. The differences in LE were not significant but for ratings of "extreme effort" small differences might exist which indicate that a short training is necessary. There was a tendency for higher LE ratings in IFFM3 conditions compared to IFFM2 which indicates that ratings depend on the number of presented sentences prior rating. Generally we suggest presenting three sentences prior rating with one short training run to get the subjects used to the material and procedure.

FP110

Evaluation of otoscopy simulation as a training tool for real-time remote otoscopy

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Background: Teleaudiology is of growing interest and relies on the use of teleotoscopy as a critical first step, allowing image and video streaming of remotely performed otoscopies. However, teleotoscopy also requires the assistance of telehealth facilitators; their basic training requirements remain to be determined.

Hypothesis: The purpose of this study was to evaluate the use of an otoscopy simulator to train facilitators, and to compare the accuracy of diagnoses made using the simulator with regular (onsite) otoscopies versus remote otoscopies sent via the Internet using a teleaudiology platform.

Material and methods: Three experts twice carried out the diagnostic identification of ten different pathological images using the otoscopy simulator (image sets 1 and 2). During set 2, experts were also asked to perform an identification task of significant anatomical landmarks, using a specific mode of the simulator. The experts were then asked to provide a diagnosis and perform the landmark identification task remotely (set 3), with the help of three facilitators with no previous experience in otoscopy who received basic training.

Results: Remote otoscopy was more accurate than regular otoscopic examination ($p=0.05$), with a good inter-rater agreement for both regular ($\kappa=0.85$ and 0.81, respectively, for sets 1 and 2) and remote otoscopy ($\kappa=1$). The use of a facilitator did not increase the time taken to perform the landmark identification task.

Conclusions: An otoscopic simulator coupled to teleaudiology software can be used to efficiently train both experts and telehealth facilitators to perform remote otoscopy, and provides a fair accuracy of diagnosis.

Free Paper Session 18 | Cochlear implants: preprocessing and outcome

FP111

Noise reduction algorithms aNR and SpatialNR: Audiometric test results

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Background: Two research noise reduction algorithms were assessed. The aNR algorithm is designed to reduce background noise by frequency specific cues and the SpatialNR algorithm aims to separate noise from speech due to additional use of microphone directionality. This study is going to analyze the effectiveness of methods for noise reduction. Speech comprehension tests in quiet and in noise were performed using the sound processor CP900. The following hypotheses were tested: (1) aNR is better in quiet speech compared to standard noise reduction; (2) SpatialNR shows comparable speech comprehension in stationary and in babble noise for S0N0; (3) SpatialNR shows improved speech comprehension in spatially-separated noise.

Material and methods: Noise reduction methods were compared in CI users concerning speech intelligibility in quiet for monosyllabic words at different intensities and for sentences in noise for various acoustic conditions (stationary and modulated noise; different noise source positions). CP900 serves as a baseline condition for speech comprehension utilizing standard SmartSound options.

18 CI patients wearing a CP900 sound processor (Cochlear Limited) took part in the investigations. All patients showed postlingual onset of profound sensorineural hearing loss. Intra-individual comparisons were performed. Examination of differences in speech comprehension were measured for each noise reduction algorithm after 2–3 weeks adaptation.

Results: aNR shows better word comprehension for soft sounds as standard noise reduction. Improved speech comprehension is found for SpatialNR with S0N0 testing. There is a tendency of improved speech comprehension using SpatialNR compared to aNR in fluctuating noise (S0N0). Best speech comprehension was found for separated noise sources when using SpatialNR in fluctuating noise.

Conclusions: aNR and SpatialNR showed improved speech comprehension in different tested conditions. This shows potential to improve speech comprehension for specific listening situations by offering specific SmartSound options.

FP112

Noise reduction algorithms aNR and SpatialNR: Subjective feedback

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Background: Noise reduction technologies have been shown to improve speech perception for cochlear implant (CI) recipients, but real-world sound quality ratings are less understood. Two such technologies are an automated background noise reduction technologies (aNR) and a directional noise reduction technology (SpatialNR). We investigated the benefit of CI patients using aNR and SpatialNR in contrast to standard processing in the CP900 series sound processor (Cochlear Limited). Subjective improvement on the basis of the Hearing Implant Sound Quality Index (HISQUI19), a numeric rating scale (NRS), and the take home use of a voting tool were assessed. The HISQUI19 is developed as an instrument for quantifying the self-perceived level of auditory benefit that CI users experience in everyday hearing situations.

Material and methods: In randomized order we programmed the sound processor of 11 CI patients utilizing the SmartSound options SNR-NR, aNR, and SpatialNR. This was followed by a 2–3 weeks take-home phase. At each clinic visit the patients completed the HISQUI19. At the take home phase with SpatialNR we programmed the Remote Assistant CR230 as a research voting tool to detect the preferred SmartSound option in everyday situation.

Results: In most cases the HISQUI score for SpatialNR show a better hearing quality than with SNR-NR and aNR. The same trend appeared for the results of the NRS. The analysis of the voting tool show that the patients prefer SmartSound option SpatialNR in noise and in a situation with speech and noise, whereas in quiet situations the preference is for aNR.

Conclusions: The HISQUI19 and NRS gave a global overview of the whole take home period, showing no specific differences for this study. The voting Tool is an adequate instrument to get a detailed subjective feedback from the patients in their specific acoustic environment and showed a preference for spatialNR in complex and aNR in quiet situations.

FP113

Off-the-ear cochlear implant sound processor: Directional microphone and processor location considerations

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Cochlear Limited

Background: Off-the-ear (OTE) cochlear implant sound processors have been recently introduced. By integrating the coil, processor, and microphones into a single unit, the sound processor is worn over the implant site providing a more discreet wearing location, but also introduces limitations due to microphone position.

Material and methods: Twenty experienced cochlear implant users completed this study. Participants were fitted with a Kanso OTE sound processor. Speech perception testing was performed in quiet, and in collocated and spatially-separated noise. User surveys were used to collect a range of performance and usability ratings compared to participants behind-the-ear sound processors. Additional analysis of sound processor location was performed to understand the effect of wearing location on performance outcomes.

Results: The use of dual microphones provided a significant speech perception improvement of 6.9 dB compared to a single-microphone sound processor, demonstrating the benefits of directional microphones in an OTE sound processor. Strong and adaptive directional microphones were also able to show a significant improvement compared to a moderate directional microphone. Clinical analysis of the wearing location did not show a correlation between location and performance, although additional analysis will discuss the considerations of location for an OTE sound processor. Users rated the OTE sound processor as the same or better than their own BTE sound processor.

Conclusions: Clinical assessment of a dual-microphone OTE sound processor has demonstrated its performance, usability, and acceptance. As the wearing location provides limitations due to head shadow effects, dual microphones are critical for OTE sound processors in providing acceptable speech understanding and user rating performance outcomes. Although implant location may be a consideration for current users considering an OTE sound processor, clinical outcomes suggest Kanso is suitable for users with a wide range of implant locations.

FP114

Improving speech intelligibility for bimodal listeners using binaural VoiceStream technology

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Background: Cochlear implants (CIs) are commonly used in the rehabilitation of severe to profound deafness. CI recipients usually show substantial speech intelligibility in quiet listening situations. However, in even moderately challenging listening situations, such as speech presented at lower levels or in the presence of competing noise, speech perception scores drop below the level required to support practical communication. In unilaterally implanted CI users with aidable residual hearing in the contralateral ear, the CI benefit can be enhanced by providing a hearing aid (HA) to the contralateral ear. This rehabilitation option is termed bimodal hearing. The ability to access low-frequency hearing through the HA can help speech intelligibility in noise, improve music and voice pitch perception, and provide better sound quality overall for unilateral CI recipients.

Material and methods: A wireless link between the CI processor and the contralateral HA enables full bandwidth audio streaming from one device to the other. Besides the ability to provide audio signals from one side of the head to both devices, the wireless link also permits improved spatial signal processing (beamforming). Both features were evaluated in 19 adult bimodal listeners using speech intelligibility measurements in noisy listening conditions.

Results: All listeners but one derived a speech intelligibility benefit in noise from the addition of the HA to the contralateral ear (bimodal benefit). For speech presented from the front in competing noise, the binaural beamforming algorithm StereoZoom provided an additional speech intelligibility benefit of 21% resulting in a total benefit of 42% on average, compared to the CI alone. When speech was presented to the HA ear and competing noise to the CI ear, wireless streaming of the HA signal to the CI provided a speech intelligibility benefit of 61% compared to the CI alone.

Conclusions: Using advanced acoustic signal-processing techniques and wireless streaming between a CI and a HA can greatly strengthen the communication abilities of bimodal listeners by increasing the signal-to-noise ratio at the input to both ears.

FP115

Directional microphone contralateral routing of signals in cochlear implant users: A within-subjects comparison

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Background: Bilateral cochlear implantation is not always possible due to medical or financial reasons. For unilateral cochlear implant (CI) recipients with bilateral sensorineural deafness, a contralateral routing of signal (CROS) device may be an alternative. This study aimed to investigate the benefit of a CROS device with a directional microphone in 3 different conditions in the same patient population: (1) unilateral CI alone, (2) unilateral CI complemented by a CROS device, and (3) bilateral CI usage.

Material and methods: Twelve experienced bilateral CI recipients were included in the study. For each participant, both audio processors were programmed with a fixed directional microphone setting. An external directional microphone was clipped to the processor on the poorer CI side (CROS device). The microphone was connected to a wireless receiver on the better CI side. Speech reception in noise was assessed with a German matrix test (OLSA). A multi noise field was generated by presenting uncorrelated speech babble noise from 0° (front), 90°, 180°, and 270°. Speech was presented from the front (S0NDIFF), the side of the CROS device (SCROSNDIFF), and the side contralateral to the CROS device (SCINDIFF). Sound localization was assessed using 12 loud speakers arranged in the horizontal plane. Three white noise stimuli were presented in random order from each speaker. The mean absolute localization error (LE) and the percentage of correctly identified speakers (PC) were assessed.

Results: The CROS device provided better speech intelligibility in noise compared to the unilateral CI situation in the S0NDIFF (1.9 dB, mean improvement, $p<0.01$) and SCROSNDIFF (1.7 dB, $p<0.01$) situations. Larger improvements were observed in the bilateral CI condition compared to the unilateral CI condition (S0NDIFF, 3.8 dB, $p<0.01$; and SCROSNDIFF, 7.2 dB, $p<0.01$). In the SCINDIFF case, the mean differences between the hearing conditions were smaller than 0.5 dB. Sound localization was not improved by the CROS device (mean differences PC=1%, LE=3°). In the bilateral CI condition, sound localization was largely improved (mean difference PC=20%, LE=42°; both $p<0.01$).

Conclusions: In bilateral deafened patients, bilateral implantation is the most preferable form of treatment. However, patients with one CI only could benefit from an additional directional microphone CROS device.

FP116

Long-term spatial hearing improvement and suppressive effect on tinnitus after cochlear implantation in profoundly single-sided deaf patients

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Background: The authors previously demonstrated that tinnitus resulting from unilateral hearing loss (UHL) can be treated with a cochlear implant (CI). The study aimed to do a long-term (LT) evaluation of tinnitus relief and binaural auditory outcomes in UHL CI recipients up to 10 YR.

Material and methods: LT evaluation was derived from 23 subjects with UHL and accompanied incapacitating tinnitus. A structured interview was conducted. The tinnitus loudness Visual Analogue Scale (VAS) and the Tinnitus Questionnaire (TQ) were obtained pre-operatively, 1, 3, 6, 12, and 36 months post-operatively and at the LT evaluation. Speech perception in noise and sound localization were assessed for the CI OFF and for the CI ON condition.

Results: The structural interview revealed that all patients still wear their CI seven days a week at the LT evaluation. In the SSD group, tinnitus suppression is still the primary benefit reported (83%), whereas in the AHL the majority of the subjects (55%) report that the primary benefit shifted to improved hearing. The VAS and TQ scores significantly improved up to 3 months after the first fitting and remain stable up to the LT evaluation. In the SSD group, a significant combined head shadow effect and an SRM benefit were found. In the AHL group, the summation effect, the squelch effect, the combined head shadow effect, and SRM benefit were significant at LT evaluation. A significant benefit in the CI ON condition was found for sound localization compared with the CI OFF condition in the UHL study cohort.

Conclusions: CI can significantly restore binaural hearing in SSD. The accompanied tinnitus relief appears to be stable over LT follow-up.

FP117

Loudness scaling and localization of cochlear implant users with single-sided deafness

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Background: One major goal after cochlear implantation in patients with single-sided deafness (SSD) is the improvement of localization capabilities. Aim of this study was to compare the loudness perception of different signals of the normal hearing ear and the cochlear implanted ear in SSD patients, and to investigate their localization skills.

Material and methods: Ten adult SSD patients, experienced cochlear implant listeners, had been enrolled in this study. All patients had been fitted with a CP910 sound-processor (Cochlear), and used ACE as speech coding strategy with 8 maxima, 900 Hz, and the same acoustic dynamic range (T-SPL 25 dB, C-SPL 65 dB). Loudness-growth functions were obtained for five different stimuli (CCITT noise, FASTL noise, Oldenburger sentences, Oldenburger noise, 1 kHz narrowband noise) for the normal hearing ear as well as for the implanted ear. Localization measurements had been performed using a German sentence in a free-field condition for 50 dB, 65 dB, and 80 dB sound pressure levels.

Results: Loudness judgements were similar for all five different stimuli comparing the CI fitted ear with the normal hearing ear. However, some significant differences were observed for the 1 kHz narrowband noise for higher sound pressure levels. Localization capabilities were as well poorer for these higher sound pressure levels: angle deviations of 14.6±5.4° for 50 dB, 17.5±6.9° for 65 dB, and 24.3±3.42° for 80 dB sound pressure levels had been measured. Loudness scaling capabilities correlate significantly (p=0.0075) with the hearing thresholds of the normal-hearing ear at 2 kHz.

Conclusions: Results show that loudness perception of the normal hearing ear and the cochlear implanted ear in SSD patients is not equal, and localization capabilities are best for lower sound pressure levels. SSD patients might benefit from a more sophisticated loudness balancing between both sides.

Free Paper Session 19 | Age-related hearing loss (2)

FP118

Older adult's expectations of cochlear implants

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One-quarter of our patients receiving cochlear implants (CI) are older than 60 years. These patients were questioned up to 12 months after first cochlear implantation to find out the reasons for their decision, their expectations on and their experiences with their CI. The data of the first 18 questionnaires were evaluated and will be presented. During the decision-making process 50% of the patients got in contact with other CI users and other 37.5% of the patients stated that they would have used this opportunity if offered to them. During this decision process, 31.25% of the patients were concerned themselves about the uncertainty regarding the new kind of hearing. Most patients (n=17) stated that they had preoperatively high expectations in hearing with the CI. Postoperatively these expectations were fulfilled for all patients in quiet situations, but only for five patients in a noisy surrounding. Also some results about cognitive development after implantation can be shown during this report. 14 patients stated that they improved in paying attention to conversations. 50% of the patients can better remember the content

of a conversation than before implantation. Additionally, speech comprehension data will complete this evaluation.

FP119

Central age-related hearing loss: An integrative view of brain structural, brain functional, and audiometric data with a focus on prosody perception

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Background: Recent studies suggested a contribution of central auditory factors in age-related hearing loss, in addition to damage of the cochlea. It has been shown that presbycusis is not only related to high audibility thresholds, but also to impairments in auditory perception. For example, behavioral studies suggest that older adults (OA) have difficulties in processing rapidly changing speech cues in contrast to slowly changing speech cues (e.g. prosody). However, it is still a matter of debate how to measure central hearing loss (behaviorally and biomarkers) and which neurological changes modulate speech processing with aging.

Material and methods: The present multimodal neuroimaging study bridges the gap between structural age-related decline measured by cortical thickness (CT) in bilateral auditory areas (Planum Temporale, Planum Polare, Heschl's Gyrus, Heschl's Sulcus, Supratemporal Gyrus and Sulcus), auditory brain function reflected in mismatch negativities (MMNs) evoked by prosodic speech processing, and supra-threshold audiometric performance in peripherally normal hearing younger controls (YA) (N=13, mean age=24.15 years) and peripherally normal hearing OA (N=23, mean age=72.39 years).

Results: Despite the lower performance of OA in supra-threshold audiometric tests with rapidly changing cues (e.g. voice onset time, short vowels, short tones) and lower CT in all auditory areas (left and right), neither the performance in a prosody task nor MMNs evoked by prosodic processing were different between YA and OA. However, while thinner cortices in right auditory regions (mainly Heschl's Sulcus and Planum Temporale) were related to lower MMN amplitudes in both groups, thinner cortices in left auditory areas were related to higher MMN amplitudes in OA only (analyses corrected for pure tone thresholds).

Conclusions: The present study highlights the relevance of morphological changes of the central nervous system in the context of central age-related hearing loss. Furthermore, the relations between CT and MMN amplitudes are in line with the 'Asymmetric Sampling in Time' model and point to an age-related from left-to-right compensatory process during speech processing. Additionally, these findings suggest that prosodic processing does not decline with age. These results may help to develop novel strategies coping with the decline of central hearing in OA.

FP120

Dual task of listening while walking: Effects of age and hearing. A comparison between young, middle-aged, and older adults

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Background: Hearing loss in the elderly is associated with increased risk of falls. Older adults rely more on executive functions rather than automatic control of gait. Consequently when engaged in simultaneous tasks (e.g. walking and talking on the phone) attention resources are divided between two tasks and the efficiency of one or both tasks is reduced (dual-task cost). When higher attention is needed for auditory perception (e.g. in individuals with hearing loss) or when gait is less automatic (e.g. in older adults) dual-tasks that involve gait and audition may result in larger dual-task cost. Inspecting the changes through life in performance of dual- compared to single-tasks, can shed light on executive functions and listening effort in various ages. The purpose of the current study was to test the effect of hearing and age on the performance of dual-tasks (walking and listening).

Material and methods: the participants were 241 healthy, normal hearing participants, divided into 3 groups: 84 young, 80 middle-aged, and 77 older adults. Each participant completed two single tasks (ST, walking or listening) and one dual-task (DT, walking and listening) under two conditions: optimal auditory input (ears open) and degraded auditory input (earplugs inserted in both ears).

Results: Performance was significantly lower in dual- compared to single-tasks in all 3 groups, but dual-task cost was generally similar between the groups. Young adults' performance was significantly better than old adults' in all walking tasks, but differences between young and old groups in auditory memory tasks were apparent only for tasks performed without earplugs. First signs of reduced performance were apparent in middle-aged adults. The young group outperformed the adult group in walking assignments in DTs, and in listening (auditory memory) assignments in STs. Old adults' performance was poorer than adults' in all walking tasks (ST, DT, with and without earplugs), but performance in auditory memory tasks did not differ between these two groups. Reduced auditory input had a general effect on auditory memory in the young and adult groups, but not on walking.

Discussion: The excessive listening effort stemming from the necessity to execute two attention-consuming tasks requires executive functions and split attention. Dual-task (walking and listening) can clarify our understanding of the relationship between hearing, age and walking, and can serve as an ecological test of listening effort.

FP123

The Repeatable Battery for the Assessment of Neuropsychological Status for Hearing-impaired individuals (RBANS-H) in an older population with age-normal hearing: Preliminary results of a cross-sectional study

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Background: Standardized cognitive tests for the diagnosis of dementia in older adults are widely available. However, performance can be negatively affected by hearing disorders. Therefore, the Repeatable Battery for the Assessment of Neuropsychological Status for Hearing-impaired individuals (RBANS-H) was developed (Claes et al., 2016, doi: 10.3389/fnins.2016.00512). RBANS-H is an adaptation of RBANS, a well-accepted cognitive assessment tool. It provides visual support to the examinee by means of an external screen. The test consists of twelve subtests and assesses five cognitive domains, namely immediate memory, visuospatial/constructional, language, attention, and delayed memory. The aim of the study is to investigate whether the norm data of the original RBANS are valid for use in the adapted RBANS-H.

Material and methods: Twenty-six subjects (13 male and 13 female) aged 55 or older (mean age: 71 [56; 86] years) with bilateral hearing thresholds normal for their age and sex were enrolled in the study. The subjects performed a cognitive assessment by means of the RBANS-H and a comprehensive audiometric assessment. In addition, the Health Utilities Index-2/3, the Dizziness Handicap Inventory, and a general questionnaire on education and profession, medical history, hearing aid use, and tinnitus were administered.

Results: The mean RBANS-H total score of this group is 99.96, which is statistically equal to the total mean norm score of the RBANS, i.e. 100 (one-sample t-test: p=0.984). Furthermore, the one-sample t-tests do not demonstrate a difference between any of the five RBANS-H index scores and the mean index norm score of the RBANS.

Conclusions: The norm scores of the RBANS may be used for score calculation and interpretation of the RBANS-H.

FP122

The Repeatable Battery for the Assessment of Neuropsychological Status for Hearing-impaired individuals (RBANS-H) before and after cochlear implantation in older adults: Preliminary results of a prospective, longitudinal cohort study

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Background: An independent relationship between hearing loss and accelerated cognitive decline in older adults has been suggested by large, longitudinal studies. Even though it is established that cochlear implants improve hearing and quality of life in older adults, little is known about the effect of cochlear implantation on the cognitive evolution in this population. The aim of the present study is to examine prospectively the cognitive functions of older adults with a bilateral severe to profound hearing loss before and after cochlear implantation by means of the Repeatable Battery for the Assessment of Neuropsychological Status for Hearing-impaired individuals (RBANS-H) (Claes et al., 2016, Front Neurosci. doi: 10.3389/fnins.2016.00512).

Material and methods: Twenty subjects (13 male and 7 female, mean age: 72 [55;85] years) with a bilateral severe to profound hearing impairment are evaluated prior to implantation and at six and twelve months after activation of the speech processor. The evaluation consists of an extensive audiometric assessment, including pure tone audiometry, speech audiometry in quiet and speech audiometry in noise, and a cognitive assessment, using the RBANS-H. The RBANS-H consists of twelve subtests and assesses five cognitive domains, i.e., Immediate Memory, Visuospatial/constructional, Language, Attention, and Delayed Memory. When administering the RBANS-H, a PowerPoint presentation with the written instructions is presented to the subject on an external screen. The PowerPoint presentation also contains the written equivalent of the auditorily presented stimuli in four subtests. In this way, the RBANS-H allows a valid and reliable cognitive assessment in hearing-impaired subjects.

Results and conclusions: To be presented at EFAS 2017 when approximately 25 patients are included.

POSTER SESSIONS

Poster Session | Pitch Presentations 01

P01

Factors affecting sentence understanding in adult cochlear implant users

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A number studies have investigated factors which may influence speech recognition scores for cochlear implanted subjects. In the current study we reduced CI users' longitudinally collected (0–12 months) sentence recognition scores to an underlying single variable "initial" score corresponding to the intercept of the function obtained from logarithmic regression of scores over time.

Recognition scores (100 words per list) for sentences presented in quiet and in noise using CI alone were collected retrospectively for the entire population of adult unilateral CI users implanted in our center over a four year period. Demographic, device and medical data were available for 118 subjects who met standard CI candidacy criteria. CT evaluation of the position of the electrode array was available for a subgroup of 86 subjects. Predictive factors were analyzed using step-wise multiple regression for the prediction of initial scores. Effect sizes (ES) were expressed in terms of the proportion of variance explained (partial r-squared).

Individual longitudinal data were well fitted by logarithmic functions. More than 60% of CI users had initial scores >50 in quiet; 25% scored >70 at 10 dB SNR. Certain etiologies such as chronic otitis, immune disease and congenital hearing loss and were associated with significantly lower initial scores (ES 0.28, $p<0.001$). Brand and design of device (ES 0.16, $p<0.01$), and duration of hearing loss (ES 0.14, $p<0.001$, –0.76 pts per year) also significantly influenced initial scores. In the sub-group with CT data, insertion depth (ES 0.15, $p<0.001$) and the proportion of the electrode array in scala vestibuli ($r=0.18$, $p<0.01$) were significantly negatively correlated with initial scores.

CI users with favorable etiologies, short duration of deafness, and insertion depths of only one turn most consistently obtained high sentence recognition scores within one month of activation – both in quiet and in noise. This has implications for surgical technique and follow-up of CI patients. It is important to take into account etiology and duration of deafness in order to interpret the potential effects of electrode array design and final position on outcomes for CI patients.

P02

Management of conductive hearing loss in children in Osijek: Our experience

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Background: Study design: retrospective research based on operational protocol and patient history data. Patients were children treated with grommet insertion at clinic for Otolaryngology, Head and Neck Surgery, University Hospital Centre, Osijek, from 1 January 2010 to 1 May 2016. All patients were subjected to tympanometry and tonal audiometry. The aim of this study was to determine whether there was an improvement in hearing sensitivity after placement of grommets in the eardrums of children affected with conductive hearing loss as a conseguence of otitis media with effusion. The study also identified how much the hearing improved, how long grommets in the eardrum were on average, and whether there was a difference in the occurrence of conductive hearing loss based on sex.

Results: There was a significant improvement in the hearing sensitivity in all patients. Average hearing sensitivity of the right ear improved by 21.3 dB and the left ear by 27.2 dB. Grommets were placed in the eardrum for 11 months on average. In the sample of 40 patients in the research group, there were 23 girls, which makes the occurrence of conductive hearing loss more common.

Conclusions: Results of this research show that there is a benefit of grommet placement in children with conductive hearing loss caused by otitis media with effusion and that corresponds well with current treatment guidelines.

P03

Analysis of the most common forms of dizziness: Possibilities for patient treatment

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Background: Many patients in ORL infirmaries refer to dizziness (vertigo) as their only and main symptom.

Problem statement: The main goal of this study was to show the connection between different diagnoses with adult patients (children were not part of the study) who refer to dizziness as their only problem and to analyze the rate of success of standard therapies.

Material and methods: Prospective clinical trial of 60 patients, examined and followed over a 6-month period. All tested patients signed the approval to participate in the project. The diagnoses of the causes of dizziness were made

after audiological–vestibular anamnesis, clinical otorinolaringological exams, and audiological–vestibular research. During the statistical analysis of the obtained results non-parametric methods were used to examine the differences.

Results: The most common cause of dizziness is BPPV (50.8%), Neuronitis.vestibularis (16.9%), MorbusMenier (15.3%), central vertigo. BPPV is more common in the female population, with patients who have head injuries, AU, migraine, surgical intervention (stapedectomy). In 80% of cases the posterior semicircular canal was affected, in 20% of cases lateral semicircular canal (geotropic nystagmus BPPV, more common), in the extreme rare cases superior semicircular canal. Repositioning maneuver (CRP) was successful in 87.5%, Gufoni maneuver in 71% of cases. Patients with the acute unilateral peripheral vestibular deficit took 3 to 4 weeks to recover, depending on the position of the damage, nature of the pathological process, CNS changes, vascular diseases, and general medical conditions.

Conclusions: Damage to the peripheral vestibular system is common, and BPPV is by far the most common condition. The most frequent form of BPPV is canalithiasis of the posterior semicircular canal (30% of all vertigo). The efficacy of CRP without transition to any other form of BPPV is 87.5%.

P04

A Swedish cross-cultural adaptation and validation of the Tinnitus Functional Index

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Background: The Tinnitus Functional Index (TFI) is a recent self-report instrument for tinnitus with potential advantages over other existing instruments, including a demonstrated high responsiveness. The objectives of this study were to translate and cross-culturally adapt the TFI into Swedish and to investigate its validity and reliability.

Material and methods: The development of the Swedish version (TFI-SE) followed published guidelines on cross-cultural adaptation of health questionnaires. Validity and reliability was investigated by correlating responses on the TFI-SE with other tinnitus measures [Tinnitus Handicap Inventory (THI) and visual analogue scale (VAS)] and a scale measuring anxiety and depression (HADS). Consecutively recruited tinnitus patients (n=100) from four Swedish clinics completed the questionnaires. The mean age of the sample was 51 years (SD=17).

Results: The internal consistency of the TFI-SE was good (α=0.95) and the test–retest reliability was high (ICC=0.93). Our results supported the eight-factor structure proposed for the original TFI, and a high correlation between the TFI-SE and the THI (r=0.8; p<0.01) and lower correlations between the TFI-SE and the HADS-D (r=0.60; p<0.01) and HADS-A (r=0.59; p<0.01) confirmed satisfactory convergent and discriminant validity.

Conclusions: We found that the Swedish translation and cross-cultural adaptation of the TFI is valid and reliable for use with adult tinnitus patients.

P05

Evaluation of hearing function in newborns by method of registration of auditory evoked responses in normal state and at perinatal central nervous system damage

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Background: Objective evaluation of hearing function in new-born children by method of registration of auditory evoked responses in normal state and at perinatal central nervous system (CNS) damage.

Material and methods: 154 children (308 ears) in age from 4 to 28 days. 2 groups included as follows: I) group of 100 children with perinatal CNS damage (perinatal encephalopathy, ischemic–hypoxic CNS lesions, hyperexcitability syndrome, muscular dystonia syndrome, purulent meningitis, and a combination of these pathologies); II) group of 54 children without signs of CNS lesion. Monoaural stimulation was applied during this study, SLAEP were registered from ipsilateral electrodes, far field potentials received by method of coherent averaging were subject to analysis. The children were examined in a staged manner starting from screening test (FSS), then step-wise temporal impetus from 10 to 70 dB, registration of standard ABR potential (from 20 to 70 dB).

Results: Positive result of the screening test was fixed in 96 (96%) children of the first group and in 49 (90.2%) children of the second group. During SLAEP study with step-wise temporal impetus in 308 ears, V-wave was registered on level of stimulating signal intensity up to 40 dB in 71.5% children of the first group and in 65.3% children of the second group, in 12.6% and 22.5% results were unanalyzable because of great number of artifacts. During registration of standard acoustic potentials, latent period of peaks in children of the first group were significantly lower, and in opposite interpeak intervals were longer, which is apparently connected with existing nervous system hyperexcitability in case of perinatal damage.

Conclusions: Analysis of the outcomes confirms that SLAEP registration represents unquestionable value as an objective method of hearing function study in newborn children in normal state and with perinatal central nervous system damage, both in result of screening examination and extended clinical examination.

P06

Patient with otosclerosis: Efficiency of different types of laser-assisted stapedotomy and stapedectomy

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Background: To compare the functional results of various methods of surgical treatment with laser-assisted stapedoplasty.

Material and methods: 335 patients with otosclerosis were examined from 2012 to 2016 years. 169 patients underwent stapedectomy (method with large window which was closed with autovenous graft and using cartilage graft to replace the stapes, 121 – stapedotomy, 45 – modified stapedotomy (with large window), in which perforation hole in the footplate was closed with a autovenous grafts and a piston prosthesis. To perform perforation in footplate a CO2 laser (l–10.6) was used. This instrument has a scanner system which works together with a micromanipulator connected to the microscope. It can generate laser pulses of extremely short duration and high peak powers. We use cartilage graft from the ear of a patient, titanium prostheses K-Piston and platinum-titanium The Big Easy™ Piston. The length of cartilage graft was – 3.5 mm, SD – 0.8–1.0 mm, piston prostheses – L – 4.25 mm, SD – 0.4–0.6 mm. Bone-conduction (BC) and air–bone gaps (ABGs) were measured in all patients before surgery, 10–12 days, 1, 3, 6, and 12 months post-op.

Results: After stapedotomy best outcomes (ABG {≤10 dB) was observed 6 months post-op in 78% of patients. The best early functional results were received, using stapes prostesis with diameter 0.6 mm after stapedotomy. After modified stapedotomy (ABG less than 10 dB) were observed after 6 months post-op in 92%. In case of stapedectomy, with cartilage graft the best results (ABG less than 10 dB) were observed 3 months post-op in 96% patients with improvement of BC thresholds of 10–20 dB.

Conclusions: The study results show the influence of size of footplate perforation and early isolation perilymph of vestibulum with an autovenous graft. This shows that the stapedectomy with cartilage graft to replace the stapes and modified stapedotomy with piston on a venous graft is more effective than stapedotomy.

P07

Tinnitus with a normal audiogram: Relation to noise exposure but no evidence for cochlear synaptopathy

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Background: In rodents, exposure to high-level noise can destroy synapses between inner hair cells and auditory nerve fibers, without causing hair cell loss or permanent threshold elevation. Such "cochlear synaptopathy" is associated with amplitude reductions in wave I of the auditory brainstem response (ABR) at moderate-to-high sound levels. Similar ABR results have been reported in humans with tinnitus and normal audiometric thresholds, leading to the suggestion that the tinnitus might be a consequence of cochlear synaptopathy. However, the ABR is an indirect measure of synaptopathy and it is unclear whether the results in humans reflect the same mechanisms demonstrated in rodents. Measures of noise exposure were not obtained in the human studies, and high frequency audiometric loss may have impacted ABR amplitudes. The present study aimed to clarify the role of cochlear synaptopathy in tinnitus, controlling for high frequency thresholds, adding the envelope following response (EFR) as a supplementary measure of synaptopathy, and assessing relations to lifetime noise exposure.

Material and methods: Twenty young adults with tinnitus and clinically normal audiograms were matched closely with controls for age, sex, and audiometric thresholds up to 14 kHz. Electrophysiological measures of synaptopathy were click-evoked ABRs at 102 dB peSPL and EFRs at two modulation depths. Lifetime noise exposure was assessed by structured interview.

Results: Contrary to previous reports, tinnitus was not associated with reduced ABR wave I amplitude, nor with significant effects on EFR measures of synaptopathy. ABR and EFR measures were uncorrelated with lifetime noise exposure. Tinnitus was, however, associated with significantly greater lifetime noise exposure.

Conclusions: Our ABR and EFR data provide no evidence for cochlear synaptopathy in tinnitus with a normal audiogram. Given the divergence from previous reports, it is possible that synaptopathy is a major tinnitus aetiology only in older adults, or is limited to high characteristic frequencies, above ~7 kHz. The finding of greater noise exposure in tinnitus subjects is important in its own right. Even in tinnitus sufferers with audiograms indistinguishable from those of controls, symptoms may arise from subclinical damage due to noise exposure.

P08

A good practice guideline for translating questionnaires in ENT and audiology

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Background: A majority of patient-reported measures to assess the impact of hearing loss and tinnitus have been developed in English-speaking countries; namely United States, United Kingdom, and Australia. For researchers in non-English-language-speaking countries, translating existing instruments and conducting an exploration of their psychometric properties are usually the preferred options when selecting patient-reported measures for diagnosis or for assessing endpoints in a clinical trial. Best practice in the process of translation and adaptation of patient-reported questionnaires is still a developing field, and numerous guidelines have been published for adapting questionnaires to cross-cultural settings. Such international guidelines do not appear to be widely known or universally applied in the field of ENT and audiology.

Material and methods: We are synthesizing existing knowledge to describe good practice for those who seek to increase confidence in accomplishing a high-quality translation. The selection of the precise method will eventually depend upon the competences, resources and timelines of the project.

Results: Our recommendations are based on common elements of several existing well-known guidelines that have drawn in the past on expert working party recommendations. We illustrate each step with published examples how the underlying steps have been applied in the translation of hearing loss and hearing-related questionnaires.

Conclusions: This project raises awareness of international progress in ENT and Audiology for creating local language-specific new versions of existing validated questionnaires for use in a different language communities, countries or cultures.

This project is supported by the International Collegium of Rehabilitative Audiology (ICRA) and the COMiT initiative (Core Outcome Measures in Tinnitus).

P09

Global audiology: The Global Resource for Audiology Information Networking (GRAIN)

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Background: Global Audiology has been developed as a way to improve communication between audiologists and those interested in hearing and hearing health world-wide.

The overall purpose of this presentation is:
- to describe the development of a website designed to provide an understanding of audiology practice in different regions;
- to connect stakeholders in hearing healthcare around the world;
- to facilitate the development of uniform audiological practice standards.

Material and methods: Five Regional Resource editors will be appointed, each to represent one of five of the United Nations defined regions: America, Europe, Asia, Africa, and Oceania. Regional Resource Editors will be responsible for providing detailed information for each key area of his/her area on the website, as well as to identify Sub-Regional Resource Editors who will populate the website with key information regarding his/her geographic region. All Global Audiology editors will be clearly listed and volunteer to provide resource information to those who are interested, facilitating the exchange of audiological information world-wide.

Results: Global Audiology is now fully functional and information for several countries has been populated. Additional editors are being recruited.

Conclusions: Our hope is that Global Audiology becomes a valuable resource for audiologists and other stakeholders around the world to share information and improve audiology services.

P10

E-learning for audiologists: A case study on integrating learning science with experience design to deliver effective online training

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MED-EL

E-learning is being utilized by many institutions and corporations as an adjunct to onsite training for new and experienced clinicians and is also becoming an important tool for the continuing professional development of many Audiologists. There are a number of online resources available to Audiologists but further developments are expected.

Usually, presentations for onsite training activities are simply converted to an online format without taking the science behind online learning and experience design into consideration. The challenge for most providers of online training is to bridge the gap between standard and accepted practices for delivering onsite training and effective practices for delivering online training materials.

The development of an e-learning program for audiologists in the field of hearing implants, including the technology used to create these materials, improvements made over the years, and experience gained will be discussed. In addition, simple changes that can be made to existing onsite presentations that will be delivered to an online audience of health professionals will be mentioned. Guidelines for creating engaging and effective e-learning materials that place a focus on knowledge of learning science and user design will also be highlighted.

P11

Serum vitamin D correction influences the recurrent rate of benign paroxysmal positional vertigo

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Background: Etiology of benign paroxysmal positional vertigo (BPPV) is unknown in 75–90% cases. It is hypothesized that calcium metabolism impairment can lead to otolithiasis. The purpose of our study was to evaluate correlation between vitamin D deficiency in BPPV patients and frequency of BPPV recurrence.

Material and methods. The study comprised 57 patients (54 women in menopause, 3 men over 50, mean age 57.3±6.84) with BPPV. Inclusion criteria: first manifestation of posterior semicircular canal (PSCC) BPPV, no calcium and vitamin D administration and 25-OHD level less than 20 ng/ml during the year before the study. All patients underwent diagonosis and treatment of BPPV controlled by VNG, serum 25-OHD assessment. Level of 25-OHD less than 20 ng/ml was considered a deficiency of vitamin D. All patients underwent series of Epley maneuvers until particle free. Vitamin B deficiency was treated according to the local clinical standards. The successful treatment criteria was the level of 25-OHD over 30 mg/ml.

Results: BPPV of right PSCC was diagnosed in 74% (n=42) and left PSCC in 26% (n=15). Average level of 25-OHD before treatment was 13.7±3.8 ng/ml. 32 patients followed the recommendations and administrated vitamin D treatment (group 1). 25 patients showed low compliance and refused vitamin D therapy (group 2). Patients were followed during one year period: 25-OHD level in group1 was 34.3±2.9 ng/ml, and in group 2–14.1±4.2 ng/ml. There were 4 cases (12.5%) of BPPV recurrence in the 1 group and 18 (72%) cases of recurrence in 2 group ($p<0.05$).

Conclusions: There is significant correlation between recurrence frequency and 25-OHD deficiency. 25-OHD deficiency may be a risk factor of BPPV recurrence.

P12

Tinnitus prevalence in teenagers

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Background: The association of tinnitus with hearing loss, noise exposure that commonly manifests with increasing age has led to its commonly perception as a disease of adulthood. However, the importance of tinnitus as a pediatric disorder can't be ignored.

Objectives: To evaluate the prevalence of tinnitus in teenagers aged 10 to 13 years and whether the prevalence is higher in teenagers with hearing disorders.

Material and methods: The sample of 114 teenagers, 48 males and 66 females. Data collection was performed by questionnaire, conducting otoscopy, tympanogram and hear/not hear 20 dB (1000, 2000, and 4000 Hz).

Results: The prevalence of tinnitus between 10 and 13 years old stood at 24.6% and it was found that the teenagers enrolled in the audiological screening have statistically significant trend to have tinnitus (contingency coefficient=0.355, $p=0.001$). There was still a higher prevalence in the female gender (71.4%), in teenagers using headphones (96.4%), and a relationship between the presence of tinnitus and hearing at 2000 and 4000 Hz in the right ear and 4000 Hz in the left ear.

Conclusions: Our results are similar to other international research where tinnitus prevalence is higher in females. The presence of tinnitus is often underestimated in adults but especially in children and in teenagers, and it is often overlooked that tinnitus is a symptom and not implicate a disease and can, in some cases, have consequences for learning, concentration, and psychological well-being of the teenager and may even be reflected in school failure.

P13

Auditory memory: Different bilingual communities

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Background: Auditory verbal memory is a type of memory which involves receiving auditory information given orally, processing and storing them after being heard. Plays the most important role in the development of language skills and of the learning process. It is divided into phonological short-term memory and into an articulatory

component. According to ASHA (2004), bilingualism is defined by the use of at least two languages.

Objectives: To know if bilingual people have better auditory memory than those with just one mother tongue. In our study, bilingual speakers are considered those who have two or more languages in oral proficiency, and one of which is the European Portuguese and literacy until fourth grade, in at least one of them.

Material and methods: The population comprises bilingual and no bilingual students. The study is made up of 41 individuals of both sexes: 15 students with only one mother tongue (European Portuguese); 15 students with Creole as their mother tongue (in speaking skills) and learned European Portuguese; and 11 bilingual students in European Portuguese and learned another language in at least 4 years. It was given a test of auditory memory, in silence and with noise.

Results: The group of bilingual people (European Portuguese and other languages in speaking and writing skills) obtained the best results in auditory memory test. Although the other two groups didn't show statistically significant differences among the study groups. In the group with Creole as mother tongue it was found a moderate correlation between the duration pattern test, in which the person had to define if the sound was short or long and the auditory memory test, both in silence and with noise.

Conclusions: Our results coincide with the international studies that claim that bilingual people may show better performance in certain cognitive tasks, in particular, those that measure the ability to ignore information, i.e. when there is background noise or competitive noise. A possible explanation is the fact that their brain plasticity has been shaped by two mother languages' phonemes, i.e. a greater number of phonemes. This situation that does not happen in the Cape Verdean Community since Creole has its greatest origin in the European Portuguese, in other words, in the phonemes of the European Portuguese. Besides, in the first years of life they are only exposed to one language, Creole.

P14

Audiological clinical validation of original Romanian speech audiometry materials for evaluation of communication abilities in children of primary school age

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Background: Communication and speech pathology in children is determined mostly by hearing loss. The assessment of hearing and speech understanding in children has to include tone and speech audiometry according to age and psychoneural condition, especially in cases with auditory neuropathy spectrum disorders, with a rising prevalence in last years. Different speech intelligibility tests are available for some languages, but calibrated materials for Romanian still were not clinically validated.

Material and methods: The study group included 24 children (48 ears) between 7 and 12 years, with normal otologic status (tympanometry and pure tone audiometry – PTA). The phonetically balanced words were grouped in 50 bisyllabic words lists and 20 monosyllabic words lists, everyone with 10 words. These original lists were generated using our own original algorithm. Speech perception was tested monaurally in quiet using a recorded speech audiometry material. The results of speech recognition tresholds (SRT), word recognition score (WRS), and maximum recognition threshold (MRT) were statisticaly analyzed.

Results: For bisyllabic tested lists we obtained a mean PTA of 13.11 dB HL with a mean SRT of 15.83 dB SPL and a mean MRT of 31.46 dB SPL. For monosyllabic tested lists we identified a mean PTA of 13.32 dB HL with a mean SRT of 17.50 dB SPL and a mean MRT of 37.38 dB SPL. One of the most important and relevant parameter is the word recognition score, which riches over 95% at 30 dB SPL for both types of lists, starting with 40 dB SPL is constantly over 99% for all bigger intensities for bisyllabic lists and over 98% for monosyllabic lists, suggesting that the speech recognition is a little more difficult for monosyllabic words.

Conclusions: The material we created for speech intelligibility test in children aged between 7 and 12 years is the first Romanian clinical statistically validated test, respecting the standards regarding homogeneity of the material: frequency of the words in the spoken language – communality factor; balanced frequencies spectrum representation similar with common spoken language; known words corresponding to speech and cognitive specific age development, according to national preschool and primary school education curriculum.

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P15

Application of Baha Connect: Long term observations

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Background: Conductive and mixed hearing loss in cases of bilateral microtia with external auditory canal atresia or after chronic otitis media can be treated by using Bone Anchored Hearing Aids. Aim of the study was to assess the effects of application of different surgical techniques in implantation of titanium fixtures: U-graft technique, dermatome technique, and linear incision technique.

Material and methods: Our method of choice in treatment of hearing impairments in presented cases was attachment

of titanium implant to the temporal bone, and removal of subcutaneous in general anesthesia. Three skin incision techniques were used: U-graft technique, dermatome technique, linear incision technique, tissue around attachment (without collecting skin graft). Our material consists of 145 patients, aged 3 y.o. to 67 y.o. Hearing aid fitting was performed after wound healing and osseointegration of the fixtures. Universally adopted Holgers classification of skin reactions was used to determine soft tissue reactions around the transcutaneous implants. In case of severe infection of the soft tissue in the implant site (Grade 4, according to Holgers scale), tissue reoperation was performed.

Results: Assessing the results of treatment it was indicated that considering inflammatory tissue reaction in the implantation site (Grade 4) 17 reoperations, including 15 in patients after U-graft technique, one reoperation in a patient after dermatome technique and one after linear incision, were performed. It was observed that the skin incision technique affects significantly occurrence of reoperations. In the groups where linear incision or U-graft techniques were used, nearly 20% of patients required reoperation, and in the group operated using dermatome technique reoperation was necessary in little above 2% of cases. Comparison of hearing thresholds for BAHA type device applied on titanium fixture with results from the same hearing device applied on BAHA test band indicated that lower thresholds levels were obtained for the BAHA device.

Conclusions: Assessment of the effects of different surgical techniques application in titanium fixtures implantation on postoperative wound healing and occurrence of early and late skin reactions indicated that the best result of wound healing and the lowest risk of skin reaction can be obtained using dermatome technique.

P16

Middle ear implants: The World Hearing Center experience with active middle ear implant devices

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Background: To present our clinical experience with the active middle ear implants: Med-El Vibrant Soundbridge (VSB) and Cochlear Middle Ear Transducer (MET).

Material and methods: Cases of patients who had undergone implantation of VSB or MET systems at the World Hearing Center between 2003 and 2016 were analyzed. Based on our experience, current indications for use of both devices in cases of different types and degrees of hearing loss, as well as the most effective surgical procedure modifications, are presented.

Results: The first implantations of VSB and MET systems in Poland were successfully conducted by Henryk Skarzynski in 2003 and 2014 respectively. These events were milestones that initiated and subsequently expanded the national program of pre- and postoperative care of patients who cannot benefit from conventional hearing aids, resulting in over 300 middle-ear implant users. The implementation of VSB and MET systems was associated with original solutions, such as the direct stimulation of the round window membrane according to Skarzynski's concept in the field of surgery.

Conclusions: Middle ear implants are effective and safe devices allowing for auditory rehabilitation. Different solutions available nowadays enable a device to be individually selected for optimal performance in patients with sensorineural, conductive, or mixed hearing loss.

P17

Subjective evaluation of hearing quality Baha Attract implant

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Background: The Baha Attract implant system is designed for patients with conductive or mixed hearing loss or single-sided deafness. The objective of this study is to evaluate the satisfaction of patients with the Baha Attract implant system. In particular, the examination aimed to verify the post-implantation audiological benefits.

Material and methods: For the purpose of the study, 28 patients was evaluated. 28 patients were assessed before as well as 6 months after the operation. 14 of them was evaluated after 12 months. The subjective audiological benefits were measured by the AHAB and SSQ questionnaires.

Results: Analysis of the data obtained from the ABHAB questionnaire showed a decreased number of patients reported problems with verbal communication, and communication in background noise or with reverberation. However, a small increase in the perception of unpleasant sounds was indicated. Analysis of the patients' responses in the SSQ questionnaire revealed improvement of hearing on every subscale.

Conclusions: The subjective evaluation made by the patients with the Baha Attract system demonstrates that the device increases both speech perception and spatial hearing just 6 months after implantation.

P18

Temporal response properties of auditory nerve fibers using short pulse intervals and sub-threshold stimulations

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Background: Electrical stimulation of auditory nerve fibers (ANFs) in animals with pairs of pulses has shown facilitation (also referred to as temporal summation) which is defined as an increase in nerve excitability caused by sub-threshold stimulation in short intervals (Dynes, 1996; Heffer et al., 2010). Apart from animal studies, the facilitation effect has also been observed in human cochlear implant (CI) recipients (Cohen, 2009). Facilitation happens when the neuron does not respond to the first pulse, but if the membrane potential remains near the threshold long enough, the second pulse can produce a response (Boulet et al., 2016). Although the facilitation effect has been reported in CI recipients, Electrically evoked Compound Action Potential (ECAP) measurements at short masker probe intervals (MPIs) have not been recorded to define this effect. Thus, the aim of this study is to examine the facilitation effect in CI recipients via ECAP measurements at short MPIs and low current levels (CLs).

Material and methods: 10 CI users implanted with Cochlear Nucleus CI512 or CI24RE took part in the study. Before the start of the measurement, individual amplitude growth functions were recorded for 3 different test electrodes (apical, middle, and basal) and 6 different masker offsets (the current level of the masker relative to the probe). ECAPs were measured with the method described by Miller et al. (Miller et al., 2000). The probe CL for each masker offset and each test electrode varied from visually detected threshold of ECAP (vT-ECAP) to the loudest acceptable presentation level (LAPL). The MPIs varied between 13 and 6000 µs and the reference measurement carried out at +10 CL masker offset.

Results: The results from 10 CI recipients will be discussed and a function for the facilitation effect will be fitted to data collected from all the participants. Collected data will be compared to the Cohen study (Cohen, 2009).

Discussion: The facilitation effect is expected to be more pronounced for lower CLs (e.g. at or below vT-ECAP) and shorter MPIs. This effect, together with other ANFs neurophysiological characteristics such as refractoriness, adaptation, and spread of excitation, can eventually be used for more effective selection of electrodes in CI coding strategies.

P19

A comparison between Samba speech processor and the AP404/Amadé for the Vibrant Soundbridge

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Background: The Vibrant Soundbridge (VSB) is an active middle ear implant for patients who cannot wear conventional hearing aids. The new Samba speech processor has an automatic directivity of the microphones and noise suppression. The aim of this study was to compare the Samba and the AP404/Amadé with respect to speech intelligibility in quiet and noise, and to the subjective rating of sound quality.

Material and methods: Patients implanted monaurally with a VSB (av. 5.8 years) were invited to two appointments in a 4-week interval. At the first appointment, a baseline measurement with the AP404/Amadé was performed and patients were upgraded to the Samba processor, which they permanently used until the next appointment 4 weeks later. On both appointments, air- and bone-conduction and unaided and aided free-field hearing thresholds were measured. Additionally, the Freiburger monosyllabic test (S0) and Oldenburg sentence test (OLSA) with different conditions (S0NVSB, S0Ncontralateral) were measured. For subjective benefits, patients completed the APHAB and the SSQ/SSQ-C. Until now, N=14 patients have completed both appointments.

Results: For the OLSA in the condition S0NVSB, it became apparent that the speech understanding in noise was better with the Samba compared to the omnidirectional mode with the Amadé (delta=3.05 dB SNR). Also in the APHAB and the SSQ-C patients reported a subjective benefit with the Samba in speech understanding in quiet and in noise.

Conclusions: On average the patients reported to be more satisfied with the new Samba speech processor. The adaptive directivity of the Samba speech processor in combination with the noise suppression leads to better speech understanding in noise and a subjectively better hearing quality in comparison to the AP404/Amadé.

P20

Paediatric hearing screening: The Belfast experience

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In 1930's hearing screening at school entry was introduced. In 1950's simple screening audiometers were introduced for schools and was the first screen after the 9 mth distraction test. In 1974 school health services were brought into the NHS, galvanising the system. The health visitor distraction test, based on a child turning to distracting

sound, had problems with accuracy and relatively late age of test (7–9 mths) The need for an earlier method of screen was necessary to help with hearing aid/educational support, leading to the introduction of the neonatal hearing screening program (NHSP). In 1997 a policy review in England saw NHSP introduced in 2001. In 2003 a pilot study in Royal Victoria Hospital Belfast led to a Northern Ireland program in 2005. Permanent childhood hearing impairment (as described by >40 dB loss at 500, 1, 2, and 4 kHz) is known to exist in 1.6/1000 live births, 1/1000 bilateral and 0.6/1000 unilaterally. Prevalence is estimated at 1.33/1000, rising to 2/1000 by age 10 due to a variety of causes. Childhood conductive hearing impairment is noted as affecting 80% of children with 1 or more episodes at age 3, which can also affect speech development. The NHSP reduced the age of diagnosis dramatically using a combination of otoacoustic emission and automated ABR. NHSP identifies the majority of children and has significantly reduced the numbers detected by the school screening program for sensorineural hearing loss. School screening programs have a wide variety of frequencies tested and pass criteria. Dr Fortnum from University of Nottingham in 2012 looked at cost-effectiveness of school screening, which was published in 2016. Comparison of two areas, one with school screen and one without, showed increased referral to Audiology in the area with screen; however there was little difference in areas for finding hearing problems, suggesting no advantage. The NI school model is referral after two screen fails. Analysis of RVH figures from 2013 to 2016 showed 97 children fitted with h/aids (53 s/n, 41 conductive, 3 mixed) of which 55 were 0–6 yrs. Refer sources 26 HNSP, 12 GP, 7 paediatrician, 5 ENT, and 5 others. Hearing aid fitting referrals for babies <1 yr had 89% from NHSP, children 4–6 yrs 81% from GPs etc., and none from school screen. This would again question the validity of school screen for detecting s/n loss. If it is to be used for detection of conductive loss, perhaps a fresh approach (e.g. questionnaire and tympanometry) would be more appropriate.

P21

Analysis of trends, challenges, and opportunities in the field of mobile apps for hearing healthcare by using the ALFA4Hearing (At-a-glance Labelling for Features of Apps for Hearing healthcare) model

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Background: In the growing area of e-Health for hearing healthcare (HHC), the emerging m-Health (mobile health) branch is extremely promising. In particular, the development of tablet or smartphone apps for HHC is rapid. To date, a systematic analysis of the current scenario of apps for HHC is lacking. The aim of this study was to take a multifaceted picture of the available apps for HHC by using a recently developed descriptive model (the ALFA4Hearing model, At-a-glance Labelling for Features of Apps for Hearing healthcare) to identify their main features and to highlight emerging trends and challenges, as well as potential opportunities for improvements.

Material and methods: We downloaded and assessed 137 apps for HHC (iOS and Android). We characterized apps by using the ALFA4Hearing model, which includes 29 descriptive features, grouped into five main components: (1) Promoters, (2) Services, (3) Implementation, (4) Users, (5) Descriptive information. We analysed the distribution of the 29 features in our sample of apps as well as in specific subsets of apps.

Results: We observed a large variety of services in our sample of apps, covering the whole patient journey from prevention to screening and diagnosis, therapy, and rehabilitation. Our analysis showed interesting trends and challenges in each model component. For example, in component (1) Promoters, our results suggested that there is ample room for a greater involvement of HHC providers, government services, and scientific institutions, for improved evidence base. In component (2) Services, our results suggested promising opportunities for app inventors, e.g., the development of apps that include more than one service for better efficacy throughout the patient journey. Similarly, we observed relevant findings in components (3) Implementation, (4) Users, and (5) Descriptive information.

Conclusions: This study provided a multifaceted picture of the current market of apps for HHC. The analysis of our sample of apps by means of the ALFA4Hearing model highlighted interesting trends and challenges, suggesting many potential opportunities for developers, HHC professionals, and stakeholders at large that could drive research, professional training, clinical use of apps, as well as technical developments towards the common goal to improve the patients' outcomes and quality of life.

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P22

Effects of soft palate radiofrequency on middle ear function

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Background: Radiofrequency tissue ablation may have potential effects on the middle ear. In this study, we aimed to investigate possible changes in middle ear function through eustachian tube and velopharyngeal mechanisms caused by RFDA which is used for the treatment of mild obstructive sleep apnea syndrome patients as a treatment option.

Material and methods: Thirty patients with mild obstructive sleep apnea syndrome who were eligible for the study were evaluated by audiometry, immitance testing, eustachian function test prior to soft palate radiofrequency

treatment and on day 3 and 7 as well as first and second months after treatment.

Results: No significant changes were detected on eustachian tube function and audiometry results at any postoperative time (p>0.05). We found only one patient who had a slight eustachian tube dysfunction on day 3.

Conclusions: The soft palate radiofrequency method for mild obstructive sleep apnea syndrome is a safe method for the middle ear. This treatment method can be preferred for patients who have middle ear dysfunction.

P23

A step forward to informed consent and informed choice for parents of young cochlear implant candidates

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Background: In 1998, 'Kind en Gezin', implemented a qualitative neonatal hearing screening protocol in Flanders, Belgium. Besides a medical-audiological diagnostic protocol, it also contained clear guidelines for early intervention and rehabilitation (Van Kerschaver, 2007). In addition, there was a technological revolution in terms of hearing devices for the deaf: the cochlear implant (CI). Due to this neonatal hearing screening, children are already checked for hearing loss in the first weeks after birth. Such an early screening has positive results for all levels of development of children with hearing loss. On the other hand, new parents are confronted with the harsh diagnosis of deafness within the first week after birth (VLOK-CI, 2008). After the diagnosis, parents are sucked into a medical circuit of doctor appointments, audiological tests, and etiological research. Relatively quickly, cochlear implantation is suggested and the preliminary medical investigations are planned and executed (De Raeve, 2013). Parents of recently implanted children testify that the information they receive in the time period following the diagnosis of deafness is inadequate (Hardonk, 2011). Are parents of cochlear implantation candidates, who do not receive all information, able to make an 'informed choice' and therefore give an 'informed consent' for cochlear implantation (Hardonk, 2011)?

Material and methods: By means of a qualitative questionnaire for parents with a child who has a cochlear implant, the gaps in the information supply were inventoried and mapped (n=35).

Results: A positive signal towards the information supply in Flanders seems to appear from the survey: 49% of the parents are generally satisfied with the information, help, and support they receive from the different professionals, and 40% are even very satisfied. Only one was dissatisfied (3%) and three were neutral (9%). Nevertheless, there are a few gaps and recommendations that could be important to further optimize the policy of CI centers.

Conclusions: The information supply regarding cochlear implantation in Flandres, Belgium, sets a high standard. The recommendations above can further optimize the offered information. Based on this survey we can state that all parents receive relevant information to make an informed choice and therefore give an informed consent for the cochlear implantation of their child.

P24

Benefits of a Contralateral Routing of Signals (CROS) system in unilateral cochlear implant users

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Background: Cochlear implants (CIs) usually provide substantial speech intelligibility benefits to severe to profoundly deaf recipients. In quiet listening situations, scores for the perception of sentences typically show a strong ceiling effect. However, in even moderately challenging listening situations, such as speech presented at lower levels or in the presence of competing noise, speech perception scores drop below the level required to support practical communication. In bilaterally deafened unilateral CI users, speech intelligibility for speech originating from the non-implanted side is further impaired by the additional attenuation of the head shadow. To overcome this limitation, one possible solution is to use a Contralateral Routing of Signals (CROS) system which captures the signals from the non-implanted side and wirelessly transmits it to the CI sound processor.

Material and methods: In collaboration with Phonak, Advanced Bionics developed a wireless CROS system compatible with the latest generations of sound processors, Naída CI Q70 and Q90. A prototype of this system was evaluated in bilaterally deafened unilateral adult cochlear implant users at several European research sites. In addition to acute speech intelligibility measurements, subjective feedback regarding sound quality, speech intelligibility as well as practical aspects of the device was collected via questionnaires during chronic take-home trials.

Results: Substantial benefits in speech intelligibility in noise could be achieved by the wireless CROS system in several spatial listening setups, especially when the target speech was located at the CROS side. Subjects reported high satisfaction with the device's practical usability. Additionally, the responses indicated that the device provides a perceived benefit in everyday listening.

Conclusions: The wireless CROS system provides a viable option to improve upon unilateral implantation for rehabilitating bilateral deafness. Such a system is most applicable in cases where medical or financial reasons only allow for unilateral implantation.

P25

The cognitive functions of older cochlear implant recipients: A cross-sectional study using the Repeatable Battery for the Assessment of Neuropsychological Status for Hearing-impaired individuals (RBANS-H)

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Background: Large, longitudinal studies indicate that hearing loss is independently related to accelerated cognitive decline. Moreover, it is suggested that more severe hearing losses go hand in hand with higher risks of incident dementia. The present study aims to investigate the cognitive capabilities of older cochlear implant (CI) recipients. In addition, the association between cognition and audiological performances is examined in this population.

Material and methods: Sixty-one subjects (30 male and 31 female, median age: 71 [58;94] years) with a bilateral severe to profound hearing impairment and at least one year of CI experience (median: 12 [1;19] years) are enrolled in the study. An audiological examination is performed including unaided pure tone audiometry, best aided speech audiometry in quiet and best aided speech audiometry in noise, using the Leuven Intelligibility Sentence Test (LIST). Cognition is measured by means of the Repeatable Battery for the Assessment of Neuropsychological Status for Hearing impaired individuals (RBANS-H) (Claes et al., 2016, Front Neurosci. doi: 10.3389/fnins.2016.00512). The RBANS-H assesses five cognitive domains, i.e., Immediate Memory, Visuospatial/constructional, Language, Attention, and Delayed Memory and is a valid and reliable tool to assess cognition in severely hearing impaired subjects.

Results: One-sample t-tests reveal that the RBANS-H total scores, as well as the index scores for all cognitive domains are significantly lower than the mean norm score. Furthermore, a significant correlation is found between RBANS-H total scores and the speech reception threshold of the LIST, independently of age (rpart=–0.275, p=0.034). The duration of CI experience, however, does not correlate with the RBANS-H total score, nor with any of the RBANS-H index scores.

Conclusions: General cognitive functioning in older CI recipients is poorer compared to the norm in age-matched adults. Since the duration of CI experience does not correlate with cognition, the accelerated cognitive decline, observed in older individuals with severe, uncorrected hearing loss, may be curbed after cochlear implantation. However, the CI recipients may not catch up with their normal hearing peers completely, as is suggested by the significantly poorer cognitive performances of the subjects compared to the norm. Longitudinal studies are needed to confirm this hypothesis.

P26

Monitoring for ototoxicity in Swiss childhood cancer patients

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Background: Ototoxicity is an adverse event of childhood cancer treatment, especially in children treated with platinum chemotherapy or cranial radiation >30 Gray. Treatment regimens, international ototoxicity monitoring and follow-up care guidelines recommend hearing assessment for patients with increased risks of ototoxicity before, during, and after cancer treatment. According to the ASHA guidelines, a hearing assessment should include audiometry, tympanometry and evoked acoustic emissions. The current state of ototoxicity monitoring in Switzerland is unknown. In this study, we present the prevalence of ototoxicity monitoring in childhood cancer patients in Switzerland and analyze factors associated with ototoxicity monitoring.

Material and methods: Inclusion criteria: Childhood cancer patients from the Swiss Childhood Cancer Registry diagnosed 2005–13 at age 0–16, potentially ototoxic treatment (OT) with platinum and/or cranial radiation >30 Gray; survival up to time of study (2015–16). We retrospectively searched for hearing assessments in the paediatric oncology clinics and ENT departments. We determined proportions of patients who had hearing assessments and described type and timing (before, during, after OT) of testing. We looked into factors associated with ototoxicity monitoring using multivariable logistic regression.

Results: We analyzed data from 185 (63%) out of 295 childhood cancer patients. The mean (SD) age of diagnosis was 8 (5) years. Patients were treated for CNS tumor (39%), bone tumor (19%), germ cell tumor (12%), neuroblastoma (9%), retinoblastoma (9%), soft tissue sarcoma (6%), or other tumors (6%). Out of the 185 patients, 40% had a complete ototoxicity monitoring with at least one hearing assessments before, during, and after OT. Pure tone audiometry (42%), extended high frequency audiometry (25%) and evoked acoustic emissions (15%) were most often used to assess hearing. Ototoxicity monitoring was more complete in patients included in a clinical study for cancer treatment, and in patients who had

received cisplatin compared to those treated with carboplatin or cranial radiation only.

Conclusions: Only 40% had a complete ototoxicity monitoring as recommended by existing guidelines. Especially those survivors not included in a clinical study or not treated with cisplatin had been followed up inconsistently.

Poster Session | Pitch Presentations 02

P27

Speech perception in a diffuse noise field with different noise reduction algorithms in bimodal listeners

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Background: Current day extended implantation criteria for cochlear implants (CIs) lead to an expanding group of CI users that have residual hearing and use a hearing aid (HA). Bimodal listeners benefit from the combination of acoustic and electric hearing that may improve speech intelligibility (SI) in adverse listening conditions. The bimodal Naidasystem features noise reduction algorithms including beamforming techniques. The UltraZoom (UZ) feature is an adaptive frontal beamformer and StereoZoom is a binaural static frontal beamformer. ZoomControl (ZC) can stream the microphone signal from the HA to the CI, and vice versa. SI studied with UZ, SZ and ZC are compared to the standard omnidirectional mode in bimodal CI users.

Material and methods: Five bimodal listeners (with a Naida Q90 CI and Naida UP HA) were recruited. Inclusion criteria were: pure tone thresholds better than 80 dB HL at frequencies ≤500 Hz and a speech score with CI-only of ≥80% in quiet. Speech reception thresholds (SRTs) were measured in a diffuse noise field with the target speaker located at 0°, 45°, –45°, and –90° relative to the CI side. For each direction of speech UZ, SZ, and ZC were tested with the HA gain switched ON and OFF.

Results: A bimodal benefit (HA gain switched on) was obtained for all target speaker conditions compared to the SI with CI only. For the frontal speech SRTs obtained with UZ and SZ were improved compared to the standard omnidirectional mode (for UZ 2.4 dB and for SZ 4.1 dB). For the speech directions from –45° to 45°, SRTs were worse with UZ and SZ. For directions of –45° and –90° relative to the CI side, the largest benefit was obtained with ZC (for –45° 4.4 dB SRT improvement and for –90° 5.5 dB SRT improvement).

Conclusions: Speech understanding in noise improved with noise reduction algorithms including beamforming techniques. The results indicate that binaural features such as StereoZoom and ZoomControl, which utilize streaming of microphone signals, provide a better performance in bimodal listeners compared to omnidirectional microphones and beamformers without streaming capabilities.

P28

Conversion and adaptation of International Outcome Inventory for Hearing Aids to Hindi language

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Background: Clinically and technically controlled data in determining outcome measures of hearing fittings are commonly used globally. However, there is growing interest to provide evidence based audiological practices focusing on patient's perspectives in determining the functional success with aural rehabilitation modalities. One of such method is combining similar beneficiary centered self-reports. The International Outcome Inventory for Hearing Aids (IOI-HA). The IOI-HA is a short and concise seven-item questionnaire with norms, developed as a standard clinical tool in world measure languages. However, there is scarcity of such standardized self-report questionnaires in Hindi. Hence there is need to translate and adapt the IOI-HA English version into Hindi.

Objectives: The purpose of the present study was to translate and adapt the IOI-HA English version into Hindi language and ascertain its validity as a clinical tool.

Material and methods: The adaptation of IOI-HA was performed in two phases. Phase I translation of English version that included the following five steps: i) forward translation; ii) review to create or synthesize the common translation; iii) backward translation; iv) expert committee review; v) pre-final testing; and vi) final translated version. Phase II involved the reliability and validity part of the translated version. The final version of the translated questionnaire was validated on 100 normal 100 subjects with hearing impairment of varying degree using Hindi translated IOI-HA.

Results: All the 50 subjects reported no problematic questions in the Hindi version and found it simple and easy to understand. The questions revealed high reliability and internal consistency at alpha {a=0.89 as calculated by Cronbach coefficient. The IOI-HA Hindi which exhibited significant correlation of greater than 0.35 with varying degree of hearing loss at significance level of 0.05. There were no IOI-HA adjusted estimates or confounder estimates with degree of hearing loss.

Conclusions: The results of Hindi translated IOI-HA version are comparable with original publicity to obtain the information about the success with rehabilitation strategies. Thus, IOI-HA translated version is a valid self report clinical tool to assess the aural rehabilitation related in Hindi-speaking population.

P29

Are suspected auditory processing difficulties in children aged 8–12 years related to attention, working memory, nonverbal intelligence, and communication abilities?

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Background: Children with difficulties in listening and understanding speech despite normal peripheral hearing, can be diagnosed with the diagnosis Auditory Processing Disorder (A). However, there are doubts about the validity of this diagnosis. The aim of this study was to examine the relation between the listening difficulties of children between 8 and 12 years with suspected A and the attention, working memory, nonverbal intelligence and communication abilities of these children.

Material and methods: In this case-control study we examined 10 children who reported listening difficulties in spite of normal peripheral hearing (3 referred by speech-language pathologist in the Northern Netherlands, 6 by an audiological center in the Southern Netherlands and one by parental concern) and 21 typically developing children (recruitment through word of mouth and by the website Taalexpert.nl), ages 8;0 to 12;0 years. The parents of all children completed three questionnaires about history, behavioral symptoms of ADHD, and communication skills (Children's Communication Checklist). Teachers of the children completed the Children's Auditory Processing Performance Scale (CHAPPS). Children were assessed for auditory processing abilities (speech-in-noise, filtered speech, binaural fusion, dichotic listening), nonverbal intelligence (Raven's Coloured Progressive Matrices), and working memory (Clinical Evaluation of Language Fundamentals). Auditory and visual attention was studied with four behavioral tests of the WAFF battery of the Vienna Test System (Schuhfried).

Results: Preliminary analysis shows no differences between groups on the auditory processing tests and nonverbal intelligence quotient. Children in the experimental group have poorer communication performance (parent report), poorer listening skills (teacher report), and poorer working memory and attention skills (behavioral tests).

Conclusions: The results of this study showed that there is a difference between children with listening complaints and typically developing children, but that the problems are not specific to the auditory modality. There seems to be no evidence for the validity of an auditory deficit.

P30

APD and acoustic reflex

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The term auditory processing disorder (APD) is relatively new in Norway, and healthcare personnel have yet to agree on what the underlying causes are. Living with APD can involve problems with speech perception in noise, sound localization, difficulty differentiating between sounds, perceiving small changes, and understanding poor sound signals. The disorder can coexist with ADHD, language difficulties, and learning disabilities, or be mistaken for them because the person's reaction patterns can look similar in many situations. It is important to include objective tests in order to achieve a correct diagnosis.

APD is not an official diagnosis in Norway, and therefore no statistics on prevalence are available. The prevalence among Danish children is between 2–7%, therefore it is likely transferable to the Norwegian population. Clinicians working with APD at St. Olav's hospital in Trondheim and Rikshospitalet in Oslo noticed a tendency of absent contralateral acoustic reflexes and encouraged a literature review on the subject. In our review we focus on the correlation between APD and abnormal acoustic reflexes and possible underlying causes of auditory processing disorder. The acoustic reflex arc, and particularly the medial olivocochlear complex (MOC), has been proved to be important for auditory processing, especially for speech perception in noise. We will also talk about poor myelination of MOC as a possible underlying cause.

P31

The importance of audiological evaluation and ENT assessment in the children affected by Kawasaki disease

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Objectives: To describe our experience in diagnosis and follow-up in audiological complications in Kawasaki's Disease

Background: Kawasaki Disease (KD) is a multsystemic vasculitis affecting small and medium sized arteries. Etiology is unknown. Mostly affects children under the age of five. Main symptoms are coronary arteritis and sensorineural hearing loss.

Material and methods: The audiological protocol contemplates subjective and objective tests according to patient's age: tympanometry, stapedial reflex, otoacoustic emissions, tonal audiometry, auditory brain response (ABR), auditory steady state response (ASSR).

Results: Description of audiological findings in the population registered in Barcelona Children's Hospital from 2011 up to today.

Conclusions: Children affected by KD must have a longterm ENT and audiologic evaluation in order to detect a sensorineural hearing loss complication and receive an early treatment.

32

Frequency-lowering technologies and speech intelligibility

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Background: One of the challenges in audiology is hearing aid fitting in cases of "ski slope" high-frequency hearing loss. In some cases, high-frequency amplification provides only limited benefit. Frequency-lowering technologies help to select a high-frequency region and present it at a lower frequency. Frequency Composition™ is Bernafon's approach to frequency-lowering. As a third-generation approach, Frequency Composition™ preserves the high-frequency signal components at the source location and superposes the relocated signal components on those in the target location. Improved high-frequency audibility, however, doesn't necessarily mean better speech intelligibility.

Material and methods. Pure tone audiometry (PTA) in headphones and in free field (FF), speech audiometry using monosyllabic words recognition test, binaural alternating speech test, Russian matrix sentence test (RuMatrix) in quiet and in noise were performed. In total, 23 adult hearing aid users from 31 to 81 years old, mean age is 63.9 years (10 female, 13 male) with chronic moderate sensorineural hearing loss participated in the study: 11 patients with mean sloping hearing loss 27.9 dB/octave (within frequencies from 1–2 kHz) – Group 1 and 12 with mean sloping hearing loss 24.1 dB/octave (within frequencies from 2–4 kHz) – Group 2. PTA and RuMatrix were performed in free field using hearing aids – with/without Frequency Composition™. The average high-frequency loss amounted to 79.2±21.8 dB HL in Group 1 and 74.1±12.4 dB HL in Group 2.

Results: Frequency Composition™ improved PTA results in FF in all listeners: by 14.5±5.2 dB in Group 1, by 12.7±9.0 dB in Group 2. Better speech intelligibility in RUMatrix (by 2.53 dB in quiet and 1.07 dB SNR in noise) was revealed in Group 1; the difference in noise was significant (p=0.032). In Group 2, these differences were less than in Group 1 (0.45 dB in quiet and 0.66 dB SNR in noise) and not significant.

Conclusions: Frequency Composition{™ helps to improve tone thresholds and speech intelligibility mostly in noise. More studies are needed to make the patient selection criteria more precise and to enhance the effective use of this technology.

P33

Differences between tympanometric diagnosis and intraoperational diagnosis with otitis media effusion

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Background: OME is a non-suppurative, clinically non-infectious type of middle ear inflammation, characterized by long-standing presence of fluid of variable viscosity behind the intact tympanic membrane. The effusion causes reduced flexibility of the tympanic membrane and of the chain of the ear bones and it is the main cause of impaired hearing among pre-school children.

Aim: This research targets the correlation between tympanometric diagnosis and intraoperative diagnosis in OME.

Material and Methods: We examined 50 children (100 ears) 22 girls and 28 boys, aged 2–10. Upon clinical ENT examination, audiometry, and tympanometry, we diagnosed OME and selected patients for myringhotomy and implantation of ventilation tubes.

Results: Tonal audiometry was successfully performed on 29 children (58%). We found 20 dB hearing threshold with 12.5% children, 65% examinees shown up to 40 dB hearing threshold, and 22.5% examinees were found with hearing threshold higher than 40 dB. We obtained a flat tympanograph from 84% examinees and a curved tympanograph from 16% examinees. Upon medicamental treatment and adenoidoctomy on 55% patients we decided to perform the implantation of ventilation tubes. The analysis of pre-operative tympanographic parameters (pressure, compliance, grading) and intra-operative evidence showed as follows: in 47 flat Ty the effusion in 45 ears; in 8 curved Ty we had effusion in 5 ears, and we had negative results (dry ear) in 3 ears. In case of compliance ranging 0.1–0.21 we had effusion in 46 out of 47 ears, while the compliance range of 1.0–1.5 indicated effusion in half of the cases despite our expectation to find dry ear. When the gradient varied 0–0.02 we had effusion in all the expected cases; when the value was 0.6–0.8 in 3 out of 8 ears we found effusion instead of dry ear. There was effusion in cases where the pressure ranged 175 dPa +80 dPa.

Conclusions: In OME it frequently occurs that pre-operation tympanometry indicates the presence of fluid in the middle ear but during tympanotomy no effusion is

found and vice versa, when the fluid is expected, we diagnose dry ear.

P34

Analysis on the usefulness of two hearing ability questionnaires about subjective satisfaction after bone conduction implant hearing aid according to hearing loss type (mixed hearing loss vs. single-sided deafness)

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Background: Various questionnaires have been developed to measure self-assessed hearing aid benefit. The purpose of the study was to evaluate the usefulness of each questionnaire in assessing functional outcomes of bone conduction implant (BCI) users.

Material and methods: Twelve BCI users with multiple types of hearing loss, implanted with either the bone-anchored hearing aid (BAHA) or Bone bridge (BB), were included. Postoperative subjective improvement was measured using the Speech, Spatial and Qualities of Hearing Scale (SSQ), and the Abbreviated Profile of Hearing Aid Benefit questionnaire (APHAB).

Results: Mixed hearing loss group (MHL, n=7) showed significant benefits in the global score with a mean decrease from 62% preoperatively to 21% after BCI use, whereas asymmetric hearing loss or single-sided deafness group (SSD, n=5) did not (from 34% to 29%). However, with SSQ, SSD group with BCI reported significant improvements for all subscales – speech, spatial, and sound quality.

Conclusions: MHL group, not SSD group, demonstrated significant benefit with the use of BCI on the APHAB. The SSQ was more sensitive than the APHAB to benefit differences in BCI users who showed asymmetric hearing loss or single-sided deafness.

P35

Evaluation of the vestibular system with video head impulse test (VHIT) in patients with Type I diabetes mellitus

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Objectives: Diabetes mellitus (DM) is a chronic systemic disease which affects the vestibular and auditory organs. The video head impulse test (vHIT) is a useful clinical tool to detect semicircular canal dysfunction. The purpose of our study was to evaluate and analyze the characteristics of vestibular function using vHIT methods in patients with Type I DM.

Material and methods: vHIT and audiological tests (audiogram, tympanometry, and OAE) were conducted on 19 healthy children and 34 Type 1 DM patients over 7 years old who were followed by Cerrahpasa Medical Faculty Endocrinology Department over years 2010–15. Furthermore, Type 1 DM patients' duration of diabetes, HbA1c levels, and lipid profiles were measured to analyze the patients' hypoglycemia and vestibular complaints.

Results: vHIT was performed in both groups to measure each of the six semicircular canals' VOR gain. Patients' RP (right posterior), LP (left posterior), and LA (left anterior) canals were found to be affected. There was a remarkable correlation between vestibular complaints and hypoglycemic episodes ($p<0.05$). There was no pathology found in audiological tests for both groups.

Conclusions: This is the first examination in literature in which Type 1 DM pediatric patients were assessed by using vHIT. The results indicate that these patients' posterior semicircular canals, and hence inferior vestibular nerve, might get affected.

P36

Sound processor modifications with frequency pitch matching for cochlear implant recipients with single-sided deafness

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Background: Recently, cochlear implants (CIs) have become a possible treatment for single-sided deafness (SSD). One of the main aims is to improve quality of sound in binaural hearing tasks. As SSD patients have artificial hearing on the CI and natural hearing on the contralateral side, it could be important to match the frequency pitch perception of both ears.

Objectives: To compare CI sound processor programs (map) with and without frequency pitch matching in SSD.

Material and methods: This preliminary study is on one experienced subject (male, 43 yo) with a N24RECA implant and CP810 sound processor (Cochlear Ltd). First we evaluated 3 different acoustic stimuli in an open sound field using sinusoidal tones, standard narrow band noise, and FRESH noise [1,2] for frequency pitch matching with the normal ear. FRESH noise was sensed closest in pitch to the electric stimuli of the CI. Also we presented, consecutively, a steady state signal on each electrode (N=22) at a clearly heard comfortable level. The subject was instructed to match the frequency pitch of each electrode in 1/48 octave steps with the pitch of the acoustic stimuli. The resulting 22 frequency pitches were defined as center frequencies and the frequency bands were calculated on a logarithmic scale accordingly. The basic profile of the map and signal processing remained unchanged. Due to software constraint concerning the minimal bandwidth, the theoretical frequency bands were adapted. Therefore we defined 3 different maps based on the frequency pitch matching results. Four maps, including the original, were uploaded

blinded. Each program was used for a period of 1 week and then evaluated with HISQUI19 [3] questionnaire. We also asked for a subjective comparison of the maps.

Results: The differences of frequency pitches between natural hearing and standard centre frequencies of the electrodes ranged from 4% (226 Hz) at E3 to 49% (1629 Hz) at E7. Subjectively, the 3 modified maps sounded different. The subject could not identify the original map. The HISQUI19 questionnaire analysis indicated no significant differences (score 97 to 103), all maps were classified good sound quality. The original map was slightly rated highest.

Conclusions: Although we found frequency mismatch up to 49% between natural hearing and the CI, frequency pitch match maps did not improve quality of sound subjectively in this single case study.

P37

Manual therapy for tinnitus resulting from atlantoaxial dysfunction: A case report

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Background: Tinnitus is an imaginary sound sensation in the absence of overt acoustic stimulation. It can be related to different etiologies such as hearing loss, noise trauma, or cervical pathologies. Atlantoaxial dysfunction is identified radiologically where there is an increased mobility or laxity between the body of the first cervical vertebra (atlas) and the odontoid process of the second cervical vertebra. Balance problems, blurred vision, continuous head and neck pain, dizziness, feeling of fullness in the ears, migraine headaches, neck pain with no motion, and reduced activity can be listed among the symptoms of atlantoaxial dysfunction. Those symptoms may deteriorate with neck rotation, tinnitus, and vertigo. For the treatment of atlantoaxial dysfunction, osteopathic manipulative intervention is recommended.

Material and methods: A man aged 27 presented a 5 year history of discontinuous tinnitus in his left ear. With neck movement, especially left lateral flexion and rotation, tinnitus became much more intense. The audiologic evaluation carried out did not produce meaningful results. THI level was 3. Meanwhile the patient reported headache around his left ear and weakness in left arm for a period of 3 years in which the complaints progressively increased. The findings from MRI screening done on the subject's brain and neck earlier were normal. As per the advice of the ENT specialist for an audiologic evaluation and tinnitus therapy, the patient underwent a physiotherapic consultation in line with the findings. On the antero-posterior cervical graphy, the atlas was observed to be located on the right translation. The vertebro-basilar artery test that was conducted to evaluate the vertebral artery insufficiency, positive result was obtained. After evaluations, the patient, diagnosed with atlantoaxial dysfunction, received a total number of six sessions of osteopathic manipulative intervention therapy consisting of myofacial release technique, atlas correction technique, and muscle energy technique. Result: Following the first therapy session, the patient's tinnitus complaints decreased and after the other sessions, the complaints faded away completely.

Conclusions: In line with this case, the importance of cervical problems within the evaluation of tinnitus and the effects of individualized multidisciplinary therapeutic approach on the results were presented.

P38

Formant frequencies of Ling sounds emitted by Turkish women

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Background: Ling sounds are important not only for initial audiological evaluation in children but also following gains in hearing aid or cochlear implant users. To provide appropriate access to verbal instruction, the frequency range of these phonemes is important. Although acoustic characteristics of Ling sounds are documented for various languages, there aren't any studies at present related to Turkish speakers. In this study we aimed to look for a range of formant frequencies (FFs) of emissions of Turkish speaking women since the maternal voice is mostly preferred during testing of young children.

Material and methods: Twelve female (mean age: 31.83, min: 21, max: 44 years) native Turkish speakers with normal hearing emitted /a/, /e/, /i/, /o/, /u/, /m/, /s/, and /ʃ/ sounds. The recordings were recorded digitally with 16 bit resolution at 44100 Hz sampling rate in wav format. Since all the rest have a meaning in Turkish with the exception of /i/, the subjects were ordered to emit all sounds in its meaning as if they were calling a child almost 3 meters away. All recordings were filtered by 80–8000 Hz bandpass filter and then first four FFs were calculated by Pratt sound analysis program.

Results: It was found that /i/ was only sound FF1 of all speakers was below 500 Hz, while 11 of 12 speakers emitted /m/ and /o/ below 500 Hz. FF1 and FF2 of /a/ was between 500–1000 Hz and 1000–2000 Hz in all speakers, respectively. FF2 and FF3 of /m/ was between 1000–2000 Hz and 2000–3000 Hz in all speakers, respectively. FF1, FF2, and FF3 /ʃ/ were between 1000–2000, 2000–3000, and 3000–4000 Hz.

Conclusions: Acoustic data of Ling sounds is important to find out affected frequency bands and improvement by fitting. In this study we found that even if emitting the sound by giving a meaning and intention there are personal variations in FFs. We found that only /ʃ/ appears to be a cut-off sound at 1000 Hz, and /a/, /e/, and /s/ at 500 Hz.

P39

Turkish translation, transcultural adaption, reliability, and validity of the Amsterdam Inventory for Auditory Disability and Handicap

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Background: The aim of this study was to adapt Amsterdam Inventory for Auditory Disability and Handicap (AIADH) into Turkish, and investigate reliability and validity of Turkish AIADH (T-AIADH).

Material and methods: This inventory contains 30 items to assess hearing disability. 240 individuals were included in the study. They were divided into two groups. The study group included 120 patients (mean age: 40.54±11.80) years with hearing loss. The degree of hearing loss in the study group ranged from very mild to profound hearing loss. 120 individuals with normal hearing (mean age: 38.67±11.31) constituted the control group. All patients completed this questionnaire.

Results: The reliability analysis of 30 items in all subjects yielded a Cronbach alpha coefficient of 0.98. All Cronbach alpha coefficients obtained were above 0.70 in five domains of T-AIADH. Fifteen subjects with hearing loss (mean age: 34.40 years, standard deviation: 10.84) completed the questionnaire 3 days after their first completion to analyze test–retest reliability. Test–retest scores of five domains of the questionnaire did not show any significant differences ($p>0.05$). There were statistically significant differences in the study group compared with the control group in respect to the mean scores of each item and the domains ($p<0.001$).

Conclusions: T-AIADH has a high internal consistency and test–retest reliability. T-AIADH can differentiate subjects with hearing loss from subjects with normal hearing.

P40

The iterative design and evaluation of gaming applications to facilitate the use of appropriate hearing aid functionalities in different acoustic contexts

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Background: The 3D Tune-In project aims to help people understand and use their hearing aid (HA) functionalities, as well as enable others to understand hearing loss. Five digital games/apps simulating different acoustic contexts are being developed for different target groups, from older HA users to young children who wear HAs and those who do not. The app developers had no prior experience of developing games for non-leisure markets, therefore the project's human factors team engaged end-users and experts in activities to ensure the app concepts were designed and refined considering the needs of HA users.

Material and methods: At the start of the project, HA users participated in paired interviews to discuss their experience of using HAs in different contexts and the typical difficulties and challenges they face. The findings were translated into user requirements to be implemented in the five apps. Early feedback from end-user evaluation of low fidelity concepts was used to guide the design process. The first stage of formative evaluation involved a) evaluation of the initial working prototypes of the apps by audiologists, and b) a detailed expert review of the apps based on gaming and usability heuristics. The second (ongoing) stage of formative evaluation of the apps has involved adults and children with hearing loss, children without hearing loss and audiologists.

Results: Personas and scenarios describing typical HA users and their everyday experiences were developed using themes from the first interviews with end-users. Most of these HA users were unaware of, or unwilling to use different HA functionalities due to a lack of knowledge or confidence. The personas and scenarios helped the games' developers to understand this target group. The first and second stages of formative evaluation have provided valuable input into the design process, in terms of improving game play and game story, game mechanics, usability, audiological aspects, aesthetics, and addressing accessibility issues.

Conclusions: Iterative design and evaluation cycles have led to working prototypes of five apps: Musiclarity (for improving HA users' experience of music), Play & Tune (games for older HA users), Dartanan (games for children with and without hearing loss), Darius Adventure (game for children without hearing loss which conveys the experience of hearing loss), and AudGam Pro (app for audiologists and patients to personalise HA fittings).

P41

Program of Varna municipality and Diagnostic Consulting Center (DCC) Chaika on "Prevention of hearing diseases in children"

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I. Purpose of the program. The program aims at implementing a large-scale prophylaxis through screening examinations in early childhood of children from the

municipality of Varna for early detection of hearing loss and timely referral for further treatment.

II. Target group. Number of persons covered: 600 children in early childhood.

III. Period of conducting: March 2017 – December 2017.

IV. Justification of the needs. According to global statistics, hearing morbidity in children is between 10 and 12%, whereas the degree of damage is different in each case. This means that within the program we have the chance to establish impairment in at least 50 to 60 children. This means that at stake is the welfare of more than 50 families, our fellow citizens, and we have the opportunity to establish early enough the respective problem and not allow de-socialization of those children that would be detrimental to them and their families.

V. General description of the activities. For the purposes of the program, children domiciled in Varna municipality will be given the following examinations: 1) Otoacoustic emissions (OAEs); 2) Audiogram; 3) Tympanogram. All examinations will be carried out with the explicit informed consent of the parents. For children for whom is established hearing impairment, the possible cause of the condition will be explained to their parents.

VI. Implementation.

1. Conducting screening examination. A) Otoscopy; B) Frontal rhinoscopy; C) Pharyngoscopy. The examination is conducted with a screening apparatus of the company Maiko by the method of otoacoustic emissions. The instrumentation is a global gold standard in the field of this type of examinations. The examination will be conducted in the specialized ENT sector within the DCC Chaika in Varna.

2. Evaluation of the conducted OAE examination.

3. Conducting additional examination. If there are deviations in hearing, the children will be further tested by audiogram and tympanogram.

4. Filling in prophylactic records and journal.

5. Preparation of a register of the children covered by the program. A special register of all children covered by the program will be prepared. Children with hearing loss will be subjected to follow-up examinations after 3 and 6 months.

6. Filling in of a questionnaire.

P42

Comprehensive auditory perception performances of a peripheral polyneuropathy patient

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Background: Peripheral neuropathies have heterogeneous origins which present sensory and/or motor deficits. A number of different disorders may cause polyneuropathy and peripheral nerve fibers are affected. Hearing loss is common sensor deficit in these cases. In this study we aimed to share the comprehensive outcomes of auditory perception performances of a patient with polyneuropathy.

Material and methods: The patient was a 30 year old male. The evaluation battery had three main parts: peripheral hearing evaluation, auditory perception assessment in quiet and noise, and neuropsychological evaluation. Peripheral hearing evaluation includes objective and subjective tests, such as OAE, ABR, and audiometry. Auditory perception assessment sentence recognition test in quiet and matrix test in noise were used. Lastly, neuropsychological evaluation includes Raven Standardized Progressive Matrices Test and Auditory Verbal Learning Test (AVLT).

Results: In peripheral hearing evaluation indicates auditory neuropathy with mild sensory neural hearing loss. Sentence recognition test results were in only auditory condition 10%, in auditory verbal condition 50%. Turkish Matrix test results (adaptive in quiet and adaptive in noise parts) were under norm values. Raven Standardized Matrices Test showed his correct responses were under norm values and his general ability is lower. His AVLT scores were in norm values, especially in long term memory performances.

Conclusions: Auditory perception performances of polyneuropathy cases should be evaluated with a multidimensional perspective.

P43

Cognitive behavioral therapy for selective sound sensitivity syndrome (misophonia): A report of three cases

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Background: Misophonia, a well-known syndrome in the audiology literature, is defined as significant distress caused by certain soft noises like chewing, breathing, smacking. Its etiology is not known, and no effective treatment exists. Recently, there has been a growing interest in psychiatric aspects of misophonia by researchers who showed high psychiatric comorbidities in misophonic people. Some

argue that it should better be classified as a psychiatric disorder. Developing effective treatments is important, since misophonia may cause serious disability. We present three misophonic cases, who received psychoeducation followed by 1 month of self-exposure.

Material and methods: Three patients, all women, with misophonic complaints were assessed for types of misophonic symptoms, associated physical and emotional reactions, and behavioral consequences. After the initial assessment, which confirmed all had significant levels of distress related to misophonia, they received one session of psychoeducation, followed by a month of self-exposure to misophonic stimuli. The psychoeducation was administered by an experienced psychiatrist, and involved information on the physiology and mechanism by which misophonia develops. The patients were then encouraged to expose themselves daily to misophonic stimuli and keep a diary on their exposures and how they dealt with them. They were also given measures of anxiety, depression, and OCD/OC. All patients were assessed for audiological problems and LDL.

Results: All three patients had normal hearing thresholds and normal timpanogram findings. Only one patient had LDL between 80–90 dB. Two out of three patients reported 60–80% reduction in their symptoms at the end of one month. One patient did not report any improvement despite the fact that she also carried out her exposure homework. Of note, her main symptom differed from the other two: she was distressed by a mechanical sound (squeezed plastic bottle), as opposed to others who were distressed by the more common sounds emanating from the mouth.

Conclusions: Our findings show that misophonic symptoms may benefit from psychoeducation and self-exposure. We do not know if the improvements will persist at follow-up. Future studies should examine if comorbid psychiatric conditions or misophonia subtypes respond differentially to treatments.

P44

Functional and morphological analysis of different aminoglycoside treatment regimens inducing hearing loss in mice

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Background: The assessment method most commonly used to determine effects on auditory function in mice are auditory brainstem response (ABR) and, less frequently, distortion product otoacoustic emissions (DPOAE). However, comparison of the relative sensitivity between ABR and DPOAE to aminoglycoside toxicity in C57BL/6 mice has not yet been reported. Furthermore, standardized and specific methods to assess peripheral auditory function before and after aminoglycoside toxicity have yet to be established. We assessed different regimens for gentamicin- and kanamycin-induced ototoxicity and evaluated ABR and DPOAE pre- and post-treatment. The aim of our study was to find an ideal in vivo assessment of hearing thresholds at baseline and after aminoglycoside ototoxic treatment, comparing the sensitivity of ABR and DPOAE.

Material and methods: 4- to 6-week-old C57BL/6J mice were used to assess the optimal aminoglycoside dose regimen to induce sufficient ototoxic injury while maintaining a low mortality rate. Three aminoglycoside regimens were administered to three separate groups (n=12), and hearing ability was assessed by ABR (broadband clicks and frequency specific tone bursts) and extended frequency range DPOAE. Moreover, quantitative morphological analysis of the organ of Corti was performed.

Results: Kanamycin treatment produced significant hearing threshold shifts in click ABR and DPOAE and a trend in frequency-specific ABR. Mortality rate was 0%. DPOAE seems to detect auditory function damage in the high frequencies earlier than ABR. Kanamycin plus furosemide as a single dose was insufficient to cause substantial threshold shifts. Gentamicin was associated with a high mortality rate and no hearing threshold shift. Inner and outer hair cell count was consistent with the data for hearing thresholds.

Conclusions: To date, a comparison of the relative sensitivity between ABR and DPOAE to aminoglycoside toxicity in C57BL/6 mice has not been reported. We compared click and extended frequency-range ABR and DPOAE in aminoglycoside-induced ototoxicity. An ototoxic regimen with kanamycin twice daily for 15 consecutive days was found to be effective, safe, and well tolerated. It produced a significant hearing threshold shift as measured by click ABR and DPOAE and a tendency for an effect on frequency-specific ABR. We demonstrate a higher sensitivity of DPOAE as it detects hearing threshold shifts earlier in high frequencies.

P45

Effect of glutathione S-transferase genetic polymorphisms on music-induced hearing loss

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Background: Both genetic and environmental factors contribute to noise-induced hearing loss (NIHL). The objective of this study is to investigate the hypothesis that glutathione S-transferase (GST) genetic polymorphisms was related to susceptibility to developing NIHL caused by music exposure.

Material and methods: This cross-sectional study recruited high school students who habitually listen to music with portable players. PTA, distortion product otoacoustic emission (DPOAE), and a questionnaire were obtained. Cumulative noise exposure (CNE) was calculated by listening

time and volume of using portable players. Effects of GST1, GSTM1, and GSTP1-105 on NIHL were analyzed.

Results: A total of 312 subjects were analyzed. Mean of PTA at high frequency (average of 3000, 4000, and 6000 Hz) was 8.07 dB HL (SD=5.98). DPOAE amplitude level at high frequency was 20.28 dB SPL (SD=5.10). Mean of CNE was 84.57 dB-year (SD=11.42). With the regression analysis model, there was a good dose–response relationship between CNE and DPOAE amplitude levels at high frequency ($p<0.05$). Furthermore, those subjects with GSTT1-null, GSTM1-null, and GSTP1-105 Ile/Ile genotypes had higher susceptibility for developing hearing threshold elevation at high frequency ($p<0.05$).

Conclusions: This study identified that GST genetic polymorphisms might modify the susceptibility of hearing threshold elevation at high frequency caused by music exposure. Moreover, investigations of other genotypic variants involved in oxidative stress response for elucidating gene–environment interaction for NIHL are warranted.

P46

The effect of garlic derivatives (S-allylmercaptocysteine, diallyl disulfide) and high-dose vitamin B12 on noise-induced hearing loss: An experimental study

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Objectives: Exposure to noise at excessive levels is known to cause damage to the inner ear, resulting in noise-induced hearing loss. Garlic with its intrinsic antioxidant activity may prove beneficial in prevention from noise-induced hearing loss. S-allylmercaptocysteine (SAMC) and diallyl disulfide (DD) are two active compounds found in garlic. Previous studies have shown a relationship between vitamin B12 deficiency and chronic tinnitus coupled with noise-induced hearing loss. In this study, we investigated the effect of SAMC, DD, and high-dose vitamin B12 on noise-induced hearing loss in rats by using brainstem-evoked response audiometry (BERA).

Material and methods: Twenty-four male Wistar rats with intact Preyer's reflex initially weighing 200–250 g were randomly assigned to either noise-induced hearing loss with SAMC treatment group (Noise-w SAMC), DD treatment group (Noise-w DD), vitamin B12 treatment group (Noise-w B12), or physiological saline (without any active compounds) treatment groups (Noise-w PS) (n=6 rats each group). SAMC 100 mg/kg and DD 50 mg/kg body weight were given intragastrically, vitamin B12 1 mg/kg body weight was given intraperitoneally, and physiologic saline 100 mg/kg orally once daily to subjects in Noise-w SAMC, Noise-w DD, Noise-w B12, and Noise-w PS groups, respectively for 4 weeks during the study. On the 14th day rats were exposed to 110 dB sound pressure level white noise for 8 h. Before noise exposure and after noise exposure at 1 h, 48 h, and 14 days hearing thresholds were evaluated by using the BERA test.

Results: The mean amplitude of auditory thresholds measured by using BERA for the treatment groups (Noise-w SAMC, Noise-w DD, Noise-w B12) were significantly better than control group (Noise-w PS) at 6 and 8 kHz. There was no significant difference between individual treatment groups.

Conclusions: SAMC, DD, and vitamin B12 seem to prevent noise-induced hearing loss.

Poster Session | Pitch Presentations 03

P47

Auditory processing disorder questionnaires in children and simplified Russian matrix test in noise

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Background: The true prevalence of auditory processing disorder (APD) is not yet known. It is estimated that 2–5% of children are affected by ADP. Identification and diagnostics of ADP in children continues to be a challenge. Screening tools help to decide the need for evaluation. Several ADP screening tools are well known: Screening Instrument for Targeting Educational Risk; Children's Auditory Performance Scale (CHAPS); Fisher's Auditory Checklist; Auditory Processing Domains Questionnaire; Buffalo Model Questionnaire Revised, etc. However, none of them are used routinely in Russian language. Among the diagnostic tests, speech audiometry in noise has been shown to be a sensitive test for ADP.

Aim: To confirm CHAPS and Fisher's Auditory Checklist in Russian and to relate the results to speech perception in noise assessed with the Simplified Russian Matrix (RuMatrix) test.

Material and methods: Data of CHAPS and Fisher's Auditory Checklist questionnaires were collected for 49 and 52 children, respectively. Children in age from 5 to 11 years were considered. All children were native Russian speakers. Pure tone audiometry, impedancemetry, and simplified RuMatrix test were performed for all children. All of them had normal hearing level, speech and language development, and normal academic achievement at school.

Results: The mean value of Fisher's Auditory Checklist was 85.7±9.3. Two children had a score of Fisher's Auditory Checklist below 2 standard deviations. The mean value of CHAPS questionnaire was equal to 0.08±0.26 and all children were within the normative range. The slope of the speech recognition function did not statistically differ across different age groups of children. Also the test–retest reliability of the simplified RuMatrix test was similar for all groups of children and equaled 1.3 dB on average. The youngest children in age of 5 and 6 years had higher (worse) speech recognition thresholds than older children.

Conclusions. The obtained results of questionnaires are in a good agreement with the test data for the English language version. The simplified RuMatrix test was shown to be a reliable tool for speech intelligibility measurements in children. Further studies are required with ADP subjects in order to validate the tests.

P48

Auditory neuroplasticity and its functional benefits in children with cochlear dead regions

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Cochlear dead regions (CDRs) are regions in the cochlea where the inner hair cells (IHCs) and/or neurons are non-functioning. Tones producing peak vibration in the CDR are then detected by functioning IHCs and neurons at or near that region's edge frequency (f_{edge}). The presence of CDRs has been shown to cause changes in the auditory nerve and the auditory parts of the brain in animals by way of neural plasticity. These changes include tonotopic reorganisation of the auditory brainstem and auditory cortex resulting in the overrepresentation of frequencies near f_{edge}. In adults with CDRs, this reorganisation can lead to some functional benefits. Moore and Vinay (2009) reported that adults with high-frequency CDRs could use low-frequency information more effectively than those without CDRs, showing enhanced frequency discrimination thresholds and performing better at consonant identification in low-pass filtered speech. In children with CDRs, this effect may be stronger due to their potential for greater neural plasticity.

The present study aims to explore the relationship between the use of low-frequency information and the presence of high-frequency CDRs among children aged 7–15 years with sensorineural congenital hearing loss. By using psychophysical tuning curves and the Threshold Equalising Noise (TEN) test to identify children with CDRs, and comparing their frequency and temporal resolution at low-frequencies, and perception of low-pass filtered speech with those of children without CDRs, any enhanced ability to use low-frequency information among children with CDRs may be detected.

The results of this study have implications for the understanding of the effect of CDRs on neural plasticity in children, and the methodological challenges facing researchers investigating this population.

P49

Subcortical and cortical encoding of click and speech stimuli: Neurophysiological evidence

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Background: Recent reports underpin the importance of speech auditory brainstem responses (SABR) recording as a biomarker of speech encoding at the brainstem level. Despite increasing literature, little is known yet about relationship between brainstem and cortical speech and click-evoked potentials. Objectives are twofold: first to objectivize the relationship between click and speech stimulus encoding at subcortical and cortical levels as a function of intensity; second to analyze generator activation at the different level of the auditory pathway.

Material and methods: Eight normal-hearing French native adult speakers (thresholds lower than 20 dB at all hearing frequencies) aged between 22 and 25 (mean=24.7 and SD=0.88 years), with no history of hearing disorders were enrolled in the study. Click-evoked brainstem and cortical responses were recorded at 6 intensities from 60 dB down to 0 dB SL. Speech auditory brainstem and cortical responses were elicited using a 150 ms natural consonant–vowel /ba/ syllable at 60, 50, 40, and 30 dB SL. Stimuli (either click or speech) were binaurally presented through insert earphones to each subject and responses were recorded using a 32-channel EEG system.

Results: We found that neural responses at both the subcortical and cortical levels vary as a function of stimulation intensity with identification of an optimum threshold allowing for a reliable SABR components analysis. No difference between click and speech generators was found at the subcortical level. Differences between click and speech stimuli were observed at the cortical level.

Conclusions: Even though common brainstem generators are shown, findings demonstrate differences in speech versus click ABR biomarker behavior as a function of stimulation intensity. We identify optimum stimulation parameters allowing for an accurate and reliable analysis of speech neural encoding at subcortical and cortical levels.

P50

Data transfer between measuring devices and tracking software: Wireless, bi-directional, efficient

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Path Medical GmbH

A universal and quality controlled newborn hearing screening program requires a number of prerequisites for a long term, efficient and reliable outcome. This includes a direct data transfer between instruments and tracking

server. Data transfer via SIM card technology is equal to an "out of the box" solution, independent of any hospital IT infrastructure. Data is encrypted and transferred directly from instruments to a central database in the tracking center. Mobile data networks are available worldwide, even in areas with limited infrastructure.

In addition, a nationwide screening program requires uniform prerequisites, especially with respect to test-settings, risk-factors, applicable data fields, user-management, and user-profiles. The evolution from one-directional to bi-directional (two-way) data exchange offers the possibility of configuring all connected measuring devices from one central location.

Historically, when any configuration changes were required the employee had to visit the facility or the device had to be sent back to the service department. With bi-directional communication all settings can be made in the tracking center, generating substantial saving in resources. Programs in nations with long distances or limited infrastructure cannot provide personal on-site service, if for example a user has changed his or her name or login credentials. But even for distances in smaller regions such as Germany, the system is working more efficiently with bi-directional data exchange.

The independent wireless data transfer can be connected to all existing tracking systems. In combination with pathTrack software, the functionality is available for all age groups and in different screening approaches, e.g. in preschool, newborn hearing screening, or telemedicine. The presentation illustrates the advantage of the telemedicine approach in screening programs as it is implemented in countries with long distances to medical professionals, like in Iran, Georgia, or Uzbekistan.

P51

Common Audiological Functional Parameters (CAFPAs) as common representation of audiological knowledge

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Background: For performing audiological diagnostics, different clinics are using different audiological test batteries. The choice of measurements depends on the preferences of the respective audiologists, as well as on their experience with different measurement procedures. For example, ENT doctors or audiologists may be convinced of different tests for measuring speech intelligibility.

Material and methods: A set of abstract parameters, called the Common Audiological Functional Parameters (CAFPAs) is proposed in order to integrate audiological knowledge from different locations. The CAFPAs are designed to represent the information obtained from audiological measurements in a uniform and abstract way, covering the most important aspects of a patient's hearing loss. By that, expert knowledge from different ENT clinics could be represented and provided back to all audiologists.

The CAFPAs are designed for the purpose of constituting a common interface from which the diagnoses can be concluded independently of the used measurements. CAFPAs represent different functional principles of the auditory system and thereby do not only form an abstract layer necessary for modeling audiological diagnostics (e.g. with Bayesian Analysis), but are also interpretable by humans. Hence, it could be used as a teaching representation of diagnostic outcomes, to be included in audiological textbooks.

A survey among experts from Hanover and Oldenburg was conducted to gather information about measurement results and a first guess of CAFPAs for 14 given diagnostic outcomes. Seven typical hearing disorders as well as seven related provision indications were asked in the survey. The survey was designed in such a way that CAFPAs were established and their relation to measurements and diagnoses was defined. In order to get structured results according to discriminable diagnostic cases, the diagnostic outcome was given, while measurement results and CAFPAs had to be rated.

Results: Diagnostic outcomes could be distinguished regarding audiological measurements or CAFPAs, respectively. A graphical representation of the CAFPAs was developed, which may be interpreted intuitively by experts, students, and patients.

Conclusions: The relationship between CAFPAs and diagnostics is now defined by collected expert knowledge. The graphical representation forms a basis of communication for diagnostic and teaching purposes.

P52

Novel MRI techniques for examining structure and function of the central auditory pathway

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Animal studies show that short-duration noise exposure and low-level noise exposure are sufficient to cause permanent damage to high-threshold auditory nerve synapses. This does not affect sensitivity to quiet sounds, only to supra-threshold sounds, such as speech in noise. It has yet to be determined whether "hidden" hearing loss is associated with a physiological change measurable in humans.

The long-term aims of this neuroimaging study are to determine: 1) which MRI measures in the human central auditory system are associated with hidden hearing loss; 2) whether these measures are also associated with tinnitus or hyperacusis.

Structural and functional MRI data were collected on a Philips Ingenia 3T MR scanner with a 32-element head coil. We compared structural images with different image contrasts (T1, T2, balanced), to improve confidence in identifying the relevant nuclei involved in auditory processing. Detection of sound-evoked activation was optimised by comparing different functional MRI (fMRI) scan parameters: continuous versus sparse acquisition, cardiac gating, and active noise cancellation. In each condition, broadband noise was presented for 24 s followed by a rest period between successive stimuli. Data were corrected for distortion and motion, and spatially smoothed. Statistical analyses were performed using a GLM of stimulus onset, offset, and duration, with motion parameters, white matter, and CSF nuisance regressors as covariates of no interest.

T2-weighted images provided the most useful structural information. fMRI data acquired using the cardiac-gated sparse scheme were limited to 10 slices, and thus challenging to plan to ensure total coverage. fMRI using continuous acquisition (TR=2 s) gave 20-slice coverage, as well as improved signal-to-noise per unit time. This provided adequate functional contrast-to-noise within the brainstem (specifically inferior colliculus). Following full optimisation of stimulus presentation to present at a higher level and reduction of the rest period to 42 s, activations in auditory cortex reached statistical significance in a single individual, FWE corrected.

We have optimised structural and functional imaging schemes to allow anatomical definition of regions of interest and sound-evoked activations in the ascending auditory pathway.

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P53

Assessment of adults' emotional prosody perception and production

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Background: Emotional prosody is characterised by stresses, intonations, pauses, pitch, and loudness variations of speech due to the expression of feelings. In this study, the emotional prosody production patterns and perceptions have been depicted using meaningless word lists in order to obtain normative data on the production and perception of emotional prosody.

Material and methods: In order to evaluate the emotional prosody perception 42 individuals (27 women, 15 men) were included the current study. 32 sentences expressed by reflecting the emotions of neutral, anger, happiness, and sadness by the actor were played. Participants were asked to mark the state of emotion they were listening to on the form which was prepared by the researcher. To evaluate the production of emotional prosody, the same cues were asked to expressed using the same emotional states and the voice recordings were analyzed in terms of fundamental frequency (F0), loudness, and duration of speech.

Results: The results showed that no variance between genders in the perception of emotional prosody ($p=0.725$). On the other hand, difference has been observed in production of emotional prosody between genders in the pitch variation of speech ($p<0.05$). Within group comparisons women tended to use higher pitch in the expression of happiness compared to feeling of sadness and neutral state of feeling ($p<0.05$). In the speech loudness examination, however, both men and women produced variable levels of loudness for different states of feelings ($p<0.05$). When the speech is analysed in terms of duration both men and women decreased the rate of their speaking while expressing the feeling of sadness compared to anger, happiness, and neutral feelings ($p<0.05$).

Conclusions: The most evident feature of Turkish emotional prosody has been observed to be changes in the loudness of speech for both men and women.

P54

A 5-year longitudinal study of central and peripheral auditory function in Alzheimer's disease and mild cognitive impairment

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Background and aim: The objective was to study the longitudinal outcome of central and peripheral auditory function in three study groups consisting of patients with Alzheimer´s disease (AD), mild cognitive impairment (MCI), and a reference group with subjective memory complaints (SMC).

Material and methods: A consecutive group of 136 individuals participated at the baseline examination. They were assessed with a test battery comprising pure tone audiometry, speech perception in noise (SPN) and quiet, and dichotic digit test (DDT), free and direct report with two digits. They were examined at baseline and at a follow-up after 4–7 years (mean: 5.1 years). Of the subjects who participated at baseline, 47 were examined at follow-up.

Results: At the end of this longitudinal study the DDT scores of the right ear in the AD group had shown a significant decline over 5 years. At follow-up, the MCI patients had excellent DDT performance similar to the performance seen in the reference group, and they had not scores in between the other two groups.

Conclusions: For those patients who developed AD during the 5 year follow up period, DDT was an indicator of the ongoing progress to dementia. At follow-up, the DDT performance of the MCI patients had not deteriorated during the study period. DDT had not the capacity to predict which non-demented patients at baseline who were at risk to develop AD.

P55

The relationship between balance and gait characteristics in mild stage Alzheimer's: A preliminary study

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Background: Alzheimer's is the most common form of dementia. It is a brain disease that causes memory loss and decreased thinking and reasoning skills. Also people with Alzheimer's may have trouble with balance and gait. This deterioration negatively affects daily living activities. This study aimed to investigate the relationship between balance and gait characteristics in mild stage Alzheimer's.

Material and methods: The study included 14 elderly patients with mild Alzheimer's disease from the Geriatrics Department. Socio-demographic characteristics such as age and gender were recorded. Othoscopic and tympanometry impedance tests, pure-tone audiometry was performed using supra-aural earphones to exclude any communication problem. Functional balance was assessed by the Berg Balance Scale (BBS) and walking characteristic was assessed by static posturographic analysis system (Neurocom SMART Balance Master, Long Force Plate).

Results: This study included 5 males and 9 females. Their average age was 77.78±5.88 years and average body mass index was 28.41±7.41 kg/m{2. Although there was a statistically significant positive correlation between BBS and stride length ($r=0.821$, $p<0.001$), walking speed ($r=0.854$, $p<0.001$); there was found no statistically significant correlation between BBS and step width, tandem walking step width, tandem walking speed, respectively ($p>0.05$).

Conclusions: It has been shown that balance was found relationship with walking across speed but no relationship with tandem walking speed. In our study, stride width not reflected balance status although it is predictor of balance in elderly. The Berg Balance Scale includes a tandem stance instead of a tandem walking. So Berg Balance Scale may not have a relationship with tandem walking speed.

P56

The impact of tinnitus on listening effort performance in individuals with normal hearing and hearing loss: A pilot study

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Background: Subjective tinnitus is the perception of sound in the absence of any corresponding external stimulus. Tinnitus is seen more frequently in people who suffer from hearing loss or different ear problems, however people with normal hearing loss may also suffer from tinnitus. As tinnitus patients among others often indicate concentration difficulties related to speech understanding, tinnitus recently has been hypothesized to impair cognitive processing. Considering its impact on people's physical well-being, a clinical measurement of listening effort is essential.

Objectives: The aim of this study was to indicate the effects of tinnitus on listening effort in relation to tinnitus, with or without hearing loss and cognitive performance.

Material and methods: In this pilot study, a total number of 45 people which consists of 15 normal-hearing subjects with tinnitus, 15 hearing loss subjects with tinnitus, and 15 people as a control group were included. Tinnitus Handicap Inventory (THI), Montreal Cognitive Assessment (MOCA), pure tone hearing assessment, and speech discrimination tests were applied before evaluating listening effort. A primary speech-recognition task and a secondary visual task were performed both separately and simultaneously. The THI was used to control for tinnitus handicap as a confounding factor. MoCA was used to screen for cognitive situation.

Results: The individual average THI score of subjects with tinnitus is calculated as 42.40 (±14.85), and of hearing loss subjects with tinnitus is calculated as 56.0 (±14.51). And the MoCA results are calculated to be 25.0 (±2.60) within subjects with tinnitus and 19.50 (±4.52) within hearing loss subjects with tinnitus. Listening effort was significantly higher in the tinnitus group across listening conditions. But the listening performance with second task of hearing loss subjects with tinnitus is observed to be reduced. Subjective listening effort did not significantly differ between both groups.

Conclusions: It is concluded that impact within the Listening Effort performances of subjects with tinnitus is closely related with hearing loss and cognitive processes and should be taken into consideration during the evaluation process. There is a need to further investigate the cognitive functions important for speech understanding and their possible relation with the presence of tinnitus and listening effort.

P57

The impact of working memory load on spoken word recognition in noise: Evidence from eye movements

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In daily life, speech perception is usually conducted in noise, while listeners perform additional tasks that tap working memory capacity. However, the role of working memory in speech processing in noise is not clear. This study examined how working memory load affects spoken word recognition in noise, as the word unfolds in time using eye-tracking. Listeners heard spoken instructions that

relate to an object presented in the visual display, while their eye movements were recorded. For example, participants might be asked to "touch the candle," as four objects are depicted on the monitor: a CANDle, a CANDy, a dog, and a bicycle. As the speech signal unfolds, several alternatives are activated in response to phonemic information, i.e., CAND leads to candy and candle. In order to successfully achieve word recognition, one has to inhibit phonological alternatives, as contradictory information is accumulated (DY). With millisecond accuracy, we tracked in real-time the extent to which the focus on the target word 'candle' (indicating linguistic processing), was delayed due to competing activation of the phonological competitor, 'candy'. Words were presented on the background of speech spectrum noise at a fixed –4 dB signal to noise ratio. We manipulated working memory load by using a digit pre-load task, where participants had to retain either one (low-load) or four (high-load) spoken digits for the duration of the word recognition trial. Thus, a trial began with 1 or 4 spoken digit(s). Listeners were asked to press on the pictogram depicting the spoken word. Next, they were prompted to recall the digit(s) aloud. Our previous study (Hadar, Skrzypek, Wingfield, & Ben-David, 2016) showed that the discrimination between the two phonologically competing alternatives was harder in the high-load than in the low-load condition, with words presented in quiet. These results suggested that working memory plays a role in speech perception, even when performed in ideal listening conditions. Initial data from the current study suggests a possible interaction of the effects of noise and working memory load. When words are presented in noise, working memory load delayed recognition more than when words were presented in quiet. This additional delay was inflated for listeners with lower, yet normal, working memory span. Finally, our data suggests that working memory and noise tap the same resources in speech perception.

P58

Tinnitus pitch in patients with normal hearing sensitivity

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Objectives: Tinnitus is one of the biggest problems that can affect the quality of life and hearing loss is an important risk factor for tinnitus. In these patients, the course of hearing loss may suggest a relation between tinnitus pitch and the audiometric frequencies of hearing loss. On the other hand patients who complain about tinnitus can have normal hearing sensitivity. Hence, we aim in our study to investigate the tinnitus pitch in patients with normal hearing sentitivity and also its relationship with the Tinnitus Handicap Inventory (THI) scores.

Material and methods: In our study, we evaluated 41 patients diagnosed with chronic tinnitus whose ages ranged between 22 and 63 years. We performed pure tone audimetry (125–8000 Hz), tinnitus pitch matching, and THI to all participants. The THI is a self-report measure that can be used to quantify the impact of tinnitus on daily life.

Results: In total, 56.1% of patients were male, and the average patient age was 45.9 years. Tinnitus was seen much more in the left ear (60.3%) than in the right. Four of the participants had moderate sensorineural hearing loss so they were excluded from the study. Audiogram shows 27% of normal hearing with flat audiograms but 32.4% of them had normal hearing up to 2 kHz and 24.3% of them had normal hearing up to 4 kHz and sloping down gradually. In 39.6% of cases, the tinnitus pitch was 6000 Hz, 20.6% of them 8000 Hz, and 17.2% 4000 Hz. In flat audiograms, 50% of subjects had a pitch of 6000 Hz and 40% of them had 8000 Hz. The THI score average was 57.1, but no correlation was found between hearing levels and THI scores.

Conclusions: We concluded that even in normal hearing, the shape of the audiogram might give some information about tinnitus pitch. Finally, THI is an important tool for the determination of tinnitus disturbance but it can not provide additional information about tinnitus pitch.

P59

Is there a negative modulation masking release in hearing-impaired listeners for speech recognition at high noise levels?

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Background: The speech level necessary to obtain 50% speech intelligibility increases with increasing background noise level and is lower for fluctuating than for stationary noise, termed as "modulation masking release". At the same time, differences in the required speech levels between listeners with normal and impaired hearing decrease. The loss in speech recognition thresholds (SRT) are mainly attributed to audibility decrease plus an individual distortion component of the hearing impairment (e.g., Plomp 1978, Plomp 1993). Kollmeier et al. (2016) used the ASR-based Framework for Auditory Discrimination Experiments (FADE) to predict the outcome of the Matrix test for hearing impaired listeners and found a theoretical basis for this relation. However, in the region between 40 and 80 dB SPL, FADE consistently predicted lower thresholds for stationary noise than for fluctuating noise. They argued that fluctuating noise occasionally exceeded audibility threshold and hence disturbed speech cue detection more than the stationary noise. The current study systematically investigates the effect of different noise presentation levels in those two maskers.

Material and methods: 10 listeners with normal hearing and 30 listeners with PTAs (0.5, 1, 2, 4 kHz) between approximately 30 and 50 dB HL were tested in monaural headphone measurements. SRTs were determined for

the stationary test-specific noise, as well as for the fluctuating ICRA5_250 noise at noise presentation levels between 55 and 85 dB SPL.

Results and conclusions: In accordance with the predictions, differences in SRT between listeners with different grades of hearing impairment for the stationary noise decreased with increasing background noise level. For ICRA5_250, however, differences in SRTs between listeners of different hearing impairment were preserved across all noise levels tested. Further, about 50% of the listeners with PTAs above 35 dB HL, or SRTs in quiet above 35 dB SPL, respectively, showed better thresholds for stationary noise than for fluctuating noise at several of the noise levels tested. Those results confirm the hypothesis of a loss of "modulation masking release" in hearing impaired listeners at noise levels that are relevant in everyday communication situations. However, the occurrence and magnitude of this loss seems to vary considerably across individuals.

P60

Idiopathic sudden sensorineural hearing loss in clinical practice

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Background: Sudden hearing loss (SHL) is defined as greater than 30 dB hearing reduction, and its incidence has been reported to be 5–30 per 100,000 person per year. There is no report how often patients with Idiopathic Sudden Sensorineural Hearing Loss (ISSHL) come to an emergency center in a year. The objective of this study was to determine the effectiveness and safety of early corticosteroid treatments for ISSHL.

Material and methods: In 2016 we treated in the Emergency Center 85,889 patients. We diagnosed 49 patients with SSHL by history, physical examination looking for infections, systemic diseases, ototoxic medications, and by documenting a recent decline in hearing. In our retrospective study, 5 patients had nevroboreliosis, 2 multiple sclerosis, and 42 ISSHL. 16 patients were not accepted in our study because hearing loss lasted more than a week. We started treating 26 patients within 2 to 5 days of symptom onset. 21 patients where treated with oral corticosteroids. 4 patients received combined treatment with oral steroids and intratympanic injections of dexamethasone. We performed intratympanic steroids as primary initial treatment in 1 patient with diabetes mellitus. 6 patients dropped out because they did not come for follow-up. Pre and post-treatment audiometric evaluations were analyzed, as well as tolerance of the procedure in 20 patients (age 44–82 years, mean age: 60 years; 9 male, 11 female).

Results: 80% of patients achieved successful treatment according to evaluate hearing improvement (Furuhashi criteria/improvement of {≥10 dB in pure-tone average). Mean post-treatment improvement regarding pure-tone average was 31±30 dB for patients recieving oral corticosteroids, 34±19 dB for patients in the combined treatment group, and 3 dB in patient with primary intratympanic therapy.

Conclusions: The literature is inconsistent regarding the dose and the duration of treatment of oral corticosteroids and intratympanic dexamethasone in the treatment of ISSHL. It is a challenge for the clinician to determine the optimal treatment. In our study, early treatments with corticosteroids showed a positive effect on hearing improvement. Insufficient hearing outcome was related to comorbidity. More research on this condition should be performed in order to determine what the optimal treatment of ISSHL is.

P61

Subgroups of Meniere's patients with different pathomorphological and clinical traits as identified by temporal bone MR-imaging

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Background and aim: Among patients with Meniere's disease (MD), a large variability exists with regard to the manifestation of clinical symptoms. This "phenotypic heterogeneity" is a major reason for the lack of disease-specific diagnostic criteria and renders MD a diagnostic challenge. The existence of multiple etiopathologies and clinical phenotypes in MD was proposed but, to date, has not been demonstrated. Here, we aimed to establish new clinical imaging-based criteria to distinguish distinct MD patient subgroups based on two MD-specific pathologies: degeneration or hypoplasticity of the endolymphatic sac (ES).

Material and methods: Retrospective study: 1) Gadolinium-enhanced magnetic resonance imaging (Gd-MRI, 3T) data of temporal bones from MD patients (n=76) was used to determine the angular trajectory (angle) of the vestibular aqueduct (VA) in the axial plane as a radiographic distinguishing marker for ES degeneration (<120°) or hypoplasticity (>140°); 2) Chart review of clinical features and audiological/vestibular work-up of MD patients; 3) Statistical subgroup comparisons for clinical parameters.

Results: Gd-MRI-based measurements identified four MD patient subgroups with either uni- or bilateral radiographic signs of either ES-degeneration or ES-hypoplasticity. Analysis of clinical parameters revealed significant phenotypic differences between MD patient subgroups.

Conclusions: Four subgroups of MD patients with distinct pathomorphological and clinical traits were identified using temporal bone Gd-MRI. Subgroup diagnosis in MD will in the future presumably enable a more specific diagnosis and allow to prognosticate crucial features in the course of MD for individual patients.

P62

Decoding selective auditory attention via EEG measurements in an office environment

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EEGs are a common tool to measure hearing parameters and they became a widely used method in audiological research during the last 80 years. Recently an analyzing tool to decode selective attention in EEGs was presented. Multichannel EEGs were used to automatically detect the listener's attentional direction on one speaker while having another competing speaker [1]. In order to improve the method's clinical applicability, the subject of the current study was to reduce the number of electrodes used in this experiment and, in addition, to make the experiment's acoustical environment more challenging.

Material and methods: For eight normal hearing adults (4 F, 4 M) without otological or neurological history, EEG (Cz, C3, C4, T7, T8) were measured while playing two speaker speech signals reading a 20-minute German audio book. The two speech signals were presented separately with two loudspeakers at an angle of +45° and –45° at a distance of 1 m from the subject. The EEG signals were analyzed in segments of 60 s. For each of the segments the attentional direction (speaker no.1 or speaker no.2) was estimated in a correlation analysis using the EEG and the two speech signals.

Results: In an office environment, the attentional direction estimation already yields an acceptable result with an accuracy of 70–80% using only a few electrodes. However, we found a decline in the detection rate for a further reduction in the number of electrodes beyond the 5 electrodes used in this experiment. Using sequential analysis we achieved a short period prognosis of the attentional direction. This assessment of the attention could become clinical diagnostic tool. Further studies are being conducted in order to determine methodological improvements that may lead to an increase in recognition rates.

References:

1. O'Sullivan JA et al. Attentional selection in a cocktail party environment can be decoded from single-trial EEG. Cerebral Cortex, 2015; 25(7): 1697–706.

P63

Evaluation of benefit from CI-implanted recipient observational study

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The reported data show a wide disparity in clinical experience, practices, and subsequent outcomes of cochlear implant recipients. Real clinical usefulness of that intervention in a real world environment in different groups of patients requires further investigation. The objective of this work was to obtain patient-related data for implanted patients, including true baseline interval data gathered prior to implant or at first activation of the device and subsequent longitudinal follow-up at annual intervals.

Each patient was evaluated at baseline to obtain baseline responses related to their hearing experiences and perception of quality of life in their pre-implant hearing condition. Evaluation tools included standardized subjective self-assessment scales: the SSQ (Speech Spatial Qualities questionnaire) and HUI Mark III (Health Utility Index) and a non-standard general patient profile forms in two versions: for the clinician and for the patient. Each patient was followed up through routine clinical procedures and in parallel asked to complete the post-implant versions of the questionnaires at their 1{st, 2{nd, and 3{rd year (optional) follow-up appointment.

Twelve patients who received a cochlear implant in the Department of Otolaryngology of the Medical University in Lublin were included in the study. There were 7 female and 5 males. The average age was 60.8 years. Demographic and epidemiological data were gathered and will be presented. Results obtained through standard clinical questionnaires, the SSQ and HUI Mark III, as well as from the nonstandard general questionnaires were analysed.

P64

Hearing aid use in UK adults

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Background: Only 26% of adults with hearing impairment regularly use hearing aids in the UK. The study aimed to determine the demographic, psychological, social, and health correlates of hearing aid use among hearing impaired adults aged 40–69 years old in the UK.

Material and methods: The research was conducted using the UK Biobank resource. Hearing impairment was identified in 18,730 adults aged 40–69 years based on performance on the Digit Triplet test of speech recognition in noise. Participants completed a computerised questionnaire about demographic characteristics, lifestyle and environmental factors, medical information, and hearing aid use.

Results: Nine percent of adults aged 40–69 years with a hearing impairment reported using a hearing aid most of the time. The strongest predictors of hearing aid use were self-reported hearing difficulties (OR 31.81 (95% CI 21.28, 47.55)) and difficulties in background noise (OR 4.19 (95% CI 3.18, 5.53)). Individuals from a 'non-white' ethnicity were less likely to use a hearing aid compared to individuals from a white British ethnicity (OR 0.55 (95% CI 0.43, 0.70)). With each year of age, individuals were 4% more likely to use a hearing aid (95% CI 1.03, 1.05). Sex and educational level were not associated with hearing aid use.

Tinnitus (OR 1.39 (95% CI 1.24, 1.56)) and chronic illness (OR 1.88 (95% CI 1.65, 2.15)) were associated with hearing aid use. But individuals with poorer self-reported health were less likely to use their hearing aid compared to individuals who reported excellent health (OR 0.71 (95% CI 0.53, 0.94)). Social factors including living status and participation in social activities were associated with hearing aid use. Individuals who live alone were 0.78 times less likely to use their aid compared to individuals who live with others (95% CI 0.67, 0.91). For each social activity participated in, individuals were 8% more likely to use their aid (95% CI 1.01, 1.16).

Conclusions: Hearing aid use was associated with psychosocial and demographic factors including recognition of hearing problems, ethnicity, age, social factors, and perceived health. Addressing low hearing aid uptake requires understanding of how psychosocial and demographic factors contribute to hearing aid uptake.

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P65

Utilization of virtual reality in vestibular rehabilitation therapy

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In line with recent technological developments, new implementations are being determined within rehabilitation. As per with these new developments, a feeling of existing at any environment by creating a 3D dynamic simulation based on new software. Thus, the environments in which the individuals with balance disorders have problems, can be created in 3D by means of the software. In addition, by using virtual reality, it becomes possible to compose stimulant fun ambiances so maximum participation and motivation can be ensured. With the computerized balance systems developed in recent years, the proprioceptive, visual and vestibular components of balance can be quantitatively and objectively measured with clinical and practical applications. Hence in our study, it is aimed to develop the Robotic Balance (RB) further by combining it with Virtual Reality (VR). So, for rehabilitation purposes it will become possible to utilize the simulations which are similar to real settings along with the assessment. By providing feedback to individuals and with the repetition of regulated interval balance measurements, it will be possible to increase the functionality of the VRT. For this purpose, RB was developed so it can evaluate the emotional input separately and provide quantitative results through simulations and games that are adequate for balance disorders and delivering feedbacks. The RB can digitally measure the test positions which simulates the postural dynamic balance of the individual and create occasions which he encounters daily and it can also determine the effectiveness of the VRT. RB is designed to provide visual stimulus with its components such as dynamic visual surround, LED screen, and VR glasses. Thus in a safe environment, the individual can easily concentrate on the rehabilitation by using visual, vestibular, and motor stimulus virtually and isolated from the environment in which he is present. With the help of the Virtual Reality which can be used along with RB, the rehabilitation can be made more entertaining, especially for paediatric and geriatric groups which may sometimes find it hard to participate, and in addition can also obtain digital figures by periodical assessments and do follow-ups for the effectiveness and progression of the VRT. The findings and results of our studies in the field of RB and VR shell be demonstrated and shared during the congress meeting.

P66

Hearing aid users reports of the challenges of adapting to a new high-power hearing aid

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Background: Because users of high-powered hearing aids are highly dependent on their hearing aids and well-used to a particular hearing aid, moving to a new hearing aid can be challenging. We interviewed users of high-powered hearing aids who had recently changed to a new hearing aid and asked i) What is HA user's experience of transitioning to a new device?; ii) Which factors are particularly problematic?; and iii) What factors support transition to a new device?

Material and methods: Users of power hearing aids (N=22) were fit with a new high-power hearing aid. 17 completed the study and 5 discontinued the study (3 due to not finding the new hearing aid agreeable and 2 withdrawing from participation for unspecified reasons). After 2 weeks' experience with the new hearing aid, participants completed a structured interview about their experiences adapting to the new hearing aid and completed a questionnaire of hearing aid benefit (IOI-HA). Interviews were audio recorded, transcribed, and analysed according to qualitative content.

Results: The positive themes reported by patients were benefits in speech understanding, general benefit, and benefit in hearing environmental sounds. Negative themes were difficulties with volume control, feedback associated with the hearing aid, and coupling to the hearing aid.

Discussion: Most participants successfully made the transition to a new hearing aid. Difficulties with feedback problems and design features (e.g. volume control) might be addressed by i) careful attention to moulds and sound leakage, and ii) instruction on hearing aid features that differ from the previous hearing aid.