Welcome to the

Fifth International Congress on
Bone Conduction Hearing and Related Technologies

May 20-23, 2015
Lake Louise, Canada

With generous support from our meeting sponsors
The new Cochlear™ Baha® 5 Sound Processor takes advantage of two unique technology building blocks

The efficient BCDrive transducer is 45% smaller than the previous generation, but still produces the same power output. The Ardium Smart platform features the latest automated signal processing technologies. It is the first bone conduction platform to utilize Bluetooth™ Smart and Made for iPhone technology that lets users stream audio and control their sound processor directly from an iPhone.

To learn more about the Baha 5 Systems, please visit www.Cochlear.com/US

*Not everyone with hearing loss is a candidate for a Baha. All surgical procedures include an element of risk, and it is impossible to guarantee success. For complete information regarding the risks and benefits of a Baha procedure, please refer to the instructions for use for the Baha Implant available at www.Cochlear.com/US/Bahaindications.

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*Meeting Planner*
4425 Cass St. Suite A  
T: 858 272-1018  
res@res-inc.com

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Page 3
The BONEBRIDGE System

With the new SAMBA* Audio Processor

Benefit from:
- Transcutaneous technology for bone conduction stimulation
- Intact skin solution
- MR Conditional up to 1.5 Tesla
- No surgical access to the middle ear is necessary
- SAMBA Audio Processor with an award winning design and cutting-edge hearing technology

hearLIFE

* SAMBA pending regulatory approval in Canada
Maps

Lake Louise
Welcome Address

Dear Colleague,

Welcome to Lake Louise. I am so grateful that you took time out of your busy schedule to come be with us in one of the most spectacular venues in Canada. Over the next few days we will learn together, laugh together, renew old friendships and start some new ones.

It is an extremely exciting time in our field. There are more options than ever. And, as always, more options lead to more questions. The pendulum has swung a great deal from what used to be a small group of people working on a small set of options to a tremendously expanded field with many new surgical, audiological and technological developments.

With growth there is always a period of intense learning and reflection. There is much we don’t yet understand about new technologies and approaches and how beneficial they are. There is also a great deal about existing ideas that we may think we understand but perhaps don’t understand as well as we would like. There is confusion in our field about what to measure and how to best capture the needs of the patient. We have done our best to put together a program that will address some of these new, exciting topics as well as provide the latest updates on current technology. At the end of this meeting, we will all be a little wiser. Chances are though, we will have even more unanswered questions. That’s the beauty of science.

Thank you once again for coming and welcome to Lake Louise.

Warmest regards,

Bill Hodgetts, PhD
Host, Osseo 2015

Conference Topics

- Bone Conduction Hearing
- Measuring Outcomes
- Alternatives to Bone Conduction
- Percutaneous Solutions
- New Technologies/Solutions
- Middle Ear Considerations

Conference Site- Lake Louise

Surrounded by soaring mountain peaks, the majestic Victoria Glacier and a glistening emerald lake, the iconic Fairmont Chateau Lake Louise hotel is located in Alberta's Banff National Park. Chateau Lake Louise is a year-round luxury mountain resort offering guided mountain tours, world-class skiing in the winter, scenic hiking and canoe activities in the summer, a luxury spa, and exceptional dining experiences.
Sophono Alpha 2 MPO™
Innovative Magnetic Hearing Restoration Technology from Medtronic

FOR PATIENTS WITH SINGLE-SIDED DEAFNESS (SSD) OR MIXED, CONDUCTIVE HEARING LOSS

• Low profile implant and sound processor
• Simple, minimally invasive procedure
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Cochlear is the global leader in implantable hearing solutions. For over 30 years Cochlear has helped hundreds of thousands of people either hear for the first time or reconnect them to their families, friends, workplaces and communities. Cochlear develops a range of products including cochlear implants, bone conduction implants and acoustic implants, which address different types of hearing loss. The all new Cochlear™ Baha® 5 Sound Processor is the smallest bone conduction sound processor in the industry. In addition, the Baha 5 Sound Processor received the Red Dot design award given to few products with excellent design and innovation. The Baha 5 Sound Processor truly is Incredibly Small and Unbelievably Smart.

Oticon Medical LLC
Kongebakken 9
2765 Smørum, Danmark
T: +45 39 17 71 00
F: +45 39 27 79 00
E: info@oticonmedical.dk
W: www.oticonmedical.com

Oticon Medical is a global company in implantable hearing solutions, dedicated to bringing the magical world of sound to people at every stage of life. As a member of one of the world’s largest groups of hearing health care companies, we share a close link with Oticon and direct access to the latest advancements in hearing research and technologies. Our competencies span more than a century of innovations in sound processing and decades of pioneering experience in hearing implant technology. By working collaboratively with patients, physicians and hearing care professionals, we ensure that every solution we create is designed with user needs in mind. We share an unwavering commitment to provide innovative solutions and support that enhance quality of life for people wherever life may take them. Because we know how much sound matters.

Gold Patron

MED-EL Corporation
2511 Old Cornwallis Rd., Suite 100
Durham, NC 27713 USA
T: 1 888 633 3524
F: 1 919 484 9229
E: implants@medelus.com
W: www.medel.com
Exhibitors

Bronze Exhibitor

Sophono Inc.
5744 Central Avenue, Suite 100
Boulder, CO 80301 USA
T: 720 407 5160
F: 720 407 5168
E: information@sophono.com
W: www.sophono.com

Exhibitor

Otorix
Ekonomivägen 4
SE-436 33
Askim, Sweden
T: +46 725 53 45 37
E: info@otorix.com
W: www.otorix.com

We wish to thank our Sponsors, Patron, Exhibitors and Organizations for their generous support. This meeting would not be possible without their contributions. We encourage all delegates to visit exhibit booths to review the latest advancements in products and services.
## Scientific Advisory Board

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<td>Ad Snik</td>
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<td>Manohar Bance</td>
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<td>Allan Ho</td>
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<td>Ann Wennerberg</td>
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<td>Arjan J. Bosman</td>
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<td>Betsy Davis</td>
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<td>Lawrence E. Brecht</td>
<td>Ulf Nannmark</td>
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Moderators

Thursday, May 21
Opening Ceremony & Keynote Moderator: Bill Hodgetts

Session I: Bone Conduction: Children
Moderator: Penny Hill-Feltham

Session II: Transcutaneous 1
Moderator: Allan Ho

Session III: Surgical Considerations
Moderator: Jack Wazen

Session IV: Audiology Considerations
Moderator: Ad Snik

Session V: Engineering Considerations
Moderator: Bo Hakansson

Session VI: Advanced Technologies
Moderator: Martin Kompis

Friday, May 22
Keynote Moderator: Jack Wazen

Session VII: Emerging Technologies
Moderator: Sabine Reinfeldt

Session VIII: Transcutaneous 2
Moderator: Arjan Bosman

Session IX: Implant Considerations
Moderator: Richard Liu

Session X: Fitting Considerations
Moderator: Bill Hodgetts

Session XI: New Techniques
Moderator: James Tysome

Session XII: Audiology Outcomes
Moderator: Allan Ho

Saturday, May 23

Session XIII: Going Forward 1
Moderator: Myrthe Hol

Session XIV: Going Forward 2
Moderator: Peter Monksfield

Keynote Moderator: Bill Hodgetts
Invited Speakers

Timothy Caulfield, LLM, FRSC, FCAHS
Canada Research Chair in Health Law & Policy
Health Senior Scholar,
Alberta Heritage Foundation for Medical Research
Trudeau Fellow and Professor,
Faculty of Law and School of Public Health
Research Director, Health Law Institute,
University of Alberta

Timothy Caulfield is a Canada Research Chair in Health Law and Policy and a Professor in the Faculty of Law and the School of Public Health at the University of Alberta. He has been the Research Director of the Health Law Institute at the University of Alberta since 1993. Over the past several years he has been involved in a variety of interdisciplinary research endeavors that have allowed him to publish over 250 articles and book chapters. He is a Fellow of the Trudeau Foundation, a Health Senior Scholar with the Alberta Heritage Foundation for Medical Research and the Principal Investigator for a number of large interdisciplinary projects that explore the ethical, legal and health policy issues associated with a range of topics, including stem cell research, genetics, patient safety, the prevention of chronic disease, obesity policy, the commercialization of research, complementary and alternative medicine and access to health care. Professor Caulfield is and has been involved with a number of national and international policy and research ethics committees, including: Canadian Biotechnology Advisory Committee; Genome Canada’s Science Advisory Committee; the Ethics and Public Policy Committee for International Society for Stem Cell Research; and the Federal Panel on Research Ethics. He is a Fellow of the Royal Society of Canada and the Canadian Academy of Health Sciences. He writes frequently for the popular press on a range of health and science policy issues and is the author of The Cure for Everything: Untangling the Twisted Messages about Health, Fitness and Happiness (Penguin 2012).

David P. Morris, MBBS, FRCS (ORLHNS), MD
Dalhousie University
Staff, Division of Otolaryngology Head & Neck Surgery
Division of Medical Education, Neurosurgery
Halifax, Nova Scotia

David joined the Staff of the Division of Otolaryngology Head & Neck Surgery at Dalhousie in 2003 after a year’s fellowship here in Otology, Neurotology and Lateral Skull-base Surgery. He was born and raised in Burnley, Lancashire, in the North West of England, completed his medical training at St Bartholomew’s Hospital London and his Residency in Manchester.

He enjoys a busy tertiary adult and paediatric practice covering the breadth of Otology and Neurotology for the Maritime Provinces of Nova Scotia, Prince Edward Island and New Brunswick.

He is a member of the Otologic Implant and Lateral Skull-base programmes and co-ordinates the Otology Fellowship. He is cross-appointed to Neurosurgery and to the Division of Medical Education and is a co-researcher in the Ear and Auditory Research Laboratory (EARLab.) at Dalhousie University.

His Master’s degree thesis (MD - London UK 2009) examined coupling interfaces in middle ear reconstruction, while current interests include functional microanatomy of the middle ear space, mastoid obliteration techniques, performance assessment of bone conduction hearing devices, communication skills training and the development of new surgical tools.

David has two young daughters and lives in Halifax.
Prof. Ad Snik, PhD  
Professor, Audiology  
Faculty of Medical Sciences  
Radboud University Medical Center  
Donders Institute for Brain, Cognition and Behavior  
Nijmegen, The Netherlands

Ad Snik obtained a master’s degree in physics. After completion of his PhD study, he became a trainee as clinical physicist/audiologist and he was registered as a clinical physicist/audiologist in 1986. Since then he worked as clinical audiologist and researcher. His main fields of scientific interest are pediatric audiology, central auditory processing, hearing implants and rehabilitation of hearing impaired subjects with special needs. In 1988 he joined the Nijmegen Baha team. In 1998, he became the head of the Radboud University Audiological Centre and the (cochlear) implant program. In 2006 he was appointed as a professor in audiology. Ad Snik is employed at the Radboud University Medical Centre and the Donders Institute for Brain, Cognition and Behavior, Nijmegen, the Netherlands.

Myrthe Hol, MD, PhD  
Radboud University Medical Center  
ENT Surgeon, Department of the Radboudumc- Otologist  
Faculty, Nijmegen Ear Surgery Course  
Board, Dutch Society of Audiology  
Nijmegen, The Netherlands

Dr. Myrthe Hol completed her medical studies in Utrecht (1995-2002) and her ENT residency (2003-2009) at the Radboud University Medical Center at Nijmegen, the Netherlands. In 2005 she completed her PhD with the thesis: “BAHA - New indications and long-term patient satisfaction”. Later she went to Lucerne, Switzerland, for a fellowship in otology (specialized otorhinolaryngology) under the guidance of Prof. Linder and Prof. Fisch. Since January 2010 she has been working as a staff member at the ENT department of the Radboudumc, focusing on otology with particular attention to titanium temporal bone implants/bone conduction devices and auricular reconstructions. She is a member of the faculty of the Nijmegen Ear Surgery Course and a board member of the Dutch Society of Audiology. She is also responsible for the chain BI (bone implants/formerly BAHA) and MEI (middle ear implants) within Hearing & Implants Radboudumc. Within the staff, she is responsible for the planning and chief OR management within the ENT department. A few years ago she and her team started a community of bone conduction device users, initially called ‘My Zorgnet’. Since January 2014 it has been organized via Hereismydata, creating opportunities for patient centered healthcare. She is the author and co-author of many international publications and currently she supervises several PhD students and carries out research among others, on the various titanium implants for bone conduction hearing devices, auricular prostheses, auricular reconstructions, single-sided deafness (SSD), directional hearing and quality of life.

Emmanuel Mylanus, MD, PhD  
Department of Otorhinolaryngology Head & Neck Surgery  
Center of Hearing & Implants  
Radboud University Medical Center  
Donders Institute for Brain, Cognition and Behavior- Neuroscience  
Nijmegen, The Netherlands

Emmanuel Mylanus is based at Radboud University Medical Center, Nijmegen, The Netherlands. After graduation from Medical College at the University of Nijmegen, he conducted research on implantable bone conduction hearing aids, which ultimately led to a PhD thesis in 1994. He received training for otorhinolaryngology at the Queen Elisabeth Hospital in Birmingham, UK and at the Radboud University Medical Centre Nijmegen. After qualifying in 1999, he became a staff member at the department of Otorhinolaryngology Head & Neck surgery at the Radboud UMC in Nijmegen. His interest in implantable hearing aids has led to clinical work, research projects, and presentations at international meetings. He is in charge of the Center of Hearing & Implants at the Radboud UMC in which high quality care is provided for patients in need of implantable devices for hearing loss. He is a principal investigator of the Centre of Neuroscience within the Donders Institute for Brain, Cognition and Behaviour.
Wednesday, May 20th

Welcome Reception & Poster / Exhibit Session  Time: 17:00
Please make plans to join your colleagues at this conference opening event. This is an excellent opportunity to pick-up your conference credentials prior to our program beginning on Thursday morning. We appreciate the dedication and support from our industry partners. Without their generous contributions this meeting would not be possible. We encourage our conference delegates to show their appreciation by visiting each exhibit booth and inquire about the latest products and services provided by our patrons. Our Poster Session will run concurrently with our Exhibit Reception, providing a casual atmosphere to review these important scientific papers. The Program Committee considers posters an important contribution to the success of this conference. Many of the presentations will provide information that is thought to be better suited to the higher level of exposure and interaction that a poster presentation affords. Poster presentations are seen as an extremely important venue for information exchange. Poster awards will be presented to outstanding posters. A cash bar and light appetizers will be available for your enjoyment.

Fee: No fee required for delegates. Accompanying guest/s require Guest Fee  
Dress: Resort Casual

Thursday, May 21st

Brewster Cowboy’s Barbecue & Dance Barn  Time: 18:00
Built in 1996 in honor of the Brewster Cowboys for over 100 years, the Brewster Dance Barn in Lake Louise provides an authentic Western atmosphere. Join us for a night of great food, live music and old fashioned line dancing. You will not want to miss this unforgettable Western Canadian experience! Reserve your spot today.

On-Site Delegate Fee:  $140 USD / person  
Dress: Casual
Reservations required

Friday, May 22nd

Reception & Banquet  Time: 18:30
Join us for a wonderful evening of networking, entertainment and a banquet dinner. A cash bar and light appetizers will also be available for your enjoyment.

On-Site Delegate Fee:  $115 USD / person  
Dress: Cocktail
Reservations required
General Information

BADGES
Each participant will receive a name badge upon registration. For security reasons all participants are requested to wear their badge during all the Congress activities and social events.

CLIMATE
The weather in Lake Louise during the summer at a high of 25 degrees Celsius / 77 degrees Fahrenheit and a low of 7 degrees Celsius / 45 degrees Fahrenheit. During the winter, temperatures average at a high of 2 degrees Celsius / 36 degrees Fahrenheit and a low of -12 degrees Celsius / 10 degrees Fahrenheit.

CONTACT
RES Seminars
4425 Cass Street, Suite A
San Diego, CA 92019
E-mail: info@osseo2015.com

DISCLAIMER
The Organizing Committee and RES Seminars accept no liability for injuries/losses of whatever nature incurred by participants and/or accompanying persons, nor loss of, or damage to, their luggage and/or personal belongings.

MEALS
Continental Breakfast, coffee breaks, conference receptions and two lunches are included in the delegate fee.

Guest fees include welcome reception, exhibit reception and 2 lunches.

GENERAL
Time Zone: Mountain Standard Time (UTC -7:00 hours)
Currency: Canadian dollar (CAD)
Language: English

VENUE
Fairmont Chateau Lake Louise
111 Lake Louise Drive
Lake Louise, Alberta
Canada T0L 1E0
T: 403 522 3511
F: 403 522 3834

PROGRAM CHANGES
The organizers cannot assume liability for any changes in the program due to external or unforeseen circumstances.
Views expressed by speakers at this meeting are solely their own and do not necessarily reflect the positions or policies of the conference program committee.

LOCAL TRANSPORTATION
Rental Car: Conference discounts have been setup with Enterprise and National care rental. Please visit Contact/Map/Travel page on conference website.
Sedan Service: 1-888-449-2901
Shuttle Service: Brewster Bus 1-866-606-6700
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<td>Exhibit &amp; Poster Set-up</td>
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<td>14:00</td>
<td>Registration Opens</td>
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<tr>
<td>17:00</td>
<td>Welcome Reception &amp; Poster / Exhibit Session</td>
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**Wednesday, May 20**

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<td>08:00-16:00</td>
<td>Registration Opens</td>
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<tr>
<td>09:00</td>
<td>Opening Ceremony and Moderator: Bill Hodgetts</td>
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<td>08:00</td>
<td>Invited Speaker: Timothy Caulfield- &quot;The Forces That Twist Science&quot;</td>
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<td>08:30</td>
<td>Industry Symposia: Cochlear</td>
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<td>10:00</td>
<td>AM Break - Exhibits</td>
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<td>Session I: Bone Conduction: Children</td>
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<td>10:45</td>
<td>Emilie Haterink- Clinical Results of BI300 Children: Two Tertiary Referral Centres</td>
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<td>09:10-12:00</td>
<td>Session II: Transcutaneous 1</td>
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<td>11:00</td>
<td>Kay Chang- Comparison of Thinning vs. Non-Thinning Techniques for Bone Anchored Implants</td>
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<td>11:15</td>
<td>Lisa Christensen- Magnetic Bone Conduction Hearing Implant System</td>
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<td>Emma Hoskison- Experience of the Ponto Bone Anchored Hearing System in Children</td>
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<td>Ricardo Cristobal- Surgical Transition: Skin-Penetrating to a Magnetic-Implant System in Pediatric Patients</td>
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<td>Session III: Surgical Considerations</td>
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<td>Mans Eeg-Olofsson- The Bone Conduction Implant-Surgical Procedure and Clinical Results</td>
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<td>Piotr Skarzynski- Lifts in Surgical Technique with Bonebridge</td>
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<td>14:00</td>
<td>Theresa Frawley- Evolving Surgical Techniques: Influencing the Specialized BAHA Nurse’s Role</td>
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<td>14:15</td>
<td>Rupan Banga- Bone Anchored Hearing Implants; Outcomes with Soft Tissue Preservation Technique</td>
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<td>14:30</td>
<td>Marcus Holmberg- New Minimally Invasive Ponto Surgery: Experience from First 80 Patients</td>
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<td>Peter Monksfield - Peri-BAHI Fluid Exudate Study, Can We Predict Soft Tissue Reactions/ Implant Loss</td>
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<td>PM Break - Exhibits</td>
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<td>15:30-17:00</td>
<td>Session V: Engineering Considerations</td>
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<td>15:30</td>
<td>Patrick Maas- Linking Skull Simulator Output to Vibrations Applied to Human Heads</td>
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<td>15:45</td>
<td>Joilen Desmet- Effect of Different Magnet Strengths on the Outcome with BAHA Attract</td>
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**Thursday, May 21**

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<td>Mans Eeg-Olofsson- The Bone Conduction Implant-Surgical Procedure and Clinical Results</td>
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<td>15:30-17:00</td>
<td>Session V: Engineering Considerations</td>
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16:15 Martin L. Johansson - Site-Specific Laser Modification Promotes Higher Osseointegration of Titanium Implants
16:30 Gary Faulkner - Comparison of ASIST and Osstell-ISQ for BAHA Implant Stability
16:45 Robert McLeod - Psychoacoustic Measurements of Phase and Amplitude Necessary for Cross-Talk Cancellations
17:00 Adjourn
18:00 Social Outing

Friday, May 22
07:30 Registration Opens
07:30 Exhibits / Continental Breakfast
Moderator: Jack Wazen
Invited Speakers: Myrthe Hol, Emmanuel Mylanus, Ad Snik - "Critical Appraisal of Today’s Amplification Options for Patients with Conductive or Mixed Hearing Loss from an Audiological and Clinical Perspective"
08:00 Industry Symposia: Oticon Medical
08:30 AM Break - Exhibits
10:45-12:00 Session VII: Emerging Technologies
Moderator: Sabine Reinfeldt
Patrik Westerkull - Performance and Design of a New Bone Conduction Device
Akhilesh Kotiya - Subcutaneous Piezoelectrically Actuated Hearing Aid: Device Development and Functional Testing
Mats Dotevall - Improving Patient Outcomes through the Development of a New Transducer Technology
Christof Roosli - Bone Conduction Pathway through Non-Osseous Contents
Karl-Johan Freden Jansson - MRI Investigation of the Bone Conduction Implant: A Pilot Study
12:00 Lunch
13:30-15:00 Session IX: Implant Considerations
Moderator: Richard Liu
Myrthe Hol - Clinical Survey of BAHI: Wide Implants and Tissue Preservation
Karan Jolly - Evaluating Predictors for BAHI Fixture Losses in Over Patients
Rik Nelissen - Five-Year Stability, Survival, and Tolerability of the BAHA Bi300 Implant
Ronen Nazarian - Comparison Study of Hydroxyapatite-Coated Versus Non-Coated bone Anchored Hearing Abutments
Anirvan Banerjee - A Wide Bone Anchored Hearing Implant: UK Prospective Multi-Center Study
Robert Stokroos - The Soft Tissue Preservation Experience with a HA-Coated Abutment
13:45 Session X: Fitting Considerations
Moderator: Bill Hodgetts
Arjan Bosman - Loudness Growth in Bone Anchored Hearing
Denise Breukels-Van Barneveld - Fitting Ranges of Various Hearing Devices for Conductive Hearing Loss
Devin McCaslin - Subjective and Objective Outcomes Using a Power Implantable Prosthetic Device
14:00 Darren Whelan - Evaluation of Increased Output and Gain in Bone-Anchored Hearing Devices
Karen Draper - Expanding the Indications for the Bone Anchored Hearing System (BAHS)
14:15 Cochlear Workshop 3
Surgical (13:30 - 15:00)
14:30 Oticon Medical Workshop 2
(13:30 - 17:00)
14:45 Shabana Arshad - Cost-Effectiveness of the Cros and Bicros Hearing Aids
15:30-17:00 Session XI: New Techniques
Moderator: James Tysome
Jack Wazen- Connect to Attract: Techniques and Pitfalls
Junaid Hanif- Acrylic Ear Template to Determine Optimal Implant Site
Margarita Trobos- Bacteriological Evaluation of the Abutment-Skin Interface of BAHS
Jaydip Ray- Early UK Experience with the New Transcutaneous BAHA Attract
Tim Calon- Understanding Skin Reactions: A Clinical Study on Objective Outcome Measures
Howard Savage Jones- Tullamore Triad: Surgical Evolution and Fixure Site Skin Reaction Reclassification
17:00 Adjourn
18:30 Reception & Banquet

Saturday, May 23
07:30 Registration Opens
07:30 Exhibits / Continental Breakfast
08:15-10:00 Session XIII: Going Forward 1
Moderator: Myrthe Hol
Andrea Pittman- Benefits of High-Frequency Amplification in Children and Adults
Ad Snik- BCDS in SSD: Long-term use and Satisfaction by Gender
Emmanuel Mylanus- Long-Term Follow-Up on BCDS in Congenital Unilateral Conductive Hearing Loss
Dave Gordey- BAHS Fitting Practices in Pediatrics: Survey Results from Audiologists
Kari Morgenstein- Bone Anchored Devices Management of Children with Single Sided Deafness
Robert Stokroos- First RCT of a Novel Minimally Invasive BCHI Surgical Technique
10:00 AM Break - Exhibits
Invited Speaker: David Morris- "Growing Up with Bone Conduction. Lessons Learned, Loose Ends and Lots More Questions Than Answers."
Anders Tjellstrom- Tribute to PI Branemark
11:30 Bo Hakansson- The Bone Conduction Implant: Technical Development and Brief Results
James Tyson and Ad Snik- AURONet: Improving Patient-centered Outcomes in Bone Conduction Hearing Implants
12:15 OSSEO 2017
12:30 Conference Adjourns

The Program Committee reserves the right to modify the program schedule as circumstances might dictate.
Views expressed by speakers at this meeting are solely their own and do not necessarily reflect the positions or policies of the conference program committee
Presenter Disclosure Statements

The Program Committee requests that all speakers shall disclose any affiliation with financial interest in a company or a product related to the subject matter of the presentation as a part of the Speaker’s Agreement. The intent of this policy is not to prevent a speaker with an affiliation or financial interest from making a presentation but any potential conflict must be identified openly so that the attendees have the full disclosure of the facts and may form their own judgments about the presentation. Any portion of the information submitted below will be shared with the attendees to gain perspective on the educational merits of the presentation.

The following speakers have indicated that they have a financial interest in a commercial product(s) or services that will be discussed in their presentation.

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<th>Shabana</th>
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The views and opinions expressed in this activity are those of the presenter and do not necessarily reflect the views of the International Symposium or supporting institutions.
## SCIENTIFIC PROGRAM SCHEDULE

### Wednesday, May 20

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<tr>
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<th>Location</th>
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<tr>
<td>09:00-17:00</td>
<td>Exhibit &amp; Poster Set-Up</td>
<td>Mt. Temple C, Heritage Hall</td>
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<tr>
<td>14:00</td>
<td>Registration Opens</td>
<td>Alpine Gallery</td>
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<tr>
<td>17:00</td>
<td>Welcome Reception &amp; Poster / Exhibit Session</td>
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### Thursday, May 21

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<td>07:30</td>
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<td>Alpine Gallery</td>
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<td>Cochlear Hospitality Room (Lower Level)</td>
<td>Plain of Six Glaciers &amp; Saddleback Trail</td>
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**Abstract**

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<tr>
<td>08:00</td>
<td>1  Timothy Caulfield  <em>The Forces That Twist Science</em></td>
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<tr>
<td>08:30</td>
<td>2  Emilie Haterink  <em>Clinical Results of BI300 Children: Two Tertiary Referral Centres</em></td>
<td>Mt. Temple AB</td>
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<td>10:00</td>
<td>3  Kay Chang  <em>Comparison of Thinning vs. Non-Thinning Techniques for Bone Anchored Implants</em></td>
<td>Mt. Temple A</td>
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<tr>
<td>10:45-12:00</td>
<td>Concurrent Session I- <em>Bone Conduction: Children</em>  <em>Magnetic Bone Conduction Hearing Implant System Outcomes in Children</em>  <em>Experience of the Ponto Bone Anchored Hearing System in Children</em>  <em>Surgical Transition: Skin-Penetrating to a Magnetic-Implant System in Pediatric Patients</em></td>
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<td>Conference Lunch</td>
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<td>13:30-15:00</td>
<td>Concurrent Session III- <strong>Surgical Considerations</strong></td>
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<td>Concurrent Session V: <strong>Engineering Considerations</strong></td>
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Victoria Room
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Mt. Temple C
Brewster Dance Barn
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*The Forces That Twist Science*                                              | Mt. Temple AB                      |                                  |
| 08:30 | Industry Symposia: Cochlear                                          | Mt. Temple AB                      |                                  |
| 10:00 | AM Break-Exhibits                                                    | Mt. Temple C                       |                                  |
| 10:45-12:00 | Concurrent Session II- *Transcutaneous 1*       | Mt. Temple B |                                  |
| 10:45 | 7 Tobias Weissgerber  
*Results of Bonebridge Implantation in Adults- A Retrospective Study* | Mt. Temple B |                                  |
| 11:00 | 8 Rolf Salcher  
*The Active Bone Conduction Implant Bonebridge in Patients with Single-Sided Deafness* | Mt. Temple B |                                  |
| 11:15 | 9 David Peter Morris  
*Bonebridge vs. Traditional Percutaneous BCIs in Conductive Hearing Loss Comparison* | Mt. Temple B |                                  |
| 11:30 | 10 Sabine Reinfeldt  
*Clinical Results of the Bone Conduction Implant: The First Six Patients* | Mt. Temple B |                                  |
| 11:45 | 11 Christina Rigato  
*Audiometric Comparison of BCI and BAHA in Matched Patients* | Mt. Temple B |                                  |
| 12:00 | Conference Lunch                                                     | Victoria Room                      |                                  |
| 13:30-15:00 | Concurrent Session IV: *Audiology Considerations*  | Mt. Temple B |                                  |
| 13:30 | 18 Julie Daugherty  
*Effects of Bone-Anchored Hearing Devices on Tinnitus* | Mt. Temple B |                                  |
| 13:45 | 19 Martin Kompis  
*Long Term Benefit of BAHS in Single Sided Deafness* | Mt. Temple B |                                  |
| 14:00 | 20 Hillary Snapp  
*Transcranial Attenuation in Pre-Operative Assessment of Individuals with Single-Sided Deafness* | Mt. Temple B |                                  |
| 14:15 | 21 Niamh Flanagan  
*Bilateral BAHA Moving Beyond Audiological Evaluation* | Mt. Temple B |                                  |
14:30  22  Mehrnaz Zeitooni  

Binaural Hearing Ability with Bone Conduction Simulation

14:45  23  Martijn Agterberg

Directional Hearing and Bone-Conduction, A Measure of Binaural Hearing

15:00  PM Break-Exhibits  

15:30-17:00  Concurrent Session VI:  
Advanced Technologies

Moderator: Martin Kompis

Mt. Temple C

15:30  30  Ann-Louise McDermott

The Adjoin Adhesive Adapter: New Innovation in Bone Conduction Hearing

15:45  31  Annelen Hedin

Maximizing the Hearing Experience Through Sound Processor Development

16:00  32  Denise Leese

User Benefits of Wireless Connectivity with a Smart Sound Processor

16:15  33  Jona Hoffman

Improving Hearing Performance Using a Wireless Remote Microphone

16:30  34  Imran Mulla

Teenagers' Use of Wireless Technologies with Bone Conduction Hearing Implants/Devices

16:45  35  Denise Creasey

Patient Benefits from a New Bone Conduction Sound Processor

17:00  Adjourn

18:00  Social Outing

Brewster Dance Barn

Thursday, May 21

13:30-15:00  Cochlear: Workshop I - Audiological

Baha® Fitting Software and Baha Smart App: Walk through and hands-on
Presenters: Karin Rødsjø, Tracey Adams and George Cire

Plain of Six Glaciers & Saddleback Trail

13:30-17:00  Oticon Medical: Workshop 1

Beehive Trail & Lakeshore Trail

15:30-17:00  Cochlear: Workshop 2 - Surgical

Cochlear Baha Attract: Surgical Technique Guidelines to Maximize Cosmetic and Performance Outcomes
Presenter: Peter Weber, MD

Plain of Six Glaciers & Saddleback Trail
### Friday, May 22

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<td>10:45-12:00</td>
<td><strong>Concurrent Session VII: Emerging Technologies</strong></td>
<td>Mt. Temple A</td>
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<td>Moderator: Sabine Reinfeldt</td>
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<tr>
<td>10:45</td>
<td>Patrik Westerkull</td>
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<td>10:45</td>
<td><strong>Performance and Design of a New Bone Conduction Device</strong></td>
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<td>11:00</td>
<td>Akhilesh Kotiya</td>
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<td>11:00</td>
<td><strong>Subcutaneous Piezoelectrically Actuated Hearing Aid: Device Development and Functional Testing</strong></td>
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<td>11:15</td>
<td>Mats Dotevall</td>
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<td><strong>Improving Patient Outcomes through the Development of a New Transducer Technology</strong></td>
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<td>11:30</td>
<td>Christof Roosli</td>
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<td><strong>Bone Conduction Pathway through Non-Osseous Contents</strong></td>
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<td>Karl-Johan Fredén Jansson</td>
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<td><strong>MRI Investigation of the Bone Conduction Implant: A Pilot Study</strong></td>
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<td>13:30-15:00</td>
<td><strong>Concurrent Session IX: Implant Considerations</strong></td>
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<td>Moderator: Richard Liu</td>
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<td>13:30</td>
<td>Myrthe Hol</td>
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<td>13:30</td>
<td><strong>Clinical Survey of BAHI: Wide Implants and Tissue Preservation</strong></td>
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<td>Karan Jolly</td>
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<td>13:45</td>
<td><strong>Evaluating Predictors for BAHI Fixture Losses in over Patients</strong></td>
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<tr>
<td>14:00</td>
<td>Rik Nelissen</td>
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<td><strong>Five-Year Stability, Survival, and Tolerability of the BAHA BI300 Implant</strong></td>
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<td>14:15</td>
<td>Ronen Nazarian</td>
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<td>14:15</td>
<td><strong>Comparison Study of Hydroxyapatite-Coated Versus Non-Coated bone Anchored Hearing Abutments</strong></td>
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14:30  51  Anirvan Banerjee  
**A Wide Bone Anchored Hearing Implant: UK Prospective Multi-Center Study**

14:55  52  Robert Stokroos  
**The Soft Tissue Preservation Experience with a HA-Coated Abutment**

15:00  PM Break-Exhibits  
Mt. Temple C

15:30-17:00  **Concurrent Session XI: New Techniques**  
Moderator: James Tysome  
Mt. Temple A

15:30  59  Jack Wazen  
*Connect to Attract: Techniques and Pitfalls*

15:45  60  Junaid Hanif  
*Acrylic Ear Template to Determine Optimal Implant Site*

16:00  61  Margarita Trobos  
*Bacteriological Evaluation of the Abutment-Skin Interface of BAHS*

16:15  62  Jaydip Ray  
*Early UK Experience with the New Trascutaenous BAHA Attract*

16:30  63  Tim Calon  
*Understanding Skin Reactions: A Clinical Study on Objective Outcome Measures*

16:45  64  Howard Savage Jones  
*Tullamore Triad: Surgical Evolution and Fixture Site Skin Reaction Reclassification*

17:00  Adjourn

18:30  Reception & Banquet  
Victoria Ballroom

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**Friday, May 22**

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<th>Time</th>
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**Abstract**

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<tr>
<td>08:00</td>
<td>Myrthe Hol &amp; Emmanuel Mylanus Ad Snik</td>
<td><em>Critical Appraisal of Today’s Amplification Options for Patients with Conductive or Mixed Hearing Loss from an Audiological and Clinical Perspective</em></td>
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<td>Industry Symposia: Oticon Medical</td>
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<td>10:45</td>
<td>Concurrent Session VIII: Transcutaneous 2</td>
<td>Christine Den Besten</td>
<td>BAHA Attract: Multicentre Clinical Investigation Protocol and First Experiences</td>
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<td>William Brassington</td>
<td>Clinical Experience of BAHA Attract - An Audiologists Perspective</td>
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<td>Ralf Siegert</td>
<td>Results of a New Implantation Technique of the Sophono Device</td>
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<td>Pete Weber</td>
<td>Global Clinical Outcomes of a Magnetic Retention Bone Conduction System</td>
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<td>Henrik Frylund</td>
<td>Paediatric Outcomes of a Magnetic Retention Bone Conduction Hearing Systems</td>
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<td>Concurrent Session X: Fitting Considerations</td>
<td>Arjan Bosman</td>
<td>Loudness Growth in Bone Anchored Hearing</td>
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<td>Denise Breukels-Van Barneveld</td>
<td>Fitting Ranges of Various Hearing Devices for Conductive Hearing Loss</td>
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<td>Devin McCaslin</td>
<td>Subjective and Objective Outcomes Using a Power Implantable Prosthetic Device</td>
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<td>Darren Whelan</td>
<td>Evaluation of Increased Output and Gain in Bone-Anchored Hearing Devices</td>
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<td>Karen Draper</td>
<td>Expanding the Indications for the Bone Anchored Hearing System (BAHS)</td>
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<td>Shabana Arshad</td>
<td>Cost-Effectiveness of the Cros and Bicros Hearing Aids</td>
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<td>15:00</td>
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<td>15:30</td>
<td>Concurrent Session XII: Audiology Outcomes</td>
<td>Torsten Rahne</td>
<td>Functional Results After Bonebridge Implantation In Adults and Children</td>
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<td>Andrea Green</td>
<td>Management of Children with Conductive or Mixed Hearing Loss</td>
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<td>16:00</td>
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<td>Sarah Healy</td>
<td>IOI-BAHA, The Patients’ Perspective</td>
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<td>Timo Gerdes</td>
<td>Transcutaneous and Percutaneous Bone Conduction Instruments: Comparison of Audiological Results</td>
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</table>
Friday, May 22

13:30-15:00

**Cochlear: Workshop 3 - Surgical**
*One Implant Two Systems: Advanced Topics for Cochlear Baha Surgery*
Presenter: Peter Weber, MD

13:30-17:00

**Oticon Medical: Workshop 2**

15:30-17:00

**Cochlear: Workshop 4 - Audiological**
*Baha® Fitting Software and Baha Smart App: Walk through and hands-on*
Presenters: Karin Rødjsø, Tracey Adams and George Cire

Saturday, May 23

07:30
Registration Opens

08:00
Cochlear Hospitality Room (Lower Level)

08:00
Oticon Hospitality Room (Lower Level)

08:15-10:00
**Concurrent Session XIII: Going Forward 1**
Moderator: Myrthe Hol

**Abstract**

08:15 71 Andrea Pittman
*Benefits of High-Frequency Amplification in Children and Adults*

08:30 72 Ad Snik
*BCDS in SSD: Long-term use and Satisfaction by Gender*
08:45    73  Emmanuel Mylanus  Long-Term Follow-Up on BCDS in Congenital Unilateral Conductive Hearing Loss

09:15    74  Dave Gordey  BAHS Fitting Practices in Pediatrics: Survey Results from Audiologists

09:30    75  Kari Morgenstein  Bone Anchored Devices Management of Children with Single Sided Deafness

09:45    76  Robert Stokroos  First RCT of a Novel Minimally Invasive BCHI Surgical Technique

10:00    AM Break - Exhibits  Mt. Temple C

Moderator: Bill Hodgetts

10:45    83  David Morris  Growing Up with Bone Conduction. Lessons Learned, Loose Ends and Lots More Questions Than Answers  Mt. Temple AB

11:15    84  Anders Tjellstrom  Tribute to Pl Branemark

11:30    85  Bo Hakansson  The Bone Conduction Implant- Technical Development and Brief Results

12:00    86  James Tysom & Ad Snik  AURONet: Improving Patient-centered Outcomes in Bone Conduction Hearing Implants

12:15  OSSEO 2017

12:30  Conference Adjourns

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**Saturday, May 23**

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<td>08:15-10:00</td>
<td><strong>Concurrent Session XIV: Going Forward 2</strong></td>
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**Abstract**

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<tr>
<td>08:15</td>
<td>77  Suzanne Jervis</td>
<td>Cost-Effectiveness of the Bone Conduction Hearing Aid and BAHA</td>
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<tr>
<td>08:30</td>
<td>78  Christiane D'Hondt</td>
<td>An Analysis of the CODACS Direct and Bone Conduction Thresholds</td>
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</table>
08:45  79  Malou Hulcrantz | A New Minimal Invasive Percutaneous Surgery, MIPS, for Osseointegrated Hearing Devices

09:15  80  Marc Van Hoof | The Hydroxyapatite Coated Abutment Integrates with the Surrounding Skin

09:30  81  Stina Wigren | International Multicenter Clinical Investigation of a Magnetic Bone Conduction System

09:45  82  Shayam Singam | BAHA Surgery without Soft-Tissue Reduction (WOSR)-Five Year Result

10:00  AM Break - Exhibits

Moderator: Bill Hodgetts

10:45  83  David Morris | Growing Up with Bone Conduction. Lessons Learned, Loose Ends and Lots More Questions Than Answers

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12:15  OSSEO 2017

12:30  Conference Adjourns

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**Saturday, May 23**

**Workshops**

10:30-12:00  Cochlear: Workshop 5 - Surgical Focus

10:30-12:00  Oticon Medical: Workshop 3
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<td>Martijn</td>
<td>Agterberg</td>
<td>Unilateral Plugged Listeners Localize Sounds with a B-71 Bone-conductor</td>
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<td>Shabana</td>
<td>Arshad</td>
<td>Sophono Outcomes on the Birmingham Adult Implant Program</td>
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<td>Arjan</td>
<td>Bosman</td>
<td>Evaluating the Efficacy of the Adjoin Plaster</td>
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<td>Jan</td>
<td>Boucek</td>
<td>BAHA Attract in SSD Patients- Surgical and Audiological Results</td>
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<td>Megan</td>
<td>Brete</td>
<td>Review of Attract Implantation at One Year</td>
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<td>Antonio</td>
<td>Caruso</td>
<td>Ponto System: Clinical Results with Tissue Preservation. Gruppo Otologico Experience</td>
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<td>Stephen</td>
<td>Cass</td>
<td>Cochlear Input Signal with Bilateral Stimulation of Bone-Conduction Implants</td>
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<td>George</td>
<td>Cire</td>
<td>Wireless Hearing Assistance Technology with Bone Anchored Hearing Solutions</td>
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<td>Christine</td>
<td>Den Besten</td>
<td>Clinical Survey of a Surgical Technique with Tissue Preservation</td>
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<td>Jolien</td>
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<td>Sound Localization in Baha® Patients with a Unilateral Air-bone Gap</td>
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<td>Eeg-Olofsson</td>
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<td>Otitis Externa: Combined BAHA/HA Strategies in Moderately Severe SNHL</td>
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<td>Søren</td>
<td>Foghsgaard</td>
<td>The Wide Implant- Prospective One-year Data on Implant Stability</td>
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<td>Foghsgaard</td>
<td>What we Know About the Long-term Outcomes of Ponto implants</td>
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<td>Tullamore Life Style Descriptor TuLiD: A Dual Centre Evaluation</td>
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<td>Karl-Johan</td>
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<td>Electro-acoustic Performance of the New Bone Vibrator Radioear B81</td>
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<td>Wojciech</td>
<td>Gawecki</td>
<td>Clinical and Audiological Evaluation of New BAHA Attract Implantations</td>
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<td>Outcomes of Percutaneous and Transcutaneous Bone Conduction Hearing Implant Systems</td>
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<td>Rehabilitation of Single Sided Deafness with a BCHIS</td>
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<td>Giannuzzi</td>
<td>First Case Series with a New Minimally Invasive Surgical Technique</td>
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<td>Hanif</td>
<td>Converting Patients from Body-worn Cordelle Processor to BE processor</td>
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<td><em>The Soundbite™</em> Hearing system in Children. Early Results- Birmingham, UK.</td>
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<td>Sarah</td>
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<td><em>Bone Anchored Hearing Aids for Single-Sided Deafness: 14 Years Experience</em></td>
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<td>Penny</td>
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<td>Using the ‘SSQ for Children’ in Paediatric BCHD Assessments</td>
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<td>Myrthe</td>
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<td><em>Comorbidity Influencing Soft Tissue and Implant Loss in BAHI</em></td>
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<td>Marcus</td>
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<td><em>Towards Direct Loading: Ponto, New Healing Cap and Early Loading</em></td>
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<td><em>Experience with a Magnetic Bone Conduction Device, Baha Attract System</em></td>
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<td><em>ASIST- A Bluetooth Real-Time Implant/Bone Interface Stability Measurement Device</em></td>
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<td>Suzanne</td>
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<td><em>The Real Life Experiences of Bone Anchored Hearing Aids Users</em></td>
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<td>Hamidreza</td>
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<td><em>Implant Loading at Three Weeks: Three-year Outcome and RFA Interpretation</em></td>
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<td>Ear Dysgenesis: Osseointegrated Implants in Conductive and Mixed Hearing Loss</td>
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<td>Don</td>
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<td>Use of Asist for Assessment of BAHA Abutment Screw Loosening</td>
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<td>Jaydip</td>
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<td>Bone-anchored Hearing Aids in an Elderly Population</td>
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<td>A Review of Recent Developments in Bone Conduction Devices</td>
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<td>Howard</td>
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<td>MIPS - Minimally Invasive Ponto Surgery: Early Days Evaluation</td>
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Symposiums

**Cochlear Symposium**
Thursday, May 21
8:30 - 10:00 AM

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**Oticon Medical Symposium**
Friday, May 22
8:30 - 10:00 AM

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Cochlear Workshops

Thursday, May 21
13:30 - 15:00
Title: Baha® Fitting Software and Baha Smart App: Walk through and hands-on
Description: As a part of the Baha 5 System launch a redesigned and more modern fitting software was introduced. Cochlear has also introduced the industry's first Smart App providing a seamless hearing experience by connecting directly to iOs devices without any intermediary devices. This session will walk you through the key benefit of both applications as well as an opportunity to try them out yourself.
Presenters: Karin Rødsjø, Tracey Adams and George Cire
Room: Plain of Six Glaciers Trail / Saddleback Trail (Lower Level)

15:30 - 17:00
Title: Cochlear Baha Attract: Surgical Technique Guidelines to Maximize Cosmetic and Performance Outcomes
Description: In 2014 Cochlear launched a revolutionary osseointegrated implant system, the Baha Attract. Since its introduction thousands of patients across the globe have benefited from amplification through bone conduction without compromising cosmetic appeal. This course will highlight the optimal Baha Attract procedure for maximizing cosmetic and performance outcomes.
Presenter: Peter Weber, MD
Room: Plain of Six Glaciers Trail / Saddleback Trail (Lower Level)

Friday, May 22
13:30 - 15:00
Title: One Implant Two Systems: Advanced Topics for Cochlear Baha Surgery
Description: Cochlear Baha Systems enable patients and surgeons a choice to accommodate audiological requirements and cosmetic preferences. This hands-on course will focus on important surgical considerations to achieve optimal outcomes and address more advanced cases including considerations in transition surgery from a Baha Connect to Attract System.
Presenter: Peter Weber, MD
Room: Plain of Six Glaciers Trail / Saddleback Trail (Lower Level)

15:30 - 17:00
Title: Baha® Fitting Software and Baha Smart App: Walk through and hands-on
Description: As a part of the Baha 5 System launch a redesigned and more modern fitting software was introduced. Cochlear has also introduced the industry's first Smart App providing a seamless hearing experience by connecting directly to iOs devices without any intermediary devices. This session will walk you through the key benefit of both applications as well as an opportunity to try them out yourself.
Presenters: Karin Rødsjø, Tracey Adams and George Cire
Room: Plain of Six Glaciers Trail / Saddleback Trail (Lower Level)

Saturday, May 23
10:30 - 12:00
This time will be open for informal conversations with customers with a few stations open for those who want more in-depth surgical technique practice.
Room: Plain of Six Glaciers Trail / Saddleback Trail (Lower Level)

Oticon Workshops

Thursday, May 21
13:30 - 17:00
Join our workshops and hear more about:
• New implant design concepts & minimal invasive surgical techniques
• The first and most powerful family of wireless bone anchored sound processors
• Demonstration of advancements within wireless connectivity
• Sound demonstration: Sound attenuation in the skin versus direct drive solutions
• Skull simulator – for technical measurements of bone anchored sound processors
• CI insertion workshop
Room: Beehive Trail / Lakeshore Trail (Lower Level)
Oral Presentation Abstracts
Thursday, May 21

Invited Speaker

THE FORCES THAT TWIST SCIENCE

Timothy Caulfield, LLM, FRSC, FCAHS
Canada Research Chair in Health Law & Policy
Health Senior Scholar,
Alberta Heritage Foundation for Medical Research
Trudeau Fellow and Professor,
Faculty of Law and School of Public Health
Research Director, Health Law Institute,
University of Alberta

There is now more health research and sources of health information than ever, and survey research tells us that the public has a strong interest in both health science and information about healthy living. Despite this reality, there remains deep confusion regarding the individual and population actions that can maintain and improve our health, such as nutrition, exercise and weight management. Moreover, dangerous myths (such as those associated with vaccination) and pseudoscientific belief systems (such as those underlying practices like homeopathy and cleansing) seem to be gaining traction. In addition, there is evidence that people are losing trust in the traditional sources of scientific information.

This talk will explore both how science is spun and why misperceptions persist. We will see that a complex interplay of various social and psychological forces conspire to twist what we all hear and believe about health research, including publication bias, ideological agendas, marketing pressures, media spin and even celebrity endorsements.

Session I:

CLINICAL RESULTS OF BI300 IN CHILDREN:
TWO TERTIARY REFERRAL CENTRES

Harterink, Emilie*, Den Besten, Christine A, Mcdermott, Ann-Louise, Hol, Myrthe KS
Birmingham Children's Hospital, Birmingham, United Kingdom And Radboud University Medical Centre, Nijmegen, the Netherlands
Department of Otorhinolaryngology
Birmingham, United Kingdom

Keywords: Bone anchored hearing implant, paediatric, soft tissue complications

Purpose: Explore the results on soft tissue outcomes of the BI300 bone anchored hearing implant in the paediatric population.

Methods & Materials: All patients implanted with a BI300 implant from November 2011 to January 2014 and 17 years or younger during surgery were included in this retrospective cohort study.

Results: Since introduction of the BI300 there have been 79 children implanted in both centres. During the mean follow-up per implant of 11.6 months, 23.5% of 115 implants implanted received at least twice a local treatment for a soft tissue reaction. In 27 implants one revision was conducted, 4 implants needed two revisions and two implants required three revisions (28.7% of implants needed revision). In 6 patients the abutment was removed temporarily because of soft tissue problems. 16 patients needed one revision under general anaesthesia, three patients needed two revisions under general anaesthesia and one patient needed revision under general anaesthesia three times.
Conclusion: The number of adverse soft tissue reactions found in the current study resembles numbers reported on previous generation implants and abutments. For revision surgery, however, an increase in frequency is noticed compared to reported results on previous generation implants and abutments.

3

COMPARISON OF THINNING VS NON-THINNING TECHNIQUES FOR BONE ANCHORED IMPLANTS

Chang, Kay*
Stanford University
Otolaryngology
Stanford, CA, United States

Keywords: BAHA, Ponto

Purpose: The technique of placing osseointegrated auditory implants has gradually evolved over the years from significant alterations to the scalp flap with use of the dermatome, to a simpler linear incision with thinning, to minimal incision non-thinning techniques. We performed a study to determine whether there are any significant advantages or drawbacks to the small-incision non-thinning technique for placing bone anchored implants in children.

Methods & Materials: Children between the ages of 5 and 17 (n=23) receiving osseointegrated auditory implants were retrospectively reviewed for indications, surgical results, and soft tissue complications, as assessed by the Holger's grading scale.

Results: 9 cases were done with the small incision non-thinning technique and 14 cases with a more traditional linear incision with soft tissue thinning. The non-thinning technique resulted in fewer complications, better cosmetic appearance, as well as significantly reduced operative times.

Conclusion: The small-incision non-thinning single-stage technique has become our preferred method of placing osseointegrated auditory implants.

4

MAGNETIC BONE CONDUCTION HEARING IMPLANT SYSTEM OUTCOMES IN CHILDREN

Christensen, Lisa*, Cristobal, Ricardo
Cook Children's Medical Center
Audiology
Fort Worth, TX, United States

Purpose: For children with conductive or mild mixed hearing loss or single-sided sensorineural deafness (SSD), a magnetic bone conduction hearing implant may be a good option as it reduces the risk of trauma and eliminates the need for daily cleaning associated with a traditional skin-penetrating device. The aim of this study was to evaluate surgical and hearing performance outcomes with a magnetic system in pediatric patients.

Methods & Materials: Sixteen patients aged 5-17 years received the Baha? Attract System (Cochlear Bone Anchored Solutions AB, Mölnlycke, Sweden). Nine patients had a conductive hearing loss due to atresia; seven patients had SSD. Two of the patients received bilateral implants. The patients’ body mass index (BMI) ranged between 14 and 44. Sound processors were fit 3-4 weeks following implantation.

Results: Surgical procedures were uneventful. The average surgery time was 29.6 minutes; the surgery time reduced gradually as the surgeon and operating room staff gained more experience. 50% of the patients had pre-operative skin thicknesses exceeding 6 mm and required surgical flap thinning. Bone polishing was performed in four patients. Seven
patients received a 3 mm implant and nine patients received a 4 mm implant. Post-operative healing and soft tissue tolerability post-fitting was satisfactory in most patients. One obese patient underwent aspiration of a small subcutaneous hematoma one day post-operatively. Another patient developed significant skin flap edema the first week after surgery. Both complications resolved within days with conservative treatment. Sound processor magnet strengths at fitting varied; some magnets replaced with a weaker one over time. Two patients with BMI>33 experienced retention issues with the strongest magnet; one of the patients had very dense hair and achieved sufficient retention with shaving, while the other patient required revision surgery for skin flap thinning. Overall patient satisfaction was high with significant increases in hearing performance.

**Conclusion:** Magnetic bone conduction hearing implants may be the first choice of treatment in pediatric patients with a conductive or mild mixed hearing loss or SSD, because of the non-skin-penetrating nature of the device. BMI should be taken into account when assessing patient candidacy as high BMI may result in retention issues despite surgical skin flap thinning.

## 5

**EXPERIENCE OF THE PONTO BONE ANCHORED HEARING SYSTEM IN CHILDREN**

Hoskison, Emma*, Gill, Jaspreet: Williams, Jo: Child, Anne: Mc Dermott, Ann-Louise
Birmingham Children's Hospital
ENT
Birmingham, United Kingdom

**Keywords:** Bone-anchored hearing aid, Oticon, Ponto

**Purpose:** Recent innovations in bone anchored hearing systems have resulted in wider and more stable implant availability. The surgical techniques have also undergone dramatic changes and sound processors now incorporate some of the most exciting technology in hearing rehabilitation. There is still a paucity of evidence for these new implant systems in the paediatric population.

To evaluate clinical outcomes of all children who were fitted with the Ponto Bone anchored hearing system (Oticon Medical) from January 2014 to date, at the Birmingham Children’s Hospital. We aim to assess patient /carer satisfaction with this implant system.

**Methods & Materials:** Retrospective case analysis of all children implanted with the Ponto Bone anchored hearing system between January 2014- to date. Patient reported outcomes measures were used: The Glasgow Children’s Benefit Questionnaire and the Single sided Deafness questionnaire.

**Results:** Forty patients were identified with a male preponderance. At the time of surgery 6 patients were under 5 years of age. More than 50% had significant co-morbidities that impacted on the clinical decisions for surgery and the surgical management. The majority underwent two stage surgery with a three month osseointegration period. Only one fixture failure was identified and peri-abutment skin complications were significantly lower than in our previous studies. Patient satisfaction was excellent and all children are still wearing their sound processor 8 hours each day, 7 days each week.

**Conclusion:** The Ponto optigrip 4.5mm wider fixture and the design of the Ponto system abutments would appear to be associated with a reduced fixture failure rate and reduced soft tissue problems. Other factors including minimal and no skin reduction techniques may also be contributory. The outcomes were not affected by patient age at the time of surgery. There was a very positive and significant reduction in Bone Anchored Hearing Implant complications when compared to the previous studies from our institution in 2009. Further evaluation of the stability of the implant system in children is needed.
SURGICAL TRANSITION: SKIN-PENETRATING TO A MAGNETIC-IMPLANT SYSTEM IN PEDIATRIC PATIENTS

Cristobal, Ricardo*, Christensen, Lisa
Texas Ear Clinic
Fort Worth, TX, United States

Purpose: Magnetic bone conduction hearing implants may be a better alternative for patients who experience recurring skin infections around their skin-penetrating abutment or who for other considerations may be better candidates for a non-skin-penetrating system. The present case series study evaluated surgical outcomes in pediatric patients transitioning from a skin-penetrating abutment to a magnetic system and offers guidelines for successful surgery.

Methods & Materials: Following a pre-operative hearing evaluation with a Baha Softband, seven (7) unilateral and one (1) bilateral patient aged 7-17 years were transitioned from the skin-penetrating Baha? system to the Baha Attract System (Cochlear Bone Anchored Solutions AB, Mölnlycke, Sweden). All patients had well-vascularized soft tissue with skin thicknesses exceeding 3 mm. Surgery was performed in two stages allowing at least two months for healing between abutment removal and implantation of the magnet. An inferiorly based C-shaped skin flap was raised for placement of the implant magnet. Sound processor fitting was performed 3-4 weeks following second-stage surgery.

Results: All surgical procedures were uneventful. Three of seven patients required surgical thinning of the skin flap. Bone polishing around the implant was performed in three patients to avoid contact with the magnet. In three cases the previous implant was reused. In five cases, a new implant was placed adjacent to the original one due to implant incompatibility (the patients had an old generation implant) or bone overgrowth; interference between the previous implant and the implant magnet was avoided. Post-operative healing and soft tissue tolerability post-fitting was satisfactory.

Conclusion: This clinical case series showed satisfactory surgical and soft tissue outcomes when transitioning from a skin-penetrating to a magnetic bone conduction hearing implant system in pediatric patients with well-vascularized soft tissue.

Session II:

RESULTS OF BONEBRIDGE IMPLANTATION IN ADULTS – A RETROSPECTIVE STUDY

Weissgerber, Tobias*, Stoever, Timo; Lenarz, Thomas; Maier, Hannes; Zahnert, Thomas; Beleites, Thomas; Mlynski, Robert; Baumgartner, Wolf-Dieter; Wiek, Robert; Rader, Tobias
University Hospital Frankfurt
Audiological Acoustics, ENT Department
Frankfurt Am Main, Germany

Keywords: bonebridge

Purpose: Bonebridge (Vibrant MED-EL, Innsbruck, Austria) is the first active bone conduction implant used as a therapy for patients with conductive or mixed hearing loss. Bonebridge is CE-certified since 2012 for adults, and since March 2014 for children older than 5 years, thus enabling the treatment of patients who could not profit from established invasive or non-invasive therapies. The aim of this multicenter study was to determine the therapy success of Bonebridge in adult patients with conductive or mixed hearing loss. To this end, a retrospective analysis was conducted using data from five university hospitals (in Dresden, Frankfurt, Hannover, Wien, and Würzburg), which were collected since the commercial launch of Bonebridge.

Methods & Materials: Data were analyzed from 29 patients (13 male, 16 female) with a mean age of 49 years (min. 28, max. 74). 18 patients had mixed, and 11 conductive hearing loss. Typical indications were otitis media (n = 10) and chronic bone abscess (n = 5). Data analysis was conducted for the following points in time: before implantation (pre-op), during the first fitting conducted within 6 months postoperatively (acute), and follow-ups within 6 to 12 months postoperatively (long term). Additionally, data from last available measurements were compared (final). Speech intelligibility in quiet was tested.
using the Freiburg Monosyllable Test (65 dB in free field). Speech reception thresholds (SRTs) in noise were determined using the Oldenburg Sentence Test (OLSA, S0N0).

**Results:** Acute speech intelligibility results in quiet showed a mean 65% improvement using Bonebridge, i.e., a mean score of 77.6% compared with 13% in the unaided condition. Long-term results remained stable, showing a mean score of 77.1%. In noise, acute SRT results showed a mean 3.5 dB SNR improvement in the implanted ear. In the best-aided condition (both ears, Bonebridge and contralateral ear), a mean SRT of 4.9 dB SNR was reached in the final results.

**Conclusion:** Bonebridge clearly improved speech intelligibility, showing stable results up to 12 months after implantation. Our results confirm the success of the active bone conduction implant as a therapy for patients with conductive or mixed hearing loss.

### 8

**THE ACTIVE BONE CONDUCTION IMPLANT BONEBRIDGE IN PATIENTS WITH SINGLE-SIDED-DEAFNESS**

Salcher, Rolf*; Schwab, Burkhard; Gerdes, Timo; Lenarz, Thomas; Maier, Hannes  
Medical School Hannover, Vianna, H4A, Germany  
ENT Department  
Hannover, Germany

**Keywords:** Single-Sided-Deafness, Bone Conduction Implant

**Purpose:** The Bonebridge is an active bone conduction implant, receiving power and sound transcutaneously across through the intact skin. The implanted bone vibrator generates the vibration that is transmitted via bone conduction to the inner ear, respectively in case of single-sided-deafness (SSD) to the contralateral inner ear. We investigated the audiological outcome of Bonebridge patients with SSD.

**Methods & Materials:** Ten SSD patients were implanted with a Bonebridge at the Dept. of Otolaryngology in Hannover between summer 2012 and spring 2013. The mean age of the four women and six men was 46 ± 17 years. The audiological test battery included air conduction and bone conduction thresholds, speech intelligibility testing with the Freiburg monosyllable test in sound field and hearing in noise testing with the Oldenburg sentence test in sound field in several relevant configurations for SSD. The patients were interviewed with the APHAB and BBSS questionnaires for subjective benefit.

**Results:** Average pure tone thresholds in sound field were improved by 38 ± 14 dB (PTA, 0.5 – 4 kHz; MV ± SD). The average Freiburg monosyllable score at 65 dB SPL with the contra-lateral ear occluded was improved by 72 %. Hearing in noise measured with speech from the front and noise from the non-occluded hearing side (OLSA S0Ncontra), was significantly improved by the Bonebridge from -1.8 dB SNR to -3.1 dB (mean). In the testing situation noise presented from the hearing side and speech from the implanted side (OLSA SipsiNcontra) the signal-to-noise-ratio was significantly improved from +1.8 dB SNR to -0.6 dB SNR by the implant. The APHAB questionnaire was improved in the aided situation, except in the category Aversiveness.

**Conclusion:** The Bonebridge is audiological equivalent to percutaneous bone anchored devices in single-sided-deafness patients. The implant is less prone to infections because of the transcutaneous transmission through the intact skin, but produces bigger artefacts in MRI.
BONEBRIDGE VS. TRADITIONAL PERCUTANEOUS BCIS IN CONDUCTIVE HEARING LOSS COMPARISON

Morris, David Peter*, Gulliver, Mark. Wickens, Brandon.
Dalhousie University
Otolaryngology Head & Neck Surgery
Halifax, Nova Scotia, Canada

Purpose: The arrival of a transcutaneous active bone conduction implant (BCI), such as the MEDEL Bonebridge, has been much anticipated as it offers significant advantages in avoiding the need for a percutaneous abutment which is one of the most stigmatizing features of traditional BCIs raising cosmetic concerns in some and a commitment to lifelong implant care in all. To date there have been no published studies making a comparison between the performance of such devices and that of traditional BCIs in conductive hearing loss.

Learning Objectives:
Attendees will be able to describe the place of the Bonebridge transcutaneous active bone conduction implant in the rehabilitation of conductive hearing loss.

Attendees will learn to appreciate the performance capabilities of this device in comparison to existing traditional percutaneous bone conduction implants.

Methods & Materials: We compare the performance of a new transcutaneous active bone conduction implant (MEDEL Bonebridge) with that of contemporary traditional percutaneous BCIs in the rehabilitation of conductive hearing loss. All members of the study group have conductive hearing loss with a healthy bone curve. The study compares the performance of our first cohort of Bonebridge recipients with a similar number of existing traditional BCI wearers from our bone conduction implant programme database. The traditional BCI wearers were tested with the most contemporary devices fitted to their percutaneous abutment and best aided performances in a soundfield were compared.

Results: Our pilot data show that the Bonebridge device performed well, especially at high frequency, and appeared to perform as well as the percutaneous alternatives.

Conclusion: This information is a welcome addition to our existing knowledge and is useful when advising patients regarding their auditory rehabilitation options when conventional amplification is poorly tolerated, contraindicated or declined.

CLINICAL RESULTS OF THE BONE CONDUCTION IMPLANT:
FIRST SIX PATIENTS

Reinfeldt, Sabine*, Håkansson, Bo; Taghavi Hamidreza; Fredén Jansson, Karl-Johan; Rigato, Cristina; Eeg-Olofsson, Måns
Chalmers University of Technology
Signals and Systems
Gothenburg, Sweden

Keywords: Bone Conduction Implant, clinical study, audiometry

Purpose: The Bone Conduction Implant (BCI) has been developed by research groups at Chalmers University of Technology and Sahlgrenska University Hospital in Gothenburg, Sweden. The BCI consists of an external audio processor, and an implanted unit called the bridging bone conductor. The skin is intact and the audio processor is attached with magnets. The transducer is attached via a flat surface contact close to the bony ear-canal opening in the temporal bone. The signals from the audio processor are transmitted to the implanted unit via an inductive link. In a first clinical study, the BCI has so far been implanted in six patients with conductive or mixed hearing loss. The purpose of this study is to investigate the audiological results and patient related outcome measures for those BCI patients. The hypothesis is that the BCI gives a significant rehabilitation effect, better than unaided condition and similar or better than a bone conduction device on headband.
Methods & Materials: This study evaluates the results from the 6th month follow-up visit for the first six BCI patients. It is based on sound field tone and speech audiometry (warble tone thresholds, speech recognition thresholds (SRT), speech recognition score (SRS) in noise, and speech-to-noise ratio (SNR) thresholds), and patient related outcome measures from two validated questionnaires (Abbreviated Profile of Hearing Aid Benefit and Glasgow Benefit Inventory). The BCI audiometric performance has been compared to unaided condition and a Ponto Pro Power (Oticon Medical) on a softband.

Results: The BCI offers a significant audiometric improvement over the unaided condition and is also better than or similar to the reference device. The BCI pure-tone-average improvement was 31.0 dB; the SRT improvement was 27.0 dB; and the SRS improvement was 51.2%. The BCI SNR threshold was -5.5 dB. The questionnaire scores showed statistically significant improvements versus the unaided condition. The surgical procedure was found uncomplicated and safe for the patients.

Conclusion: The clinical results show that the BCI provides significant hearing rehabilitation and is a competitive bone conduction device for patients with conductive or mixed hearing losses.

11
AUDIOMETRIC COMPARISON OF BCI AND BAHA IN MATCHED PATIENTS

Rigato, Cristina*, Reinfeldt, Sabine; Håkansson, Bo; Fredén Jansson, Karl-Johan; Eeg-Oloffson, Måns
Chalmers University of Technology, Gothenburg, Sweden
Department of Signals and Systems
Göteborg, Sweden

Keywords: Bone-Conduction-Implant, Bone-Anchored-Hearing-Aid, audiometry

Purpose: Patients that are suffering from outer or middle ear hearing impairment can often benefit more from rehabilitation using bone conduction devices (BCDs) rather than conventional air conduction devices. The most widely used BCD is the percutaneous Bone Anchored Hearing Aid (BAHA), which gives excellent sound, but can cause side effects from the skin penetration abutment. There is a growing interest in the development of transcutaneous BCDs such as the Bone Conduction Implant (BCI), comprising an externally worn audio processor wirelessly driving a transducer implanted in the temporal bone. In an ongoing clinical study, the device is used in six patients and the objective with this study is to compare their audiometric results with patients using the BAHA.

Methods & Materials: Audiometric measurements are currently carried out on patients using a BAHA (Ponto Pro Power, Oticon Medical) that are matched one by one according to age- and hearing loss-based criteria with the six first patients treated with the BCI. In particular, warble tone thresholds, speech recognition score (SRS) in noise, speech recognition threshold (SRT) and signal-to-noise ratio (SNR) threshold are compared in a sound field. The patients' general health status and personal satisfaction is also evaluated using Glasgow Benefit Inventory and Abbreviated Profile of Hearing Aid Benefit questionnaires. Furthermore, maximum power output and total harmonic distortion are measured for each device on a skullsimulator.

Results: The study is on-going and detailed results will be presented. Preliminary results from two patients tested with the BAHA indicate that they generally perform the same or slightly worse than matched patients with BCI regarding warble tone thresholds, SRS, SRT and SNR threshold. The self-reported questionnaires show in general similar outcome for both devices, but slightly better results for BCI compared with the BAHA concerning physical benefit and avoidance of negative reactions to unpleasant sounds.

Conclusion: Preliminary results from audiometric measurements show a clear improvement over the unaided condition for both devices, and indicate that the BCI is equal or slightly better than the BAHA. As this study is currently ongoing the results may change when all BAHA patients have been measured.
THE BONE CONDUCTION IMPLANT - SURGICAL PROCEDURE AND CLINICAL RESULTS


The Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden.
Department of Otorhinolaryngology Head and Neck Surgery, Sahlgrenska University Hospital Gothenburg, Sweden

Keywords: Bone Conduction Implant - BCI, Surgical procedure

Purpose: The Bone Conduction Implant (BCI) is a transcutaneous active bone conduction device. The external audio processor transmits sound signals using an inductive link. The implanted part is called the Bridging Bone Conductor (BBC) and consists of a transducer, a signal demodulator, and a retention magnet. The transducer has a flat contact to the underlying bone, no screws are used. So far 6 patients with conductive or mixed hearing losses have been implanted with the full BCI system. One of the objectives in this study is to evaluate the efficacy of the implanted BCI system and to compare the hearing rehabilitation performance over time with the unaided situation, and with a Ponto Pro Power on a head band. Another objective is to study the safety of the BCI system. This presentation will focus on the surgical procedure which should be safe and simple.

Methods & Materials: The position of the BBC is guided so that the microphones of the external audio processor are above the superior level of the pinna. The transducer has a size of 12 x 14 x 7.4 mm and is positioned in a 4-5 mm drilled recess in the mastoid part of the temporal bone, or more posterior in case of a mastoid cavity. The transducer is secured using a thin titanium wire exerting a slight pressure towards the bottom of the recess. Sound field tone and speech audiometry was done preoperatively with the Ponto Pro Power on a head band, and postoperatively with the implanted BCI system.

Results: The surgical procedure installing the implanted unit was easy, and safe for the patient. No adverse reactions have been observed. With the BCI there was a significant improvement over the unaided condition for both tone and speech audiometry, and the results were in the majority of audiometric measures also superior to the reference device on a head band, and also stable over the present follow up period of 6 months.

Conclusion: The BCI offers a competitive rehabilitation for patients with conductive or mixed hearing losses. The surgical procedure is safe and uncomplicated.

LIFTS IN SURGICAL TECHNIQUE WITH BONEBRIDGE

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Keywords: active bone conduction system, surgical procedure, lifts

Purpose: Bonebridge is an active bone conduction system, which provides the transmission of the sounds as vibrations. The external processor collects the sound signals and transmits the signals by the radiofrequency to the implanted part, which generates vibrations of the bone and then stimulate the cochlea. The internal part of this device is implanted directly on the skull. It can be localised on the retrosigmoid or sinodural region. It is recommended to perform preoperative planning of surgical placing the BC-FMT (Bone Conduction- Floating Mass Transducer). Thickness of the cortical part of temporal bone and its density are crucial for correct prediction of interfering with underlying structures during preparation of BC-FMT bed. In cases of small mastoids, with reduced volume of the bone, malformed congenitally, lifts can be beneficial or even necessary for performing this implantation.
Methods & Materials: General analysis concerns all 41 cases of Bonebridge implantations, which were performed since the beginnings of this method in the Institute of Physiology and Pathology of Hearing in Kajetany in Poland - from 19 December 2012 to 28 November 2014

Results: Our study confirmed benefits of application of the lifts during the surgical procedure. It allows to perform more implantations as also to cope with unpredictable difficulties.

Conclusion: Bonebridge implantation requires careful analysis prior to the surgical procedure due to anatomical differences between individuals. In some cases it is necessary to use additional tools, which allow to perform the procedure. Lifts can be a solving in the cases of reduced volumes of the mastoid bone for example among patients after radical surgery. Taking into account these additional tools, allows to perform more Bonebridge implantations, apply safer procedures and include some patients with congenital malformations of mastoid as a one of the most technically demanding group.

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Evolving Surgical Techniques:
Influencing the Specialised BAHA Nurse’s Role

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Purpose: The principal of BAHA involves surgical implantation of a fixture in bone (BAHA) to enhance hearing for those with conductive, unilateral sensorineural or mixed hearing loss. Changes to the surgical technique for BAHA systems have implications for the patient, but also the MDT. The need for nursing within that team is presented here in terms of the role from the past, present and future.

Methods & Materials: Formally, the surgical procedure was carried out under general anaesthesia and involved substantial soft tissue reduction (STR) techniques. Pre and post anaesthetic management and wound care would have been nursing priorities. The recent evolution of Linear Scalp Sparing (LSS) techniques, Minimally Invasive Ponto Surgery (MIPS), and fully implantable magnet retention systems has altered the emphasis of the role of nursing from wound care to self-care management practices. In adults, these procedures are primarily conducted under LA placing greater emphasis on the role of the nurse to inform, enable and empower the patient.

Results: The specialised nursing role has become: • Appropriate assessment of patients • Education and counselling • Liaison and follow up within the MDT • Long term wound management and skin care.

Conclusion: We present a review of the nursing role in light of surgical transition from STR to SS (percutaneous and transcutaneous) techniques. The influence of LSS and MIPS techniques on skin management has diminished the nursing and surgical role placing less emphasis on post operative wound care but greater importance on patient education and self-care support.

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Bone Anchored Hearing Implants:
Outcomes with Soft Tissue Preservation Technique

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Keywords: Bone anchored hearing implant, tissue preservation

Purpose: Bone anchored hearing implant (BAHI) surgery has been performed for over 3 decades and over that time there have been a number of changes. Initially BAHI surgery was performed as a two-stage procedure however in adults
typically this is now performed as a single stage. Fixture and abutment design have been modified in order to minimise complications such as fixture failure and skin reactions. Longer abutments are now available and surgical technique has evolved tending towards soft tissue preservation. At the Queen Elizabeth Hospital Birmingham (QEHB), traditionally the dermatome split skin graft technique was used. In more recent years the linear incision technique was introduced and since February 2014 the presenting author has started performing the soft tissue preservation technique with longer abutments. The aim of this paper is to evaluate the outcome of BAHI surgery using soft tissue preservation method and to compare this with the dermatome and the linear incision BAHI techniques

**Methods & Materials:** A single centre retrospective notes analysis was carried out comparing soft tissue preservation technique with dermatome and one stage linear incision technique. Patient demographics and comorbidities were recorded. Outcome measures included number of follow up visits to the clinic, skin reactions, abutment changes and fixture failures.

**Results:** 35 patients were included in each group. Patients were followed up for a minimum of six months. The fixture failure rate in the soft tissue preservation group was 2.5%. A previous audit of the Birmingham adult program yielded a fixture failure rate of 4%. Patients required less follow up visits. Further data regarding skin reactions will be presented.

**Conclusion:** The soft tissue preservation technique is easy and well tolerated by patients under local anaesthetic. The wound heals well with typically only one postoperative visit prior to fitting of the sound processor. The cosmetic result is excellent as there is no area of hair loss or defect around the abutment. The procedure is faster than techniques using soft tissue reduction. In the short to mid term there is no increased rate of fixture failure or skin reactions compared with other techniques.

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**NEW MINIMALLY INVASIVE PONTO SURGERY: EXPERIENCE FROM FIRST 80 PATIENTS**

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**Keywords:** surgery, minimally, invasive

**Purpose:** Over the years, surgical teams all over the world have modified the surgical procedure for implanting the bone anchored hearing system in order to further improve the outcome. The long-term success of tissue preservation techniques has inspired Oticon Medical to develop the Minimally Invasive Ponto Surgery (MIPS) as an alternative single-stage surgical procedure. MIPS is a sutureless surgical technique for implanting the Ponto bone anchored hearing implants. To overcome the limitations of other punch-only techniques, a new set of surgical instruments has been developed for this purpose. Objective: 1) Summarize the results after the first 80 MIPS surgeries performed, and 2) Investigate surgeons’ experiences with the technique.

**Methods & Materials:** A service evaluation of the MIPS technique was performed in more than 10 separate centres in Germany, Italy, the Netherlands, Sweden, Ireland and the United Kingdom. Data recorded included intra- and post-operative complications, surgical time, skin healing after surgery and Holgers scores. Secondly, a questionnaire was used to investigate surgeons’ subjective experiences with the technique.

**Results:** Full results will be available in May 2015.

**Conclusion:** The preliminary results from the first approximately 25 surgeries are encouraging with very few intra-operative complications and quick healing.
PERI-BAHI FLUID EXUDATE STUDY, CAN WE PREDICT SOFT-TISSUE REACTIONS/IMPLANT LOSS

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Keywords: BAHI, Cytokines, Biomarkers

Purpose: Bone-anchored hearing implants (BAHIs) are a well-established method of auditory rehabilitation. A small proportion of adult patients who undergo BAHI surgery suffer extrusion of the osseointegrated titanium fixture1 and a larger group2 experience skin infection or inflammation, which is often transient and self-limiting but may require medical or surgical intervention. Peri-BAHI fluid is a feature of skin infection or inflammation at the junction of the skin and the BAHI. In a previous study we compared fluid samples from patients with healthy peri-BAHI soft-tissues with fluid from patients with inflamed peri-BAHI soft-tissues3. This study demonstrated that inflamed BAHIs yielded significantly greater fluid volumes than non-inflamed fixtures. Moreover, the former contained elevated levels of key pro-inflammatory peptides and a biomarker profile that was consistent with increased tissue and bone remodeling.

Methods & Materials: Consecutive patients undergoing primary BAHI surgery were invited to take part in the study. Fluid and microbial samples were collected as previously described3. Samples were harvested approximately one week, six months and twelve months following surgical BAHI implantation. Clinical photographs were obtained at the same time points as fluid collection. In due course exudate samples will be analysed by multiplex technology for the cytokines IL-1beta, IL-6, TNF-alpha as well as MMP9 and RANKL, which were the most valuable analytes in our preliminary study. We also propose to evaluate other bone metabolic markers, including osteocalcin, osteopontin and parathyroid hormone (PTH). Patients will be monitored for at least 4 years and fluid biomarker concentrations correlated with indices of peri-BAHI soft-tissue reactions and fixture failure.

Results: 111 patients have been recruited to the study. 100 patients had a unilateral BAHI placed and 11 had bilateral BAHIs generating a total number of 122 fixtures. 50 patients (45%) were male. The surgical approach was a split skin graft in 51 (42%), linear incision in 54 (44%) and soft-tissue preserving approach in 17 (14%). Data on fluid volumes and fixture and soft-tissue complications will be presented.

Conclusion: Greater volumes of peri-BAHI fluid were found in the tissue preservation approach and may imply tissue inflammation. The longer-term implications will be reported in due course.

Session IV:

EFFECTS OF BONE-ANCHORED HEARING DEVICES ON TINNITUS

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Purpose: Tinnitus is a disturbing symptom that is often experienced in patients with single-sided deafness. While there is considerable evidence that hearing aids and cochlear implants can reduce tinnitus disturbance, there is a paucity of literature on the effectiveness of bone-anchored hearing devices on tinnitus control. The present study investigates whether a bone-anchored hearing device influences the subjective level of tinnitus disturbance in patients with single-sided deafness.

Methods & Materials: This prospective trial was designed to include 30 adult participants with single-sided deafness and tinnitus, which met candidacy criteria and underwent bone-anchored hearing aid implantation. Tinnitus was measured prior
to and at 1, 3, 6 and 12 months following fitting of the Oticon Medical Ponto processor. Subjective measures included the Tinnitus Handicap Inventory (THI), Tinnitus Reaction Questionnaire (TRQ), a visual Analogue Scale (VAS) for subjective loudness and an abbreviated Tinnitus History Questionnaire (THQ). Psychoacoustic measurements including tinnitus pitch matching for frequency and loudness were also obtained. This presentation will provide the outcome measures for 15 subjects.

**Results:** Due to the small sample size, nonparametric statistical analyses were employed. The results revealed a negative linear trend in the mean THI, TRQ and VAS scores from baseline to 12-months post-processor fitting, suggesting reduced tinnitus disturbance. There was minimal change in the tinnitus pitch matching and frequency among participants. However, subjective loudness scores decreased over time.

**Conclusion:** The results suggest the bone-anchored hearing device may reduce negative characteristics associated with tinnitus over time in adults with single-sided deafness. Further investigation is needed.

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**LONG TERM BENEFIT OF BAHS IN SINGLE SIDED DEAFNESS**

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**Keywords:** Bone anchored hearing system, long term use, single sided deafness

**Purpose:** To analyze the use and usefulness of bone anchored hearing system (BAHS) in single sided sensorineural deafness (SSD) after 2 or more years of use.

**Methods & Materials:** For a cross sectional analysis, questionnaires were sent out so far to 40 German speaking recipients of BAHS with SSD meeting the above criteria. The questionnaire included all 10 questions from the Bern Benefit in Single Sided Deafness (BBSS) questionnaire, as well as 10 additional questions regarding the subjective benefit, wearing time, as well as past and present expectations.

**Results:** So far, results from 21 subjects (8 Female, 13, male, ages 18 to 84, mean 59.2 years) were received. They had received their first BAHS devices 2.4 to 12.0 years ago (average 7.8 years). 15 subjects were still using their device, 6 only occasionally, 9 on a daily basis for a self-reported duration of 4 to 17 hours a day (average 11.3 hours). 6 had stopped using their BAHS permanently between 2 months and 7.5 years (average 2.0 years) after the first fitting. In the BBSS, highest average scores were reached for overall benefit (+2.1 on a scale between -5 and +5) and for conversations in a car (+1.7). The lowest benefit was reported for conversations in noise (+0.2). 11 subjects would still choose a BAHS today, 6 were undecided and 4 would not do it again.

**Conclusion:** Even after 2.4 to 12 years of use, BAHS offer subjectively a benefit in everyday life and are still used by the majority of the recipients, although only occasionally by a sizeable portion of them. More than a quarter of the subjects stopped using their devices permanently. The perceived benefit for speech in noise is small when compared to other everyday situations.

**Use of BAHS 2.4 to 12 years after implantation (N=21)**

- **Daily (42.8%)**
- **Occasionally (28.6%)**
- **Non-user (28.6%)**
TRANSCRANIAL ATTENUATION IN PRE-OPERATIVE ASSESSMENT OF INDIVIDUALS WITH SINGLE-SIDED DEAFNESS
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Keywords: single-sided deafness, transcranial attenuation

Purpose: Bone anchored implantation has been a well-documented, effective treatment option for individuals with single-sided deafness (SSD). However, wide inter-subject variability for both objective and subjective outcomes in patients treated with bone-anchored implants (BAI) continue to be reported. It has been suggested that variations in transcranial attenuation may contribute to the variability seen in the SSD population. This study investigates the use of pre-operative transcranial attenuation measures as a predictor of benefit in individuals treated with BAI for SSD.

Methods & Materials: A retrospective review of all adult patients evaluated for bone-anchored implantation at the University of Miami Ear Institute from 2013-2015 was conducted. Demographic information, audiometric data, speech in noise measures, transcranial attenuation, and audiologic outcomes were reviewed. Speech in noise performance was assessed with and without device using the QuickSIN test materials in the soundfield.

Results: A comparison of speech in noise performance outcomes in patients undergoing BAI for SSD by degree of transcranial attenuation will be presented. Preliminary data indicates transcranial attenuation varied widely across individuals in the SSD population, varied widely by frequency, and was not correlated to pure-tone average. Preliminary data suggests that average transcranial attenuation values for the frequency range of 1000 – 4000Hz provides the best predictive value for aided speech in noise performance with BAIs.

Conclusion: Patients with SSD receive significant improvement in speech in noise performance, but degree of objective improvement varies widely across subjects. The pure-tone average in the better ear is not a reliable predictor of post-treatment outcomes in the SSD population. Transcranial measures can be performed easily and quickly in the clinical setting to provide clinicians with objective information regarding potential benefit with BAIs. Further, this information can be used to determine potential gain needs of the patient post-operatively.

BILATERAL Baha MOVING BEYOND AUDIOLOGICAL EVALUATION
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Purpose: A cohort of 12 patients with bilateral Baha were evaluated using both audiological and Quality of life tools. We used the Glasgow Benefit Inventory (GBI) and the Tullamore Lifestyle Descriptor (TuLiD), a qualitative tool designed to extract Baha specific social and quality of life data. The sample included patients with conductive, mixed and sensorineural losses. The benefits of binaural hearing, improved speech perception, localisation of sound, improved listening and quality of life data is presented here.

Methods & Materials: The standard audiological assessment used includes pure tone audiometry, speech discrimination and speech in noise; self completion of the GBI and TuLiD followed thereafter. Quantitative data was reviewed using frequency distributions and qualitative data was sorted into emerging themes and presenting personalised statements.

Results: The audiological findings were influenced by the pathological condition, with conductive hearing losses performing better audioligically, than the mixed and sensorineural cases. However, we present data indicating a quality of life benefit that exceeds audiological expectations.
Conclusion: Whilst key performance indicators for hearing rehabilitation, understandably focuses on a readily quantified metric evaluation. The more holistic benefits of BAHA can be lost unless a qualitative tool that capture, subjective patient specific information is employed. A more global concept of benefit can be derived and this may well prove to be of significance in supporting the service providers and funding bodies in providing bilateral rehabilitation, particularly in those e.g. With moderately severe sensorineural hearing loss whose assessment solely on audiological grounds may not otherwise substantiate the benefits binaural implantation.

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BINAURAL HEARING ABILITY WITH BONE CONDUCTION STIMULATION
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Purpose: Binaural hearing with bone conduction (BC) stimulation is believed to be limited due to cross-skull transmission where BC vibrations from one stimulation position on the skull reach both cochleae. Previous data on normal hearing subjects revealed an ability to extract binaural cues with bilateral mastoid applied BC stimulation. However, those results cannot be directly implemented in patients using bone conduction hearing aids (BCHAs) as the BCHA implant position is placed further back than the mastoid position. This study aimed to investigate binaural hearing when BC stimulation was applied to the audometric mastoid position, and compared to BC stimulation at the BCHA implant position.

Methods & Materials: Binaural hearing was explored in normal hearing subjects when the stimulation was provided bilaterally with BC transducers on the mastoid and on the BCHA implant position. The ability to use binaural information with BC stimulation was also compared to ordinary air conduction (AC) stimulation using earphones. The participants were tested with spatial release from masking (SRM), binaural intelligibility level difference (BILD), binaural masking level differences (BMLD), and the precedence effect.

Results: Bilateral BC stimulation at the BCHA implant position illustrated an ability to use binaural cues similar to BC stimulation at the mastoid position. The binaural benefit was overall better with AC stimulation than BC stimulation at both positions. In the speech based tests (SRM and BILD), the binaural benefit was approximately half in terms of dBs compared to AC stimulation. For BMLD, the binaural benefit for the two BC positions with signal phase inversion was approximately twice the benefit with inverted phase of the noise. The precedence effect results with BC stimulation at the mastoid and BCHA position were similar for low frequency stimulation but differed with high frequency stimulation.

Conclusion: The results confirm that the ability to extract binaural hearing cues with bilateral BC stimulation at the BCHA implant position is similar to the mastoid position. This indicates the ability for binaural hearing in patients with good cochlear function when using bilateral BCHAs.

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DIRECTIONAL HEARING AND BONE-CONDUCTION, A MEASURE OF BINAURAL HEARING
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Purpose: Introduction: When listeners are able to use interaural differences in sound level (ILDs), and phase (interaural time differences, or ITDs), they are able to localize sounds with a high accuracy (<3 degrees) and they can better understand speech in difficult listening situations. There is limited objective data about sound localization abilities in listeners with conductive hearing loss who are fitted with bone-conduction devices (BCD). Some studies demonstrate a decline in sound localization when using a BCD. Other clinical-studies demonstrate improved aided directional hearing, as tested in a setup with a limited number of speakers. These studies also demonstrated that ambiguous monaural cues like the head-shadow effect and sound level were used.
Methods & Materials: Methods: Listeners point a head-fixed laser in the perceived sound direction in a completely dark, sound-attenuated room. Horizontal and vertical head-movements are recorded with the magnetic search coil induced technique. Stimuli are roved over a large range (45-65 dB SPL) and consist of broadband (0.5-20 kHz), high-pass (3-20 kHz) or low-pass (0.5-1.5 kHz) noise bursts. Listeners with unilateral conductive hearing loss or bilateral conductive hearing loss were tested in the unaided and (bilateral) aided condition. They were fitted with one or two percutaneous BCD(s) at least three months before the first directional hearing tests were performed.

Results: Results: Listeners with acquired unilateral conductive hearing loss fitted with a BCD demonstrated improved localization abilities. Listeners with bilateral conductive hearing loss demonstrate also benefit of their BCD, although they rather lateralized sounds instead of localizing the noise bursts.

Conclusion: Conclusions: We demonstrate that percutaneous BCDs can improve localization abilities of listeners with conductive hearing loss. Earlier experience with binaural hearing might affect the sound localization abilities when listening with a BCD. Our data indicate that aided listeners have access to ILD and ITD processing.

Session V:

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LINKING SKULL SIMULATOR OUTPUT TO VIBRATIONS APPLIED TO HUMAN HEADS
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Purpose: For precisely determining a patient’s bone conduction hearing threshold levels, and for calibrating bone-anchored hearing system (BAHS) vibrators, it is necessary to determine the magnitude of vibrations (force) applied to the human skull bone. In recent years, technological advances in objective measurement tools like the skull simulator (SKS) have allowed for determining magnitude of vibrational output of BAHS devices in clinical practice. SKS measurements are utilised for verification and quality control purposes, determining BAHS device force output in reference to a constant mass. However, the skull simulator does not precisely reflect vibrational characteristics of a typical human head because of its complex frequency-dependent mechanical impedance.

Methods & Materials: Specific measurement probes were developed for applying vibration signals to a human skull bone and simultaneously determining the acceleration of the counterweight mass of the respective vibrator. Exploiting Newton’s 2nd law, it is, therefore, possible to estimate the force level applied to an individual’s skull bone. Measurement results provide insight regarding the force output and vibratory behaviour of a particular system.

Results: A variety of patients’ individual force levels have been measured with different Ponto vibrators assembled as measurement probes and will be presented.

Conclusion: It will be discussed how these measurements relate to variability investigations of impedance data on human heads previously published. Validity of SKS magnitude representation of force level will be analysed and discussed for different vibrators. By means of probe measurement results, it is possible to define vibrator and application specific transformations from head to skull simulator. Practical applications for the measurement results, e.g. in fitting software, will be briefly presented.
EFFECT OF DIFFERENT MAGNET STRENGTHS ON THE OUTCOME WITH BAHA®ATTRACT

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Keywords: Transcutaneous, Pressure, Force

Purpose: Despite the success of the Baha® Connect system, the percutaneous abutment also has a number of drawbacks, including the need for life-long care and the risk of infection and trauma. Therefore, some patients are reluctant to choose the BAHA connect system. An approved and functional transcutaneous solution (Baha® Attract) may be an alternative for these patients because it leaves the skin intact and therefore avoids adverse skin reactions. The influence of the external magnet is however insufficiently known. The purpose of the current study is to find out if direct bone conduction (BC) thresholds, and magnet pressure and force, change over time after Baha® Attract surgery. Based on these findings, a second aim is to study if the audiological gain with this new system is related to these properties (pressure and force) and if there is a need for re-fitting of the sound processor after changing magnet strength.

Methods & Materials: 6 subjects were included in the study so far. All patients were implanted with the Baha® Attract system. Testing was performed at fixed pre operative and postoperative intervals: baseline before surgery, during surgery, 4 weeks post-op, 6 weeks post-op and 10 weeks post-op. During Surgery, skin thickness is measured. Maximal force measurements are performed with a dynamometer. Change in pressure is detected in the I-scan software with a sensor placed between the skin and the external magnet during 5 minutes. Direct BC thresholds are measured through the Baha sound processor and speech audiometry is performed in quiet.

Results: Data are currently collected. Data analysis will be done in the next few months and the results of the current study will be presented at Osseo 2015.

Conclusion: Data are currently collected. Data analysis will be done in the next few months and the results of the current study will be presented at Osseo 2015.

ADVANCED SYSTEM FOR IMPLANT STABILITY TESTING (ASIST)

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Purpose: The success of bone-anchored hearing aids relies on proper osseointegration of the implant and it is important to monitor the quality of integration over time to prescribe loading or to determine when other interventions may be necessary. Current approaches to evaluate the stability (or stiffness) of the bone-implant interface rely on a correlation between interface stiffness and the resonance frequency of the system; however, the geometry and mechanical properties of the implant-abutment system (which affect the natural frequency) are not taken into account in the interpretation. The Advanced System for Implant Stability Testing (ASIST) has been developed to noninvasively assess the integrity of the bone-implant interface. By including a mathematical model of the implant-abutment system, the ASIST measurement is independent of the attached components and can provide a quantitative measure of the interface characteristics. This study presents an evaluation of the ASIST for BAHA implants and abutments in a laboratory setting as well as preliminary clinical evaluation for BAHA patients.

Methods & Materials: The ASIST uses an acceleration signal measured during impact with the abutment coupled with a mathematical model of the system to estimate the interface characteristics. The procedure overview is shown in Figure 1. A laboratory evaluation with a BAHA implant-abutment system was performed to validate the system. A preliminary clinical
evaluation has been done with a small sample of BAHA patients (n=3). The ASIST was used to monitor the implant stiffness at each clinical visit from the time of implantation to 6 months post-op.

**Results:** Through laboratory testing, the ASIST has been shown to provide a repeatable measure of interface stiffness that is independent of attached components for a BAHA implant-abutment system. Preliminary clinical evaluation has been successful. Longitudinal changes in interface stiffness have been noted during the healing phase in individual patients.

**Conclusion:** The developed ASIST technique provides a noninvasive assessment of BAHA implant stability that is independent of attached components. Understanding the changes that occur at the bone-implant interface, particularly during the healing phase, can help to determine the optimum time to begin functional loading considering the balance between early loading (and thus early functional improvement) and long term success.

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**SITE-SPECIFIC LASER MODIFICATION PROMOTES HIGHER OSSEOINTEGRATION OF TITANIUM IMPLANTS**

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**Keywords:** osseointegration, surface modification, BAHS

**Purpose:** Experimental studies show that titanium surface modifications may promote faster bone formation and higher implant stability than the original machined surfaces. Laser modification allows site specific modification on the complex screw-shaped implants, while maintaining the rest of the implant as-machined. Yet, there is a need of evidence to support the hypothesis that laser, site-specific, modification of titanium implant will promote faster and better osseointegration than that promoted using machined implant. The purpose of this study was to evaluate the early bone response to selective laser modification, in the thread valley, of titanium implant in comparison to entirely machined implant. The evaluation is based on the measurements of removal torque and resonance frequency analysis (RFA) in rabbit tibia.
Methods & Materials: The two implant types were inserted bilaterally in rabbit tibiae and the baseline RFA values (ISQ) were recorded. After 8 weeks, implants were exposed, RFA recorded and the removal torque was measured. The means of ISQ and removal torque, respectively, were statistically compared between the two implant types (n=10). The values of insertion and retrieval ISQ were correlated with each other and with the removal torque (n=10).

Results: A significantly higher removal torque (153% increase) (p=0.008) was demonstrated for the laser modified in comparison with the machined implants. The load deformation plot of the machined implant showed a slightly linear increase in the torque and then reaching a plateau. In contrast, the load deformation plot of the laser-modified implant revealed a sharp increase in torque, having a distinct breakpoint with shorter or no plateau period. ISQ values significantly increased from baseline to 8 weeks, irrespective of the implant type. No significant difference was detected between machined and laser implants, neither for insertion, nor retrieval RFA. The machined implants revealed significant correlation between insertion and retrieval RFA (r=0.78; P=0.007) whereas laser-modified implants showed significant correlation between retrieval RFA and removal torque (r=0.69; p=0.02).

Conclusion: Selective laser modification, resulting in a site-specific surface modification in the thread valley of the machined implant, significantly promoted a stronger bone anchorage of the whole implant during the early healing period of osseointegration.

Purpose: Ongoing evaluation of the integrity of the bone-implant interface is important to understand changes in interface stiffness during healing and throughout the life of the implant. The Osstell ISQ is a widely used measurement technique that is commercially available. It uses a SmartPeg attached to either the implant or abutment and determines an implant stability quotient (ISQ) based on resonance frequency analysis. Alternatively, the Advanced System for Implant Stability Testing (ASIST) has been developed to assess the stiffness at the bone-implant interface by using an accelerometer signal measured during impact with the abutment coupled with a mathematical model of the system. This study presents a laboratory evaluation of both the ASIST and Osstell ISQ techniques and provides a comparison in terms of repeatability of measurement, sensitivity to changes in interface properties, and ability to assess interface properties independent of system components for a BAHA implant-abutment system.

Methods & Materials: Laboratory samples were prepared by installing BAHA implants into a plastic material to simulate an implant in bone. Several different samples were created with different interface preparations to simulate varying levels of interface stiffness. Three different lengths of BAHA abutments were used with each implant sample and stability measurements were obtained with both the ASIST and the Osstell ISQ. Each measurement system was evaluated in terms of repeatability of measurement, sensitivity to differences in interface stiffness, and effect of abutment length on the stability measurement.

Results: Through a laboratory evaluation, the reliability and effectiveness of both the ASIST and the Osstell ISQ have been assessed and compared for a BAHA implant-abutment system.

Conclusion: This work has presented a quantitative evaluation of the newly developed ASIST technique for implant stability measurement as well as a comparison with the currently available Osstell ISQ system.
PSYCHOACOUSTIC MEASUREMENTS OF PHASE AND AMPLITUDE NECESSARY FOR CROSS-TALK CANCELLATION

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Keywords: BAHA, cross-talk

Purpose: In theory, two BAHAs could deliver improved stereo separation using a cross-talk cancellation system. Sound vibrations from each BAHA arriving at the contralateral cochlea would be cancelled by an out-of-phase signal of the same amplitude from the ipsilateral BAHA. Psychoacoustic methods are needed to measure the amplitude and phase required for these cancellation signals. Two such methods were developed and cross-validated.

Methods & Materials: Participants with normal hearing wore two B71 bone transducers (one on each mastoid) and bilateral ER2 earphones, which could both block any airborne sound and deliver additional signals. In the first method, both bone transducers were stimulated with the same pure tone and the amplitude and phase adjusted in the right bone transducer in order to cancel all perceived sound at the right ear. This method is applicable clinically. In order to confirm improved interaural level differences, bone-conducted sound in each ear was cancelled via adjustment of the amplitude and phase of the same tone presented from each ER2 earphone (figure 1). This should result in no remaining audible sound at both cochleae.

Results: Participants were able to achieve cancellation with the first method at 1500-8000 Hz and at all tested frequencies using the second method. The mean differences in results between methods were smallest at 3000-5000Hz (0.4dB in level and 3° in phase). The second method could also be used to predict the amplitude at the ipsilateral cochlea using the first.

Conclusion: The two methods for measuring the cross-talk signal gave consistent results. The first method, using two bone stimulators, is directly transferable to use in patients with middle ear dysfunction, but does not cover the full audiometric spectrum. The lower frequencies may be filled in through extrapolation using normative data from the second method.
THE ADJOIN ADHESIVE ADAPTER: NEW INNOVATION IN BONE CONDUCTION HEARING

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Keywords: Hearing aid, implant, paediatric

Purpose: As part of the assessment period for a Bone anchored hearing implant (BAHI), children are traditionally evaluated with the sound processor on a headband then encouraged to trial it for at least 3 months. The headband is a significant cosmetic and uncomfortable deterrent to acceptance of a Bone Anchored Implant. A recently developed adhesive adapter ‘Adjoin’ is an exciting alternative. This adapter from Otorix, Gothenburg is attached to the skin behind the ear and a version, adapted to be compatible with the Ponto sound processor from Oticon Medical, was used. 1.To evaluate the audiological effectiveness of the Ponto sound processor when worn on the adhesive adapter as an alternative to the traditional headband options. 2. Evaluate the experience of the children and their carers with the adhesive adapter

Methods & Materials: All children under assessment for a BAHI were offered the sound processor on the adhesive adapter for an evaluation period of 12 weeks. Patient demographics were recorded and standard audiological testing; BC in situ, Free field tests were performed. Quality of life questionnaires and a specific ‘Adjoin’ feedback questionnaire were completed.

Results: 20 children opted to use the Ponto Hearing aid with the Adjoin. There was a male preponderance. Age range was 7 to 16yrs. Mean 10.9 yrs. The principle aetiologies were microtia/ atresia and CSOM. One case with SSD was included. GCBI and Adjoin questionnaires demonstrated significant benefit with more than 50% of the children deciding not to proceed with BAHI surgery and continue with the Adjoin. Minimal problems were identified, the most common being loss of the adhesive quality after just 48hours. Audiological findings revealed that the Adjoin is comparable or better than the softband for standard PTA frequencies and in particular the higher frequencies.

Conclusion: The Adjoin adhesive adapter is an exciting development in the rehabilitation of children who would traditionally benefit from a BAHI. The Adjoin has proven to be cosmetically superior to the traditional headbands that frequently deter the uptake of BAHI surgery in appropriate children. The audiological results would appear comparable or better than the softband. The Adjoin offers a more child/ young person-friendly and acceptable way to encourage BC hearing.

MAXIMISING THE HEARING EXPERIENCE THROUGH SOUND PROCESSOR DEVELOPMENT

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Keywords: Sound processing, development, bone conduction hearing implants

Purpose: Each generation of sound processor aims to provide an improved hearing experience to adults and children who use bone conduction hearing systems. The development process for sound processors is an iterative process where we need to validate the system performance in many situations. Key aspects of testing involve (a) compatibility with different connection types (e.g. Connect, Attract and Softband), (b) Feedback, (c) different conditions (e.g. wind), (d) signal processing (e.g. directionality and noise reduction) and (e) wireless accessories and Apps.

Methods & Materials: Up to ten adult participants take part in each experiment. For any given sound processor development project there may be up to forty different experiments. This presentation will focus on five key focus areas,
testing methodologies and results relating to connection types, feedback, wind noise, signal processing and accessories. In each experiment, a number of objective measures (e.g. speech understanding, Matrix test, and/or loudness growth) are combined with subjective measures of preference are conducted depending on the question to be addressed.

**Results:** The results from the different experiments will be discussed and described. The relationship to the experiment and the final sound processing system together with the claims will also be discussed.

**Conclusion:** The hearing performance testing in sound processor development is an interesting and comprehensive process. This presentation aims to provide the audience with insights into that process and lead the discussion on how testing should adapt to increasingly complex systems and requirements.

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**USER BENEFITS OF WIRELESS CONNECTIVITY WITH A SMART SOUND PROCESSOR**

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**Purpose:** Recently wireless technology using the 2.4Ghz protocol has become available for bone conduction sound processors. The purpose of the study was to investigate clinical benefits of the latest this wireless technology for the patients and to aid clinicians in accessory selection.

**Methods & Materials:** Ten patients using a bone conduction sound processor with wireless connectivity were evaluated. Patients were offered one of four different wireless options (mini microphone, remote control, phone clip or TV streamer), in addition to the ability to link their sound processor to a smartphone via Bluetooth. Outcomes were collected using the SSQ-12, a wireless benefit questionnaire and objective measures of speech understanding in noise.

**Results:** Patients demonstrated a clear preference for one type of accessory based on either lifestyle or hearing preference. For example, patients who desired the best possible hearing performance selected an option such as the “mini microphone”. Whereas, those who wished for connectivity appreciate the ability to connect a dedicated smartphone “App” to their sound processor. Speech understanding in noise scores and subjective preference will also be discussed.

**Conclusion:** Clinically, the development of wireless accessories combined with the latest generation of smart sound processors provides significant clinical benefits. Benefits are demonstrated in terms of both improved hearing performance in addition to improved subjective benefit was observed.

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**IMPROVING HEARING PERFORMANCE USING A WIRELESS REMOTE MICROPHONE**

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**Keywords:** wireless, remote microphone, speech in noise

**Purpose:** Hearing impaired individuals require improved speech understanding in challenging listening situations. While, directional microphones provide significant benefits, another potential solution is to use wireless transmission technology to transmit the signal directly to the sound processor.

**Methods & Materials:** The study involved both a technical and clinical evaluation of the performance of an external microphone. For the technical measurements we measured the signal-to-noise ratio (SNR) in three rooms; (a) lecture theatre (RT=0.25s), (b) cafeteria (RT=1.8s) and (c) sound isolated room (RT=0.5s). For clinical measurements, ten
patients with a bone conduction hearing system participated. Each patient wore a sound processor paired to a wireless microphone. Testing took place in a sound booth with two loudspeakers. The HINT test was used to determine the 50% level of speech recognition in noise. Speech was presented from the front loudspeaker (0) with noise from the rear loudspeaker (180). Three test situations were conducted: (1) omni-directional microphone, (2) automatic directional microphone, and (3) a wireless microphone was placed 15cm in front of the front loudspeaker. The testing was completed in two set-ups, (a) sound processor microphone + mini-mic, or (b) mini-mic only.

Results: For both, the technical and the clinical tests, the wireless configuration demonstrated the largest benefit in hearing performance in noise. For technical measurements, in each of the technical measurements, the use of a mini-mic alone was able to improve the recorded SNR. For the situation of sound processor microphone and mini-mic combined a significant mean improvement of 3.08dB was observed (p<.0001). For the mini-mic only situation a significant mean improvement of 7.5dB was observed (p<.0001). Subjective reports using a visual analogue scale (VAS) indicated that all the participants found it easier to listen to the test material using the wireless accessory than with the conventional sound processor level microphone in this test situation.

Conclusion: Results of the study conclude that sound processor incorporating wireless technology improve speech recognition in noise compared with conventional bone conduction sound processor. The clinical situations and implications of this new technology will be discussed.
PATIENT BENEFITS FROM A NEW BONE CONDUCTION SOUND PROCESSOR

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Purpose: Recently, new signal processing and wireless connectivity have been available for bone conduction hearing implant systems. These latest generation sound processors have been developed to deliver improved signal processing features, feedback cancellation algorithms and wireless capabilities through the 2.4GHz protocol. Importantly, we need to validate the patient benefits from this new technology through formal evaluation with existing BAHA users.

Methods & Materials: Ten adult patients using a bone conduction hearing solution either with a direct abutment connection or magnetic attachment were evaluated using the latest generation processors. Patients were also offered one of four wireless accessories. Each patient was upgraded from their current sound processor with measurements collected at pre-fitting, fitting and 4-6 weeks post fitting. Evaluation measures included a measurement of speech recognition in noise (BKB-SIN), and two questionnaires (SSQ-12 and a subjective assessment of performance).

Results: Data is currently being analysed and will be presented at the conference. We will update the abstract as data becomes available.

Conclusion: We will discuss the potential benefits obtained from the new sound processing algorithms and wireless possibilities from this latest generation of sound processors. Importantly, we will discuss how these benefits are realised in a major hospital clinical environment.

Friday, May 22

CRITICAL APPRAISAL OF TODAY’S AMPLIFICATION OPTIONS FOR PATIENTS WITH CONDUCTIVE OR MIXED HEARING LOSS FROM AN AUDIOLOGICAL AND CLINICAL PERSPECTIVE

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Nowadays, several different amplification options are available for patients with mixed or conductive hearing loss. E.g. conventional air-conduction devices, percutaneous (Baha, Ponto) and transcutaneous (Sophono, Attract) bone conduction devices, active transcutaneous bone conduction devices (Bonebridge, BCI), but also devices with their actuator coupled directly to the cochlea (VSB, Codacs). When choosing a treatment, with that many amplification options, a critical appraisal is inevitable and takes into account several important factors. Among others: auditory capacity of the devices, safety (including MRI compatibility), stability, complexity of the surgery, risks for revision surgery and last but not least costs. The speakers will alternating critically appraise all the current options and provide the professionals with all the information they need to help our patients decide in making decisions.
**Session VII:**

### PERFORMANCE AND DESIGN OF A NEW BONE CONDUCTION DEVICE

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**Keywords:** Bone conduction, otorix, softband

**Purpose:** The objective was to develop a new type of non-invasive bone conduction (BC) hearing system. There is a significant need for a well-functioning non-surgical BC device for conductive hearing loss, especially in paediatrics. Some of the typical limitations of existing non-surgical BC devices are poor wearing comfort or unacceptable aesthetics. The objective was to overcome such drawbacks. The new concept was based on a unique new adhesive attachment with a new sound processor suitable for patients in need for BC amplification.

**Methods & Materials:** Different compositions of advanced medical grade adhesives were identified as suitable for the purpose together with expertise in the field. After evaluation of skin interaction and macroscopic design aspect a most favourable material and design was identified to be carrier in an Adjoin unit to carry the coming Bonect sound processor. Initial audiometric evaluation was performed by enabling the connection of an established Ponto sound processor to a version of Adjoin. BC thresholds were compared with the Softband arrangement.

**Results:** The results showed that a BC system with acoustic performance similar to a Softband arrangement could be developed. The Adjoin was found to be a practical arrangement with excellent wearing comfort without any discomfort or pressure against the skin. The selection of a well-functioning adhesive material was important to ensure a reaction free and secure skin adhesion. A suitable interval between changes of the adhesive was found to be twice a week but may vary between 2 to 7 days.

**Conclusion:** Multiple factors had to be considered in the development of the new BC concept. The Adjoin was found to be a well-functional and user friendly arrangement with excellent wearing comfort and the new advanced sound processor should be a valuable and aesthetic new treatment option for patients preferring a non-invasive BC solution. As for any ear level BC concept where the vibrations are damped when being transmitted through the skin, this type of ear level concept is mainly suitable for conductive, unilateral and bilateral hearing losses and not for more severe mixed hearing losses.

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### SUBCUTANEOUS PIEZOELECTRICALLY ACTUATED HEARING AID: DEVICE DEVELOPMENT AND FUNCTIONAL TESTING

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**Keywords:** BoneConduction, Piezoelectric, FunctionalTesting

**Purpose:** Subcutaneous bone conduction implants avoid the recurrent skin infection and stigma that are often associated with percutaneous implants. In 2010 we presented the results of a feasibility study on a new class of subcutaneous implant, the Subcutaneous Piezoelectrically Actuated Hearing Aid (SPAHA) consisting of a piezoelectric bending actuator bonded to the skull. We report on design improvements, modeling and validation experiments on a SPAHA housed in a hermetic titanium package suitable for clinical implantation.

**Methods & Materials:** The design of the SPAHA is determined by surgical and fabrication constraints. The current design consists of a piezoelectric PMNPT disk [20 mm diameter x 750 um thick] encased in a hermetically sealed titanium housing [25 mm diameter, 3 mm deep] with hermetic electrical feedthroughs. The base of the housing is dual acid-etched to enhance implant adhesion to the skull. The optimal thickness and material of the piezoelectric disk was determined using finite element modeling and vibration testing of SPAHAs attached to acrylic plates. Functional testing of encased and bare SPAHAs was performed on a cadaver head. The device was attached to the levelled implant site using glass ionomer.
cement. As a measure of hearing level, the vibration of the cochlear promontory in response to the SPAHA was measured using a laser Doppler vibrometer [Polytec CLV 3000]. To assess the performance of device, the efficacy of the SPAHA was compared with that of a BAHA BP110 motor.

**Results:** The efficacy of the encased SPAHA was found to be within 10 dB of the BAHA efficacy except between 500-1000 Hz near the BAHA resonance. The bare SPAHA efficacy was equal to or greater than the BAHA efficacy except around the BAHA resonance.

**Conclusion:** Based on these results, the SPAHA appears capable of achieving performance comparable to the percutaneous BAHA.

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**IMPROVING PATIENT OUTCOMES THROUGH THE DEVELOPMENT OF NEW TRANSDUCER TECHNOLOGY**

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**Keywords:** Sound processing, wireless, bone conduction hearing implants

**Purpose:** A key limitation to the further improvement of patient outcomes is the transducer technology. Transducer design has been subject to incremental improvements over the past 10 years. This investigation will highlight the improvements that can be realised in terms new transducer development and the impact that may have on hearing performance.

**Methods & Materials:** Fifteen adult patients using a bone conduction implant system were recruited for this investigation. Two control sound processors were used (BP100 & Baha 4) together with a test sound processor with a new transducer design. Testing was randomly allocated between the three different options. After a period of acclimatisation, measurements were collected in terms of aided audibility, speech in quiet (50, 65 & 80dB) and speech recognition in noise (Matrix test). Measures of subjective preference were also collected.

**Results:** In measures of speech recognition in quiet and noise both the Baha 4 and the test transducer system showed significant benefits over the BP100 in terms of speech recognition in quiet and noise. No significant differences between the test transducer and Baha 4 sound processor were measured in speech recognition in quiet or noise. Importantly, there
were significant benefits measured in terms of reduced distortion and improved sound quality of the test transducer system over the two control sound processors. In measurements of sound quality, loudness and speech intelligibility the majority of the patients preferred the test transducer design. Ratings of overall preference also showed a majority preference towards the test transducer.

**Conclusion:** Further improvements to transducer design can lead to significant benefits in terms of patient preference and sound quality which may not be apparent in objective measures of speech recognition that we typically use the laboratory. We will discuss the impact of improving transducer design and sound quality on future sound processor designs.

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**BONE CONDUCTION PATHWAY THROUGH NON-OSSEOUS CONTENTS**

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**Keywords:** non-osseous bone conduction, intracranial pressure, bone conduction hearing aid

**Purpose:** Bone conduction hearing aids (BCHAs) are commonly used for patients with conductive or mixed hearing loss who cannot wear conventional hearing aids, or for patients with single sided deafness. Whereas several BC pathways have been revealed, recent studies proposed direct stimulation of the cochlea via non-osseous pathways such as brain and cerebro-spinal fluid (CSF). While some studies argue that stimulation on non-osseous sites such as the eye and neck generates BC propagation mainly through non-osseous pathways, contribution of these pathways to hearing and their interaction with osseous pathways are still controversial. This study investigates on roles of non-osseous pathways in BC hearing. Non-osseous cranial contents are excited by direct stimulation on the dura in cadaver heads.

**Methods & Materials:** Measurements were performed in human cadaveric heads. A bone conduction hearing aid (Bonebridge, Med-El) was attached to the dura after craniotomy, and stepped-sine signals in the frequency range of 0.1 – 10 kHz were delivered directly to the transducer. Motions of the cochlear promontory were measured using a Laser Doppler Vibrometer (OFV-3001, Polytec) system and intracranial pressure change was simultaneously recorded with a hydrophone (Type 8103, Brüel & Kjær) placed within the cranial space. Then, the relative magnitudes of the two measured values were compared in the frequency domain for stimulation at the dura and at the mastoid.

**Results:** Intracranial pressure change and promontory motion were measurable for direct stimulation on the dura. The intracranial pressure change maintained flat magnitudes up to 1.4 kHz, and then the magnitudes decreased with frequency. The phase was also flat up to 1.4 kHz, and decreased with frequency. The promontory motion showed the maximum magnitude around 1.4 kHz, and the magnitude decreased with frequency at higher frequency range. The phase decreased with frequency uniformly along the entire considered frequency range of 0.1 – 10 kHz. The relative magnitude of bone vibration and intracranial pressure shows similar values for stimulation at the dura and at the mastoid.

**Conclusion:** The intracranial pressure changes show comparable magnitudes and phases to vibrations of the cochlear promontory above 1.4 kHz, suggesting the non-osseous contents interact with bone vibrations in this frequency range. Regardless the mode of stimulation relative magnitude of bone vibration and intracranial pressure is similar, indicating a dominance of bone vibration.

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**MRI INVESTIGATION OF THE BONE CONDUCTION IMPLANT: A PILOT STUDY**

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**Keywords:** Magnetic Resonance Imaging, Bone Conduction Implant
**Purpose:** The objective of this pilot study was to investigate if the bone conduction implant (BCI) used in an ongoing clinical study withstands magnetic resonance imaging (MRI) of 1.5 Tesla. In particular, the MRI effects on maximum power output (MPO), total harmonic distortion (THD) and demagnetization were investigated. Implant activation and image artifacts were also evaluated.

**Methods & Materials:** One implant from the ongoing BCI clinical study was placed on the head skin of a test person at the position corresponding to the normal position of an implanted BCI and applied with a static pressure using a head bandage and scanned in a 1.5 Tesla MRI camera. Scanning was performed both with and without the implant, in three orthogonal planes and for one spin-echo and one gradient-echo pulse sequence. The implant functionality was verified in-between the scans using an audio processor programmed to generate a sequence of tones when attached to the implant. Objective verification was also carried out by measuring MPO and THD on a skull simulator as well as retention force, before and after MRI.

**Results:** It was found that the exposure of 1.5 Tesla MRI only had minor effect on the MPO, i.e. it decreased over all frequencies with an average of $1.1 \pm 2.1 \text{ dB}$. The THD remained unchanged above 300 Hz and was increased only at lower frequencies. The retention magnet was demagnetized by 5%. The maximum image artifacts reached a distance of 9 and 10 cm from the implant in the coronal plane for the spin-echo and the gradient-echo sequence, respectively. The test person reported no MRI induced sound from the implant.

**Conclusion:** This pilot study indicates that the present BCI implant may withstand 1.5 Tesla MRI with only minor effects on its performance. No MRI induced sound was reported, but the head image was highly distorted in the vicinity of the implant.

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**Session VIII:**

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**BAHA ATTRACT: MULTICENTRE CLINICAL INVESTIGATION PROTOCOL AND FIRST EXPERIENCES**

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Nijmegen, Netherlands

**Keywords:** Attract

**Purpose:** Presentation of the study protocol of a multicentre, prospective investigation on the Cochlear Baha Attract System and first surgical and fitting experiences.

**Methods & Materials:** Fifty-two adult patients will be included in the prospective cohort study. Follow-up visits are scheduled at 10 days, 4, 6 and 12 weeks, and 6, 12 and 24 months. Main outcome measures will be hearing performance of the Baha Attract System compared to unaided situation and compared to a pre-operative test situation using the sound processor on a softband, mid- and longterm safety of the Baha Attract System, hearing related quality of life, surgical information, sound processor magnet strength and magnetic retention force over time, and information on postoperative pain, discomfort, numbness and soft tissue status.
**Results:** The study protocol of the multicentre investigation and the first surgical and fitting experiences in our centre will be presented.

**Conclusion:** The objective of the study is to collect data regarding the usability and clinical performance of the Baha Attract System in subjects with hearing impairment that are candidates for Baha surgery.

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**CLINICAL EXPERIENCE OF BAHA ATTRACT - AN AUDIOLOGISTS PERSPECTIVE**

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**Purpose:**
The Baha Attract system was launched in the UK in 2014. Over a 12 month period over 30 patients have chosen the magnetic "attract" system in preference to the traditional percutaneous "connect" system. This presentation will review the data obtained from these patients during different stages of their treatment pathway. It will address trends in prescriptions and identify common themes associated with magnet strength and user outcomes that will help inform Audiologists management plan and also support the need for further development of alternative algorithms for use in fitting BAHA on the attract system.

**Methods & Materials:**
Data from 30 patients fitted with BAHA attract will be reviewed Hearing aid prescription/fitting data will be observed Functional listening tests/ Speech results will be observed Outcomes from Cochlear fitting questionnaire and Client Orientated Scale of Improvement (COSI) will be utilised.

**Results:**
The results are still under analysis and will be updated prior to the final abstract update deadline. Results analysed so far demonstrate there are high levels of satisfaction and functional benefit being achieved with the Baha Attract despite significant numbers of the fittings being classified as failing to reach the target prescription.

**Conclusion:**
Again results so far still under analysis so this section will be updated- As currently stands. The introduction of the Baha Attract into the UK Market has increased the acceptability of Baha for many patients previously unwilling to proceed with implantation of a percutaneous device. The Baha Attract has proved successful with minimal problems encountered by patients. The challenges of meeting prescriptive targets are apparent yet this is not reflected in clinical outcomes and end user satisfaction, the paper therefore raises questions about the suitability of current algorithms for transcutaneous devices and the need for further development in this area.

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**RESULTS OF A NEW IMPLANTATION TECHNIQUE OF THE SOPHONO DEVICE**

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**Keywords:** bone conduction clinical results

**Purpose:**
We have developed a new, simple „up-side-down“ (USD) implantation technique of the semi-implantable Sophono device and used it clinically since 2013. The aim of this study was to analyze its clinical and audiological results and compare these to our previous implantation technique. In addition we analyzed the very early, even on the day of surgery adaptation of this new method.

**Methods & Materials:**
20 patients (14m, 6f) with 22 implants with atresia which have been implanted in the USD-Technique with a Silastic cover were examined. The age of the patients were 17.9 +/- 12.6 years. The youngest one was less than 2 years. The fitting was done in the first week after the operation, mostly between the first and third day.
Audiological measurements were performed in free field with pure tones and speech. The pressure of the device onto the skin was measured with a digital gauge and the skin thickness by ultrasound. The clinical status of the skin was evaluated with the Holger score.

Results: All operations and clinical courses were uneventful. The PTA (Pure Tone Average, averaged for 0.5, 1, 2 and 4 kHz) of the healthy ears was -22 dB ± 17.3 dB with an Air/Bone Gap von -7.67 ± 12.7 dB. The malformed ears had an PTA of -73 ± 14.7 dB with an Air/Bone Gap von -51 ± 13.7 dB. In free field measurements the patients showed an increase of speech perception from 14 ± 15% to 58 ± 26%. The immediate hearing gain was 24.3 ± 12.2 dB. The skin thickness was 4.9 ± 2 mm, the Holger-Score 0.16 ± 0.37 and the force 1.4 ± 0.8 N.

Conclusion: The new USD-implantation technique offers the possibilities of a very simple, up to now complication-free implantation and a very early fitting with clinical and audiological results comparable to the "classical" implantation technique. It allows implantations in young children because it is independent from bone thickness.

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GLOBAL CLINICAL OUTCOMES OF A MAGNETIC RETENTION BONE CONDUCTION SYSTEM
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Research
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Keywords: bone conduction, magnetic retention, Attract

Purpose: Recently, a bone conduction hearing system that uses a magnetic rather than a percutaneous attachment between the sound processor an internal osseointegrated implant has become clinically available. With any new system it is important to evaluate the performance of such a system in a clinical population, and compare with the percutaneous option.

Methods & Materials: In total, 224 adult and paediatric (>8 years) patients participated in the investigation across 73 centres in Europe, North America and Australia. The cohort was followed for between three to nine months following surgery. To assess outcomes, two questionnaires were used. At time of surgery and at the time of sound processor fitting. In addition, an event form was used to capture any events that could affect clinical outcomes such as soft tissue healing, sound processor magnet change or acoustic feedback.

Results: Questionnaires were returned from 89% of surgeries and 90% of fitting visits. An additional 16 event questionnaires were received relating to soft tissue, sound processor magnet change or acoustic feedback. In each occurrence, the reported event was later satisfactorily resolved. The system was used across the indications with 52% conductive, 16% mixed hearing loss and 32% of single-sided sensorineural deafness patients receiving the system. In terms of sound processor selection, 54% chose a power sound processor and 44% the less powerful variant. In addition positive results were received for perceived loudness, sound quality and hearing performance.

Conclusion: The follow-up of the first 224 patients to receive a magnetic based bone conduction hearing solution is positive, with reportedly good hearing outcomes combined with low rates of clinical events. Interestingly, 38% of patients had previously decided against the percutaneous system due to adverse feelings about a skin penetrating abutment. Given this, it could be that such a cosmetically appealing magnetic retention system may offer an additional clinical option. We will further compare relative benefits of either system.
**PAEDIATRIC OUTCOMES OF A MAGNETIC RETENTION BONE CONDUCTION HEARING SYSTEM**

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**Purpose:** A number of reports have discussed the option of a bone conduction system using a magnetic connection. While these reports have been generally positive, we need to examine how such a system may be applicable to the paediatric population. In order to gather information a global clinical investigation was conducted.

**Methods & Materials:** 54 paediatric (<20 years) patients participated in the investigation from hospitals in Europe, North America and Australia. The cohort was followed post surgery for three-to-nine months. To assess outcomes, two questionnaires were used, (1) at time of surgery and (2) at time of sound processor fitting. In addition, an event form was used to capture any events that could affect clinical outcomes such as soft tissue healing, sound processor magnet change or acoustic feedback.

**Results:** The system was used across all the Baha indications with 75.9% conductive, 1.8% mixed hearing loss and 22.2% of children with single-sided sensorineural deafness receiving the system. In terms of implant length, from surgical decision, 33.3% required a 3mm implant and 66.7% required a 4mm implant. The decision for implant length was based on age and bone thickness. 58% of patients required a premium sound processor while 42% required a power sound processor. Clinician ratings demonstrated a benefit of 98% in sound quality, 100% in speech understanding and 93% in loudness acceptance from first fitting.

**Conclusion:** The follow-up 54 children to receive a magnetic attachment bone conduction hearing solution is positive, with good hearing outcomes combined with low rates of clinical events.

**Session IX:**

**CLINICAL SURVEY OF BAHI: WIDE IMPLANTS AND TISSUE PRESERVATION**

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**Keywords:** ponto wide implant, tissue preservation

**Purpose:** To compare the stability, survival, and tolerability of two percutaneous titanium implants for bone conduction hearing: a 4.5-mm-diameter implant (wide) and a 3.75-mm diameter (control). Additionally, to compare the outcome after a surgical procedure with soft tissue preservation and surgery with soft tissue reduction.

**Methods & Materials:** For the first comparison, fifty-seven adult patients were included in a randomized controlled clinical trial. Sixty implants were allocated in a 2:1 (wide-control) ratio. Follow-up visits were scheduled at 7, 14, 21, and 28 days, 6 and 12 weeks, and 6 months. At every visit, implant stability quotient (ISQ) values were recorded by means of resonance frequency analysis (RFA) and skin reactions were evaluated according to Holgers’ classification. For the soft tissue preservation comparison, twenty-five patients were included in the prospective cohort with soft tissue preservation. The control group consisted of the last 25 patients implanted with a wide implant in the randomized controlled clinical trial. Follow-up visits were scheduled at 7 days, 21 days, 12 weeks, and 6 months. At every visit, implant stability quotient (ISQ) values were recorded and a range of outcome measures related to skin status were collected, including Holgers scores. In both studies, implants were loaded at three weeks.
Results: ISQ values were significantly higher for the wide implant compared to the control implant. No implants were lost and soft tissue reactions outcomes were comparable for both implants. Positive results were reported in the hearing related quality of life questionnaires. For the tissue preservation comparison, results will be presented on all the main outcome measures for a six-month follow-up

Conclusion: The six-month results on the randomize trial indicate both implants and its corresponding hearing devices to be safe options. Three weeks loading did not affect implant stability for either of the implants.

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EVALUATING PREDICTORS FOR BAHI FIXTURE LOSSES IN OVER 1500 PATIENTS
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Keywords: BAHA, fixture loss

Purpose: The Queen Elizabeth Hospital Birmingham (QEHB) was one of the first UK hospitals to offer Bone Anchored Hearing Implants (BAHI) to patients and has been successfully doing so since 1988. Fixture loss is a well recognised complications of BAHI surgery and various predictors of failure including infection and diabetes have been determined within the literature. The aim of this study was to evaluate fixture losses within the Birmingham group of patients over the last 5 years (2009-2014), including their predictors for failure.

Methods & Materials: A departmental database was used to identify all adult patients currently being maintained for their BAHIs at QEHB. Fixture losses within the last 5 years were identified using theatre records and BAHI follow up data. Casenotes were reviewed and data extracted for the following possible predictors: demographic details, co-morbidities, previous irradiation, trauma to fixture, infection of fixtures, time to fixture loss from insertion, number of fixtures lost and smoking status.

Results: A total of 1599 patients were identified. Of these, 60 (3.8%) patients had a single fixture loss within the last 5 years. A further 3 patients lost 2 fixtures each during this time, resulting in a total number of fixture losses as 66 (4.1%) in 63 patients (3.9%). Further data will be presented on patient factors in this group.

Conclusion: Fixture loss is cited as a complication to patients when consenting for BAHI surgery and certain patient factors may increase this risk. Appropriate counselling is therefore required in such patients. The fixture loss rate of 3.9% at the Birmingham centre is well within the 2013 UK guidelines from NHS England for successful implantation surgery.

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FIVE-YEAR STABILITY, SURVIVAL, AND TOLERABILITY OF THE BAHA BI300 IMPLANT
Nelissen, Rik*, Stalfors, Joacim (2), Flynn, Mark (3), Wigren, Stina (3), Eeg-Olofsson, Måns (2), Green, Kevin (4), Aggarwal, Rhoini (5), Mylanus, Emmanuel (1), Hol, Myrthe (1)
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Department of Otorhinolaryngology
Nijmegen, Netherlands

Purpose: To ascertain the five-year stability, safety, and tolerability of the BI300 implant and abutment.

Methods & Materials: Seventy-seven adult subjects who participated in a previous three-year multicenter randomized controlled trial were invited to participate in this follow-up study five years after implantation in order to evaluate the long-term outcome of the BI300 implant and abutment and previous generation implant and abutment. Implants were loaded
from six weeks post implantation. Follow-up after surgery was conducted at 10 days; at 4, 6, 8, and 12 weeks; at 6 months; and at 1, 2, 3, and 5 years. At each follow-up visit, implant stability quotient (ISQ) values were recorded by means of resonance frequency analysis (RFA) and soft tissue reactions were evaluated according to the Holgers classification.

**Results:** An initial dip in ISQ at 10 days after implantation was noticed. Hereafter, a gradually increasing trend in ISQ values was found until 6 months, after which ISQ values remained above baseline values. Implant survival was high for both implants. Clinically relevant soft tissue reactions were superior in the BI300 compared to the control implant.

**Conclusion:** This is the first time five-year data, including ISQ, on the same patients is collected in a standardized manner. The clinical outcome of the BI300 was superior to that of the control implant.

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**COMPARISON STUDY OF HYDROXYAPATITE-COATED VERSUS NON-COATED BONE ANCHORED HEARING ABUTMENTS**

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**Keywords:** hydroxyapatite, BAHS, BAHA

**Purpose:** To compare healing outcomes and skin reactions between patients receiving hydroxyapatite-coated abutments and non-hydroxyapatite-coated abutments used in bone anchored hearing systems.

**Methods & Materials:** The study design consists of prospectively enrolling 40 adult patients, randomized to either the coated or non-coated study groups. The hydroxyapatite-coated abutment (Baha 4 Connect System) is compared to the non-coated abutment (Ponto bone anchored wide implant system). Both groups underwent implantation using a standard, minimally invasive surgical technique without subcutaneous tissue reduction. The two groups were compared in regard to post-operative soft tissue reactions, infections, pain, and numbness at the implant site. Post-operative visits were pre-scheduled at 1 week, 3 weeks, 6 weeks, 3 months, 6 months, and 1 year following implant insertion. A clinical evaluation of the skin status was made at all follow-up visits, with classification according to a modified Holgers Scale. A separate visual analogue scale for pain and numbness was administered at each follow-up visit. The processors were fitted at 3 weeks postop.

**Results:** Preliminary results of the first 20 implanted patients will be presented with a follow up period up to 6 months post implantation. All but 1 implant had Grade 0 findings throughout the post-operative period. One patient had a grade 1 rating that resolved into a grade 0 with topical treatment. Our findings also suggest that there was no significant difference in the pain or numbness scores between the hydroxyapatite-coated and non-coated abutments.

**Conclusion:** There appears to be no measurable difference between the hydroxyapatite-coated and non-coated abutments when comparing skin reactivity, pain and numbness scores post-operatively. Furthermore, there is no measurable difference in aesthetic outcomes or healing time when comparing the hydroxyapatite-coated and non-coated abutments. The minimally invasive surgical technique without subcutaneous tissue reduction using the longer abutments appears to be a safe procedure, leading to shorter surgical times, faster healing, and no significant complications.
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A WIDE BONE ANCHORED HEARING IMPLANT: UK PROSPECTIVE MULTI-CENTER STUDY
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Keywords: implant, stability

Purpose: To investigate the wide Ponto implant from Oticon Medical, with focus on initial stability, stability development over time, implant loss and skin reactions. The wider diameter (4.5 mm) bone anchored hearing implants have been introduced to ensure a higher initial stability, ultimately aimed at further reducing implant loss rates and improve predictability of the treatment.

Methods & Materials: The study is a prospective multi-centre study, including three tertiary referral centres in the UK. The study was designed as a case series study, with thirty adult patients included. The surgical technique was varied, and included both soft tissue preservation and skin thinning using the dermatome. Implant stability was measured at surgery and at all follow-up visits (10 days, 6-12 weeks, 6 months and 12 month after surgery) using resonance frequency analysis (ISQ values). At all follow-up visits, skin status and skin height was assessed and skin reactions classified according to the Holgers’ scale.

Results: The final data with a minimum of 12 month follow-up for all patients will be available at the conference. 30 patients with a total of 33 implants were included. A similar proportion of 6 (34%), 9 (38%), and 12mm (28%) long abutments were used, allowing stability comparison across different abutment lengths. Stability at surgery (measured as ISQ low) was 60.8, 49.3, and 41.5 for the different abutments respectively. Stability increased after surgery, and no implant was lost. Skin reactions were rare, with a rate of adverse skin reactions (Holgers = 2) of 3.1% of the visits.

Conclusion: The wide Ponto implant is a clinically stable implant with comparably low skin complications, and the same family can successfully be used both for tissue preservation and skin thinning techniques.

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THE SOFT TISSUE PRESERVATION EXPERIENCE WITH A HA-COATED ABUTMENT
Stokroos, Robert*, Van Hoof, Marc (1), Van Tongeren, Joost (1), Hof, Janny (1), Brunings, Jan Wouter (1), Wigren, Stina (2), Flynn, Mark (2)
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Keywords: surgical outcomes, soft tissue preservation, HA-coated abutment

Purpose: Since its introduction, soft tissue preservation for bone conduction hearing implant surgery has been adopted generally. Surgery has proven to be shorter and complications which can be associated with trauma to the soft tissues such as pain and numbness have decreased. Soft tissue thinning had historically been introduced to cope with soft tissue complications associated with soft tissue preservation. This underscores the need for a statistically powered randomized controlled trial (RCT) to confirm that this shift in practice is evidence-based and preferably also cost-effective. A trial was designed and seven European centres participated in evaluating soft tissue preservation with a Hydroxyapatite (HA)-coated abutment (test) in comparison to the usage of an all-titanium abutment with soft tissue thinning (control). Here, experiences from the coordinating centre are presented prior to quantifying the results.

Methods & Materials: Patients (30) recruited for the RCT in Maastricht were qualitatively evaluated. Half of them were
randomly allocated to the control or test group. Aspects which were assessed included the surgical procedure, cosmetic outcomes and complications. The stability of implants was measured using the Osstell ISQ (Osstell AB, Gothenburg, Sweden).

**Results:** Soft tissue preservation surgery was perceived to be shorter and easier to perform. It does require particular attention in positioning the implant in relation to the linear incision. The onset of dehiscence around the abutment in the incisional scar was a common finding in the control group. In this group baldness, indentation and scar formation around the abutment was often present. Inflammation in the test group had different characteristics such as skin swelling and exudate formation. Other observations included the clinical significance of ISQ measurements. Severely decreased ISQ measurements proved to be clinically associated with on manipulation loose implants. Two exemplary cases showed that both extrusion as re-osseointegration (with an ISQ rise) are possible outcomes during antibiotic therapy.

**Conclusion:** Clinically distinguishably outcomes were present in the two groups. In general, the experience with soft tissue preservation surgery and the HA-coated abutment was positive. The statistical analysis of all 106 patients in the multicentre RCT will be available in the summer of 2015.

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**Session X:**

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**LOUDNESS GROWTH IN BONE-ANCHORED HEARING**

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**Keywords:** bone-anchored hearing, loudness growth

**Purpose:** Patients with bone-anchored hearing devices often use device settings that provide too little amplification in relation to the sensorineural component of their hearing loss, i.e. to their boneconduction thresholds. In other words, many patients are underfitted relative to standard prescription rules like DSL or NAL. The cause of this underfitting is unknown. It may either be the long-term deprivation of sound, resulting in a reduced need for higher sound levels or an avoidance to high-level distortions due to the inherent limited output power of bone-anchored hearing devices. In the case of auditory deprivation an abnormal growth in loudness may be expected.

**Methods & Materials:** We will measure loudness growth in 20 patients at the frequencies 0.5, 1, 2, and 4 kHz with the ACALOS procedure of Brand and Hohmann (2002). Stimuli are delivered by a vibration transducer on an abutment (e.g. Ponto Plus Power, Baha Cordelle) that is directly driven by a D/A convertor and power amplifier. Both experienced and newly fitted patients with bone-anchored devices with boneconduction thresholds up to 45 dB HL will be included.

**Results:** Both measurement results and their implications will be presented at this meeting.

**Conclusion:** Both measurement results and their implications will be presented at this meeting.
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FITTING RANGES OF VARIOUS HEARING DEVICES FOR CONDUCTIVE HEARING LOSS
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Purpose: Both maximum power output (MPO) and gain are important device characteristics when fitting bone conduction devices and middle ear implants. The MPO is the highest output level a device can deliver without distortion, while gain refers to sound amplification. For example, a device with high gain and low MPO will provide much amplification for soft sounds, but it will distort loud sounds. Therefore, only measuring aided thresholds to determine device performance can be misleading. By analyzing MPO, gain and dynamic range we will define fitting ranges of the devices.

Methods & Materials: We measured the MPO and the patient's dynamic range provided by several bone conduction devices (MedEl Bonebridge, Oticon Ponto Plus Power on abutment, Cochlear BP110 on abutment and on the Attract magnet) and of a middle ear implant (Med-El Vibrant Soundbridge). To establish the MPO we measured the generation of sound by these devices in the ear canal of patients with mixed or conductive hearing loss (REM, Affinity, Interacoustics). We also performed loudness scaling tests and measured sound-field performance. Additionally, BP110 and Ponto Plus Power were measured on a skull simulator (SKS-10, Interacoustics). All test devices were programmed linearly with maximum gain settings without feedback. In addition, the microphone setting was omnidirectional and the feedback cancellation and noise reduction algorithms were turned off.

Results: We determined in each individual the functional gain of each device by subtracting the aided sound-field thresholds from the unaided bone conduction thresholds. The MPO is defined as the input level at output saturation plus the functional gain. The patient's dynamic range is defined as the aided threshold subtracted from the input level at output saturation.

Conclusion: We analyzed MPO, gain and dynamic range at seven frequencies (0.5, 0.75, 1, 1.5, 2, 3, 4 kHz). Based on these data we will define the fitting ranges of the devices.

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SUBJECTIVE AND OBJECTIVE OUTCOMES USING A POWER IMPLANTABLE PROSTHETIC DEVICE
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Keywords: bone-anchored, unilateral, asymmetrical

Purpose: Under the current FDA indications for bone anchored hearing systems (BAHS) for patients with unilateral sensorineural hearing loss (USNHL), the hearing in the good ear must be better than or equal to 20dB HL. However, in clinical practice, patients with mild to moderate hearing loss in the better ear do receive BAHS as part of their standard of care and they are known to benefit from using such a device (Bosman et al., 2013). The aim of the present study was to systematically investigate the benefit, handicap, and user satisfaction of a more powerful BAHS (i.e. Ponto Plus Power) in patients with single sided deafness where the better (contralateral) ear had varying degrees of sensorineural hearing loss.

Methods & Materials: This study was comprised of two groups of patients with USNHL where one ear was unaidable and the better hearing ear demonstrated some degree of hearing loss. All patients had been fit previously with a BAHS and were recruited from the Vanderbilt community. The first group of patients with asymmetric hearing loss had at least mild SNHL in the better hearing ear. The second group consisted of patients with unilateral or bilateral mixed hearing loss in the better hearing ear where bone conduction (BC) hearing threshold levels were at least 45 dBHL. Both groups of participants received a Ponto Plus Power device. All groups underwent free field speech in noise testing using the QuickSIN and AzBio. Speech stimuli were presented unaided and aided with both the patient’s current processor and Ponto Plus Power.
In addition, subjective performance measures, hearing handicap, and quality of life scales (Speech, Spatial and Qualities [SSQ] scale, Abbreviated Profile of Hearing Aid Benefit [APHAB], Satisfaction with Amplification in Daily Life [SADL], hearing handicap inventory for adults [HHIA] and Glasgow Benefit Inventory [GBI]. These instruments were administered during the patients first visit and then again following a one month acclimatization period with the Ponto Plus Power device in the participants’ daily living environment.

Results: Data collection is currently in progress. An overview of the findings between patient’s subjective and objective results will be presented.

Conclusion: Data collection is currently in progress

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**EVALUATION OF INCREASED OUTPUT AND GAIN IN BONE-ANCHORED HEARING DEVICES**

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Keywords: BAHD, speech intelligibility, audibility

**Purpose:** The output of bone anchored hearing devices is fairly low, though devices with higher output have entered the market. This laboratory based study was designed to primarily investigate the effect of different output and maximum gain on audibility and speech intelligibility in quiet using three bone anchored hearing devices with different outputs. The secondary purpose was to compare using the same device two different types of sound processor coupling (fitting on headband and directly via the abutment) to investigate the effect on audibility, speech intelligibility in quiet and sound quality ratings. The sound processors were optimally fitted on headband and abutment and therefore the auditory dynamic range varied in the two test conditions when fitted on headband and abutment.

**Methods & Materials:** In this study speech intelligibility in quiet using the Matrix and Triple Digits tests and aided threshold was measured in 20 patients with conductive or mixed hearing losses up to 40 dB HL (BC). All measurements were conducted in a randomized order for the four test conditions, three Ponto devices (Ponto Pro, Ponto Plus and Ponto Pro Power) fitted on abutment and Ponto Plus fitted on headband the subjects acted as their own control. The subjects were also blinded when the direct comparison of the Ponto Plus was made when fitted on abutment and headband.

**Results:** To be updated prior to meeting.

**Conclusion:** The measurement results of audibility, speech intelligibility and sound quality ratings for the three BAHD will be presented at this meeting.

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**EXPANDING THE INDICATIONS FOR THE BONE ANCHORED HEARING SYSTEM (BAHS)**

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**Purpose:** Evaluate the benefit of bone anchored hearing systems (BAHS) in patients with single sided deafness, and a mild to moderate contralateral sensorineural hearing loss

**Methods & Materials:** We retrospectively reviewed the audiological data of 102 patients with single-sided deafness, implanted with a bone anchored hearing system between January 2009 and January 2015. Patients were categorized into 3 groups depending on their hearing in the contralateral ear: Group 1 (n=39) had a bone conduction (BC) 4 frequency pure tone average (PTA) between 0dB and 20dB HL; Group 2 (n=43) had a BC PTA/4 between 21dB and 40dB HL, and Group
3 (n=20) had a BC PTA/4 between 41dB and 55dB HL. The PTA/4 was calculated as an average of bone conduction thresholds at 0.5, 1, 2 and 3 kHz. Speech perception testing was completed using CNC words and AzBio or HINT sentences, one month following fitting of the processor. Forty-two of the patients completed the quality of life surveys at least 6 months following their fitting, and included the Glasgow Benefit Inventory (GBI), Speech, Spatial and Qualities (SSQ) scale, and the Abbreviated Profile of Hearing Aid Benefit (APHAB).

**Results:** Preliminary findings reveal that all 3 groups of patients with SSD showed a significant improvement when compared with the unaided condition. When compared to group 1 (normal hearing in non-implanted ear), groups 2 and 3 did not score as high on word recognition and AzBio/HINT sentences, but both groups exhibited significant improvement in individual scores from an unaided condition. The GBI, SSQ, and APHAB results revealed that a majority of these patients reported improvement in their quality of life and would recommend the procedure to others. Detailed statistical analysis will be presented.

**Conclusion:** The Bone Anchored Hearing System is effective in the rehabilitation of patients with SSD and mild to moderate hearing loss in the only hearing ear with measurable audiological and quality of life benefits. Mild to moderate contralateral sensorineural hearing loss ought not be a contraindication to bone conduction implants in SSD patients.

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**COST-EFFECTIVENESS OF THE CROS AND BICROS HEARING AIDS**

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**(Purpose):** CROS aids are well recognised devices to support patients with single sided deafness. BiCROS aids are also useful in this context but deliver hearing input to the better hearing ear in addition. They are a favoured alternative to ACHAs when the unilateral loss is significant and a non-surgical alternative to BAHA.

The aim of this study was to perform a cost-utility analysis for CROS and BiCROS aids using the validated Health Utilities Index (HUI version 3,) in which hearing function is analysed as an independent component. This would then be used to determine QALYs and combined with cost data to generate a cost per QALY gained.

**(Methods & Materials):** All adult patients referred to Audiology for unilateral deafness were invited to take part. HUI3 questionnaires were completed based on their current hearing or hearing with aid and again 4 weeks later after the trial of the CROS or BICROS aid. The cost data was determined from aid hardware costs and service appointments with accessories. This was then combined with life expectancy data2 and HUI3 scores to yield a cost per QALY gained.

**(Results):** 8 patients had complete data and were therefore analysed. 75% were female. 63% had unilateral sensorineural hearing loss. The remainder had bilateral hearing loss of asymmetrical nature and trialled a BiCROS. 75% were not previously wearing any aid, the remainder were wearing an ACHA. The median range of hours of wear was 4-8 hours.

The mean initial HUI3 score was 0.582 and at 4 weeks was 0.664. The mean gain in health utility was 0.08. 63% of patients elected to continue with their CROS or BiCROS aid, 12.5% elected to undergo BAHA surgery, 12.5% continued with their previous ACHA and 12.5% continued with no aid.

Cost per QALY gained was calculated to be approximately £1000.

**(Conclusion):** Overall, patients provided with CROS aids found them beneficial and wore them for a reasonable period of time during the day, with a majority choosing to continue with their CROS or BiCROS. CROS and BiCROS aids are therefore an acceptable, non-surgical and cost-effective device for single sided deafness.
**Session XI:**

**59**

**CONNECT TO ATTRACT: TECHNIQUES AND PITFALLS**

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**Purpose:** The purpose of this presentation is to describe the techniques of switching a patient from a BAHA Connect to BAHA Attract system and present the surgical results, complications, and audiological outcomes.

**Methods & Materials:** We have switched 6 patients from the traditional Connect system to the Attract. The first patient was performed as a one stage procedure, the rest were staged. The abutment was removed in the office and the Attract procedure was then scheduled after the abutment site was healed over the implant. A new implant site was also chosen to prevent pressure injury and necrosis over the previous abutment site. Audiological evaluations with the Attract system were then compared to those done prior while the patients were using the Connect system.

**Results:** All 6 patients were successfully transferred from abutment to magnet. The first patient, done in one stage developed an ulceration over the implant site where the suture line for the closure of the abutment site broke down. The area eventually healed with local care, and the patient is using the Attract system successfully. There were no complications in the staged 5 other patients. The processor was fitted after 4-6 weeks postoperatively. The audiological evaluations confirmed the patients' reporting of poorer hearing results when compared to the Connect.

**Conclusion:** Patients who are having difficulties caring for their abutments and suffering recurrent skin infections can be safely switched to the Attract system in a staged procedure. They may require a stronger processor if they have a mild to moderate sensorineural hearing loss to compensate for the transcutaneous conduction of sound.

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**ACRYLIC EAR TEMPLATE TO DETERMINE OPTIMAL IMPLANT SITE**

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**Keywords:** BCHD, implant site, bone conducting

**Purpose:** The optimal site for a bone conducting hearing device (BCHD) has been described as a post-auricular point lying approximately 50-55 mm from the external auditory meatus. This point may vary, however, given the differences in anatomy from patient to patient and the selection of the most precise site for implantation remains a difficulty. Inappropriate site selection is one cause of negative outcomes, which can range from sub-optimal benefit from the implant to a poor cosmetic result and impracticality, post-operatively. We present our method to optimise the implant site placement.

**Methods & Materials:** All patients accepted for Bone Conducting Hearing device surgery have an acrylic template made of the auricle with an extension spanning over the post-auricular region. Patients bring any head-ware that they may use, e.g. hard hats, helmets, spectacles, to the prosthetics department. The optimal site is chosen with the head-ware in place.

**Results:** In over 200 patients there has not been a single case of difficulties with the site of implant due to impractical placement.

**Conclusion:** Our method of determining the implant placement site for BCHD is an ideal way to avoid impracticalities causing difficulties with head-ware, such as helmets, caused by the positioning of implant and processor.
BACTERIOLOGICAL EVALUATION OF THE ABUTMENT-SKIN INTERFACE OF BAHS

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Keywords: microbiology, skin-abutment interface, tissue preservation

Purpose: Bacterial adhesion to percutaneous implants in different host sites can develop into a symptomatic clinical infection, leading to long-term antimicrobial treatment or implant removal. The implant surface characteristics play an important role in relation to bacterial colonization, but the effect of micro-roughness in the promotion/inhibition of bacterial adhesion and biofilm formation in vivo is not well understood. Reducing bacterial attachment to surfaces may prevent future adverse reactions in these patients. A prospective controlled study has been designed with the primary objective of investigating the bacterial colonization, inflammatory response and skin reactions at the abutment-skin interface of two different topologies of abutments.

Methods & Materials: An in vivo human model has been developed combining different analytical techniques like bacterial culturing, gene expression and histology in order to evaluate the biological response of Ponto standard abutments with a machined surface and modified Ponto abutments with a polished surface (Oticon Medical AB, Sweden). The implantation was performed using a novel minimally invasive surgical technique (MIPS). The total viable bacteria (aerobic and anaerobic) present at three different compartments (abutment surface, peri-implant exudate and tissue) have been quantified by colony forming unit (CFU) counting. In addition, several genera of aerobic bacterial species have been quantified by means of selective culturing: staphylococci, enterococci, Pseudomonas aeruginosa and Escherichia coli.

Results: To date, a total of 6 patients have been implanted with a Ponto machined abutment. Tissue biopsies before implantation (baseline) showed no presence of aerobic bacteria, except in one patient where staphylococci were detected after enrichment. Anaerobic bacterial counts were in the range of 10^3-10^5 CFU/biopsy. One patient was negative for both aerobic and anaerobic growth from the retrieved tissue. Follow-up data on the bacterial colonization after 3 months implantation from tissue biopsies, paper points and abutments will be presented.

Conclusion: A technological platform has been developed, consisting of sampling techniques and analytical tools, enabling a correlative analysis of microbiota, gene expression and histology. The platform, performed in humans, allows spatial (abutment, peri-implant exudate and tissue) and temporal analyses of biological events around BAHS.
EARLY UK EXPERIENCE WITH THE NEW TRANSCUTAENOUS Baha Attract

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Purpose: It has been observed that much of the soft tissue problems in bone anchored hearing solutions are related to the percutaneous nature of the coupling of the device which requires lifelong aftercare. Hence tissue preservation and non skin penetration (transcutaneous) are felt to be the direction of travel. We report the early results with the BAHA Attract transcutaneous system.

Methods & Materials: This is a prospective longitudinal study of 35 consecutive cases of BAHA Attract surgery since September 2013. Perioperative data included indications, audiology, incision type, surgical technique, skin thickness, fixture, bone polishing and surgical time and postoperatively (at 1 week, 4 weeks and 3 months). Post operative data included audiological outcome measures, soft tissue status, pain and numbness.

Results: The 35 patients were a mix of adult and paediatric cases with a small minority transitioning from percutaneous to the transcutaneous device. Average age was 28 years (range 4 – 60). The commonest indications were conductive deafness and single sided sensorineural loss. 8 cases were performed under local anesthesia only. The incision in all cases was “C” shaped with the open limbs facing inferiorly. Average surgical time was 40 minutes. All received the 4mm fixture. Average skin thickness in the midpoint was 6.2mm for adults and 4mm for the paediatric patients but varied by 1mm at the anterior and posterior rim of the flap. There was minimal nursing care required post operatively as the wound healed neatly by 1 week without any hair loss and minimal numbness in the surrounding area. No wound complications were reported. Two reported some pain after a month but settled conservatively. None reported any swelling or skin tenderness. Majority were loaded with the processes in 6 weeks and the magnet strengths varied from 2 to 4 with average use of 6 hours per day.

Conclusion: The initial experience with the non skin penetrating BAHA Attract is positive with negligible post operative care and no complications or patient morbidity. The results are aesthetically pleasing and have high patient satisfaction due to absence of skin penetrating abutment, no bald patch and no aftercare. Longer term results would be needed.

UNDERSTANDING SKIN REACTIONS:
A CLINICAL STUDY ON OBJECTIVE OUTCOME MEASURES

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Keywords: Bone anchored hearing implant, Soft tissue reactions, Outcome measures

Purpose: Patients who have a bone anchored hearing implant (BCHI) are prone to complications such as inflammation, skin overgrowth, pain, loss of sensibility and implant extrusion. Although inflammation is common, little is known about its precise etiology, however it is presumed to be multifactorial. Inflammation may result from shear stresses of the skin around the abutment, an immune response to the implant and the persistent breach of the skin and thereby bacterial colonization. The role of each of these factors, their interactions and contributions to soft tissue reactions warrant further research. To gain insight in immune responses related to bone anchored implants and prepare a clinical trial pro-tocoi, a literature search was conducted to identify cytokines and chemokines involved in inflammation, bacterial infection, wound healing and foreign body reaction.

Methods & Materials: The study design is a prospective clinical trial including forty adult BCHI patients. Skin biopsies and bacterial swabs are collected prior to surgery, 3 months post-surgery and during soft tissue inflammation. Reverse transcriptase-PCR (Qiagen RNeasy Kit, Qiagen, Hilden, Germany) is used to evaluate cytokine expression of the
previously identified cytokines in skin biopsies. IS-pro (IS-Diagnostics, Amsterdam, The Netherlands), a PCR based profiling technique, is used to obtain the bacterial profile on the skin. Use of time-lapsed photography establishes the skin position after implantation and is assessed as well as the skin movement 3 months post-surgery.

Results: For better understanding of local immune responses in the skin, a set of cytokines was analyzed in skin biopsies. By gathering information on the bacterial flora present on the skin prior to implantation, after implantation and during soft tissue reaction, bacterial profiles present during several stages can be analyzed. Time lapsed photographs give an indication of the position of the skin around the abutment after implantation, compared to the pre-surgery position. Also, they give an indication of the shear stresses of the skin close to the implant. All the above described factors were included in the design of a randomized, controlled clinical trial, which is currently being performed.

Conclusion: Preliminary results will be available in March 2015.

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TULLAMORE TRIAD: SURGICAL EVOLUTION AND FIXTURE SITE SKIN REACTION RECLASSIFICATION
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Keywords: BAHA, Fixture-site, Skin-reactions

Purpose: We review the influence of the transition in soft tissue management from Soft Tissue Reduction (STR) to Linear Scalp Sparing (LSS) techniques and its impact on fixture site skin reactions (FSSR).

Methods & Materials: Our data incorporates a prospective review of 100 STR and 50 LSS cases with a post-op follow up duration >12. FSSR were recorded at 1, 3 and 6 month intervals post-op, and thereafter 6 monthly or as clinically required based on telephone triage or smart phone photography.

Results: Skin reaction classification was plotted against time and a pathophysiological sequence identified; it became evident that the Holger’s classification does not translate into current the FSSR experience. We have devised the ‘Tullamore triad’ system of classification to fulfil the clinico-pathological needs and derived a comparison matrix for cross reference with Holger’s classification. The Tullamore Triad classifies FSSRs as: T1 excoriation with moist / crusted flat granulation; T2 heaped granulation; T3 abutment overgrowth with stable skin. We found: H2-3/T1-2 reactions occurring at 2-3 months; H4 reactions occurring at 3-6 months; T3 stable soft tissue overgrowth at 12-36 months (not classified under Holger’s); Histological review of these reactions indicated differing pathological processes at play; the surgical evolution to soft tissue ‘scalp sparing’ techniques, facilitated by the development of abutments up to 12mm in length have obviated H4 reactions. T3 stable skin overgrowth is a function of abutment length and skin depth and requires inclusion in future skin reaction classification.

Conclusion: Our histological and clinical evidence allied to the surgical evolution supports the need for a revised classification for FSSR.
Purpose: In patients with conductive hearing loss caused by middle ear disorders or atresia of the ear canal, a Bonebridge implantation can improve hearing by providing vibratory input to the temporal bone. The expected results are improved puretone thresholds and speech recognition. In the European Union, approval of the Bonebridge implantation was recently extended to children. In situations relevant to daily life, hearing deficits were nearly completely restored with the Bonebridge implantation in both adults and children.

Methods & Materials: We evaluated the functional outcome of a Bonebridge implantation for eight adults and three children.

Results: We found significant improvement in the puretone thresholds, with improvement in the air-bone gap. Speech recognition after surgery was significantly higher than in the best-aided situation before surgery.

Conclusion: The Bonebridge significantly improved speech recognition in noisy environments and sound localization.

Purpose: The influence of conductive and mixed hearing losses in the pediatric population is well-documented; however, the lack of specific assessment and intervention guidelines can make the management of this population challenging. The aim of this presentation is to generate discussion on current practices in pediatric bone anchored devices from a global perspective. Case examples from the University of Miami Pediatric Bone Anchored Implant (UM PBAI) program will be provided.

Methods & Materials: The audiological profile of this population will be discussed, including air-conduction and bone-conduction threshold measurement procedures and speech recognition testing in quiet/noise. Additional assessments including a basic review of the child’s academic development, speech/language development, and consideration of other significant medical diagnoses will be identified.

Results: Outcome data including speech assessment results and other objective test results will be discussed through the use of individual clinical case studies. Special considerations regarding evaluation procedures and limitations in this population will also be discussed. Current research and outcome measures will be reviewed and compared to the UM PBAI program guidelines. Potential advantages and disadvantages of the use of bone conduction devices will be discussed.

Conclusion: Pediatric patients with conductive or mixed hearing loss receive significant benefit from the use of bone conduction devices. However, the audiometric profile can vary considerably among children with conductive or mixed hearing loss, making a uniform approach to treatment challenging. Additionally, children with conductive and mixed hearing loss are more likely to present with additional co-morbidities that may complicate or delay the intervention process. However, there are appropriate pediatric strategies available for maximizing intervention effectiveness and improving outcomes.
IOI-BAHA, THE PATIENTS' PERSPECTIVE

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Keywords: IOI-BAHA

Purpose: The International Outcome Inventory for hearing aids (IOI-HA) is a seven item questionnaire which was developed at an international workshop on hearing aid outcomes. The aim of the IOI-HA was as an adjunct to existing outcome assessment tools, enabling comparison across different centres for research purposes. In addition, the results provided a crucial subjective analysis of effectiveness from the patient's perspective. With the introduction of the bone anchored hearing aid (BAHA), the IOI-HA was modified to include an additional two validated questions, and called the IOI-BAHA. In Wrexham Maelor Hospital, BAHA operations are performed by a single Consultant surgeon, and patients are regularly followed up in Audiology where monitoring should include completion of an annual IOI-BAHA. This study aimed to assess the use of the IOI-BAHA in patient follow up, and to review patient reported outcomes.

Methods & Materials: Patients included in the study were adults who were operated on in Wrexham Maelor Hospital since February 1998, who were at least one year post-surgery. Data was collected retrospectively from the Auditbase software system.

Results: 93 patients met the inclusion criteria with a mean age at implantation of 54 years. Patients' scores ranged between 3.93 and 4.78 out of a possible maximum score of 5, with an overall annual IOI-BAHA completion rate of 76%. The longest follow up period was 12 years.

Conclusion: There is a need for a recognised standardised method for patient reported outcomes for BAHA. Overall, patients are satisfied with their BAHA, and results appear to be maintained over time, although the patient group size dips at 8 years post-implantation. Improved completion rates should be achieved; however, the IOI-BAHA is a useful tool in the management and monitoring of BAHA patients. Suggested future advances include the development of a more comprehensive database for prospective IOI-BAHA data, to include information on BAHA device, use of a contralateral HA, audiometry data, and the incidence of surgical complications.

TRANSCUTANEOUS AND PERCUTANEOUS BONE CONDUCTION INSTRUMENTS: COMPARISON OF AUDIOLOGICAL RESULTS

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Keywords: BAHA, Bonebridge, Bone conduction

Purpose: In conductional, mixed hearing losses and single-sided-deafness bone anchored hearing aids are well established treatments. The transcutaneous transmission across the intact skin avoids the percutaneous abutment of a bone anchored device avoiding the risk of infections and requires less care. In this study audiological results of the Bonebridge transcutaneous bone conduction instrument from MED-EL were compared to a generally used percutaneous device.

Methods & Materials: Ten patients from the ENT department at the Medical University Hannover, implanted between Aug. 2011 and Feb. 2014 with a transcutaneous hearing instrument, were audiologically analysed and compared with the results of ten matched patients, implanted with a percutaneous device, between Oct. 2002 and Nov. 2011. All patients fulfilled the audiological criteria for both devices (BC = 45 dB HL at 0.5, 1.0, 2.0, 4.0 kHz) and had at least 8 weeks of experience with the respective device. Patients with single-sided-deafness were excluded from the study. Tests included AC and BC thresholds with headphones and unaided and aided thresholds in sound field. The speech intelligibility was determined with speech from the front (S0) using the Freiburg monosyllable test and hearing in noise with the Oldenburg test.
Results: In comparison to unaided condition there was a significant improvement of aided threshold, word recognition score and speech reception threshold in noise for both devices. The comparison of the two devices revealed a minor but not significant difference in functional gain (Bonebridge: PTA=27.5 dB (mean); BAHA: PTA=26.3 dB (mean)). No significant difference between the two devices was found comparing the improvement in word recognition score for monosyllables and the speech reception thresholds, measured with the OLSA (Bonebridge: improvement WRS=80% (median), improvement SRT=6.5 dB SNR (median); BAHA: improvement WRS=77.5% (median), BAHA: improvement SRT=6.9 dB SNR (median)).

Conclusion: Our data shows that the transcutaneous bone conduction hearing instrument is an attractive alternative to bone anchored avoiding the transcutaneous abutment yielding equivalent results.

Case Presentation: We have selected the patients of the present study from 122 cases of single sided deafness (SSD) rehabilitated in our department with a Cochlear BAHA device from 2003 to 2012. Forty eight patients fulfilled the entry criteria: unilateral deafness (pure tone average >90 dB, SDS <20%) and normal hearing in the contralateral ear (pure tone average <20 dB, SDS >90%). The patients in this group were contacted by mail or by phone. Seven patients are non-users of the device (3 for aesthetic reasons, 2 for cutaneous problems and 2 for absence of benefit). Twenty one patients (mean age: 44 years, median age: 50 years, range: 15-64 years) accepted to come in our department for an evaluation. Etiologies were as follows: after acoustic neuroma excision (n=5), congenital (n=5), petrous bone fracture (n=3), sudden sensorineural hearing loss (n=2), ototoxicity (n=1), labyrinthitis (n=1), meningitis (n=1), after labyrinthectomy (n=1) and unknown reason (n=2). The unilateral deafness arose at a mean age of 28.4 years (median: 31 years, range: 0-56 years). The rehabilitation with the BAHA device took place at a mean age of 37.7 years (median: 43 years, range: 7-57 years). The follow-up time ranged from 1 year to 10 years with a mean of 6.4 years and a median of 8 years. The task used in this paper is a sound localization identification task. Seven loudspeakers were setup on a circular array at 30-degree intervals in our stereauditorium. The subject was seated such that his head was in the center of, and in the same plane as the array of loudspeakers at a distance of approximately 1.5 m from the listener. The subject was allowed to move his head. The BAHA settings were those used during usual day use. The stimulation consists of a 2 kHz narrow band sound with duration of 1 sec. The participants were asked to indicate the number of the speaker they thought the sound was coming from (3 random stimulations per speaker for a total of 21 stimulations). Among various localization measures, our main criterion of judgment was the RMS localization error which is calculated by averaging the squared deviations of each patient’s error (azimuth of the simulated position minus that of the identified location). The mean RMS localization error was initially estimated at 66° without any rehabilitation (for a chance level RMS estimated at 81° by Monte Carlo statistics). With the BAHA device at 1 month, the RMS localization error dropped not-significantly at 53°. However, a significant decrease at 27° was noted at the last follow-up evaluation. Our main hypothesis to explain this localization performance improvement is that the auditory system relearns to localize via adaptive plasticity. However, the learning effect of presenting additional azimuth-dependent spectral cues with the BAHA on to the good cochlea takes time. When the sound localization performance is studied, long term follow-up (> 2 years) should be considered.
SPEECH-IN-NOISE ABILITIES AND SOUND LOCALIZATION: OSSEONTEGRATED DEVICE OUTCOMES

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Keywords: speech-in-noise, localization, osseointegrated devices

Purpose: Difficulties hearing in noise and localizing sound sources remain two of the chief complaints of individuals living with single-sided (sensorineural) deafness (SSD). These two auditory phenomena are both known to rely heavily on binaural processing which likely accounts for the known relationship between these two processes in normal hearing populations. While people with SSD can opt for osseointegrated device (OI) implantation, these devices fail to restore the binaural processes that underlie both the ability to hear in noise and localize sounds. To date, research on OI device benefits has addressed these questions separately. Here, we measured hearing in noise and localization ability in SSD individuals to better understand the relationship between these two skills in a clinical population.

Methods & Materials: Adults with SSD who had been using an OI device for at least 6 months were recruited from Washington State to participate in both localization and hearing in noise tests. For localization, subjects sat in the center of an 8 loudspeaker surround array (R-Space) and indicated which speakers presented a sound. For the hearing in noise test (QuickSIN), subjects were asked to repeat speech presented from a loudspeaker directly in front of them (0 degrees azimuth) with the competing noise originating from speakers at a 90 degree angle directed to either the OI device or to the normal hearing ear.

Results: For hearing in noise, OI patients performed better when noise was presented to their OI device rather than their normal hearing ear (p < 0.01). While localization ability was noted to be a challenge for OI users, sound source localization performance correlated with speech-in-noise ability. Specifically, better sound localization skills were related to improved hearing in noise (p < 0.01).

Conclusion: OI patients capable of accurate sound source localization benefit also from better speech in noise perception despite subjective reports of difficulty with both. Future work is needed to determine whether hearing in noise and localization ability can be improved with a single auditory training regimen, suggesting domain general mechanisms to both, or whether focused, separate auditory interventions (domain specific) for localization and hearing in noise are required.
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BENEFITS OF HIGH-FREQUENCY AMPLIFICATION IN CHILDREN AND ADULTS

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Keywords: High-frequency, amplification, learning

Purpose: Hearing aid benefit is traditionally evaluated using speech perception measures which require the listener to repeat words presented in either a quiet or noisy listening environment. While this approach is useful for confirming hearing aid function, it is insufficient for predicting many of the challenges that the hearing aid user will continue to experience in a variety of communication settings. This purpose of this presentation is to review recent work examining the effects of hearing loss and hearing aids on listening and learning skills.

Methods & Materials: Tasks that varied in cognitive demand were administered to children and adults with permanent, mild to moderately severe hearing loss with and without amplification. Their performance was compared to that of children and adults with normal hearing. Tasks included: 1) a conventional word repetition test, 2) an auditory lexical decision and repetition task in which the listeners repeated each word presented and then judged the lexicality of the word (real or not real), 3) a non-word detection task requiring the listener to count the number of nonsense words embedded into short sentences, and 4) a word learning task in which listeners mapped nonsense words to nonsense images through a process of trial and error.

Results: The results revealed that, without amplification, performance for both groups decreased as the cognitive demands of the tasks increased. With amplification, performance improved significantly across tasks with decreasing benefit for more cognitively demanding tasks. Efforts to fine-tune the amplification by maximizing the audible bandwidth (from 4 to 10 kHz) resulted in significant benefits that increased with cognitive demand.

Conclusion: Overall, these results indicate that hearing aid benefit is dependent on the quality of the amplified signal provided to the user and that cognitively demanding tasks may reveal benefits of amplification that cannot be detected, or predicted, with conventional measures of speech perception.

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BCDS IN SSD: LONG-TERM USE AND SATISFACTION BY GENDER

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Purpose: Bone conduction devices (BCDs) attached to a bone-anchored hearing implant (BAHI), working as a transcranial CROS device, are a well-established rehabilitation option for patients with single-sided deafness (SSD). The current study examined the long-term satisfaction and possible effects of gender in patients with SSD who underwent BAHI surgery.

Methods & Materials: In the current retrospective case-control study all (n = 145) consecutive SSD patients fitted with a BAHI between January 2001 and October 2011 were asked to complete a questionnaire consisting of the abbreviated profile of hearing aid benefit (APHAB), the Communication Profile for the Hearing Impaired (CPHI), and the SSD questionnaire.
Results: Twenty-three of the 135 responding patients (17%) reported discontinuation of the device over an average follow-up time of 61.7 months. No significant differences were found in the degree of disability or coping between men and women, according to the APHAB and CPHI scores. Improvement in quality of life and appreciation of the BAHI were not affected by gender, age, directional hearing ability, and handling of the device. The appearance of the device positively affected their appreciation. Concerning the first 28 implanted patients at a mean follow-up of 117 months, 69% was still using their BAHI. In the domains background noise and listening in reverberant surroundings, the mean APHAB scores had deteriorated over time (at 3 months, 1 year and 10 years after implantation).

Conclusion: The current study examined the results of BAHI use in SSD patients over a relatively long follow-up period, with an average of 5 years. The majority of users (83%) were satisfied with the device. No significant gender differences were found in terms of reported appreciation, hearing disability or coping with a BAHI.

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LONG-TERM FOLLOW-UP ON BCDS IN CONGENITAL UNILATERAL CONDUCTIVE HEARING LOSS
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Keywords: unilateral conductive hearing loss, bone conduction

Purpose: Purpose: Patients with congenital unilateral conductive hearing loss (UCHL) can either be watchful monitored or treated surgically through the fitting of a percutaneous bone conduction device (BCD) or, in some cases, atresia repair. The current study evaluated the long-term compliance and satisfaction with a percutaneous BCD in this specific population.

Methods & Materials: Materials and methods: Fifty-three consecutive patients with congenital UCHL treated with a percutaneous BCD in our tertiary referral center between 1998 and 2012 were identified. Clinical and audiological data were retrospectively gathered from the patients’ files. The patients were interviewed by telephone about their current device usage status and were asked to complete the Speech, Spatial and Qualities of Hearing Scale (SSQ). In 20 patients that participated in a previous study, extensive data on binaural processing skills were available.

Results: Results: Compliance with the BCD was 56.6% after a mean follow-up of 7 years. The mean age at implantation of the users (22 years) was significantly higher than that of the non-users (10 years). The mean time of device usage before the patients stopped using the BCD was 5 years. The primary reasons mentioned for quitting the BCD were experiencing excess background noise and/or subjectively not receiving enough benefit. Objectively measured features of binaural processing affected by the BCD were found to correlate with long-term BCD usage. The SSQ revealed significant improvement in the aided condition compared to the non-aided condition in the users, in contrast to the non-users.

Conclusion: Conclusion: The current disappointing long-term compliance figures indicate the need for an even more careful and individualized approach with life-long follow-up when fitting BCDS in this specific population, especially in children.
BAHS FITTING PRACTICES IN PEDIATRICS: 
SURVEY RESULTS FROM AUDIOLOGISTS

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Keywords: selection, assessment, validation

Purpose: With the implementation of early hearing detection and intervention (EHDI) programs, infants with permanent hearing loss are being identified and managed during the critical period for speech and language learning. As part of intervention, many families choose to pursue personal hearing aids to support their child’s development. The evolution and availability of evidence-based protocols for fitting air conduction hearing aids to children offers a vital resource for pediatric audiologists (e.g., American Academy of Audiology, 2013; Bagatto et al, 2010). Optimal air conduction hearing aid fittings have resulted in positive outcomes for children involved in EHDI programs (e.g., Bagatto et al, 2011; Sininger et al, 2010). For some children, air conduction hearing aids are not appropriate due to anatomical abnormalities, active middle ear disease or single sided deafness and a bone conduction hearing device is required. Unfortunately, fitting protocols for bone conduction devices for children are not as well-developed leaving clinicians feeling uncertain about management practices. This work aims to understand current practices of clinicians who fit bone conduction hearing devices to children.

Methods & Materials: An online survey was distributed to over 300 pediatric audiologists in North America to gather information regarding their activities related to the selection, fitting, verification, validation and follow-up of their pediatric patients who are candidates for bone conduction hearing devices. Information about the clinicians’ work setting, clinical equipment and measurements used to evaluate the devices was also addressed.

Results: During the presentation, the findings of the survey and their potential impact on clinical practice will be explained.

Conclusion: Data obtained from this work could be used to inspire and inform a foundation with which to develop standardized pediatric fitting protocols for bone conduction hearing devices than what is currently available. This will provide pediatric audiologists who fit these devices the support they need to confidently manage this unique clinical population.

BONE ANCHORED DEVICES:
MANAGEMENT OF CHILDREN WITH SINGLE SIDED DEAFNESS

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Keywords: pediatric, single sided deafness

Purpose: Considerable challenges exist in the evaluation and management of single-sided deafness (SSD) in the pediatric population. While long established evidence exists demonstrating the negative impact of unilateral hearing loss on speech and language development as well as academic performance, intervention is often delayed or overlooked in those children with unilateral hearing loss. This presentation will address the current management of children with SSD and discuss the protocols in place at the University of Miami Ear Institute pediatric SSD clinic. Case studies will be reviewed in this presentation in order to demonstrate the need and limitations of such testing in the pediatric SSD population.

Methods & Materials: A definitive protocol for evaluating pediatrics with SSD is not well defined and today’s intervention options have several limitations. There are several challenges to ensuring that all children with SSD are receiving timely intervention services and that parents are aware of the possible difficulties that these children may have as they develop. An evidence-based and verified protocol was created in the adult SSD clinic at UMEI. This published protocol has been taken and modified for the pediatric SSD population discussed in this presentation. Evaluations included comprehensive hearing evaluations, speech in noise testing, subjective questionnaires, comprehensive speech and language
examinations, and basic review of academic performance.

**Results:** Outcome data including objective and subjective evaluations with be presented. Case studies will be discussed and will include information about the child’s speech and language development, parent reported outcomes, and speech and noise testing post intervention. Special consideration regarding evaluation procedures and limitation in this population will also be discussed.

**Conclusion:** Bone anchored hearing devices provide a means for early intervention for infants and young children with SSD who might otherwise would be subject to delays in intervention. In addition, a goal of this presentation is to generate discussion on current practices in bone anchored devices from a global perspective for children with SSD and how we can focus our research efforts to ensure these children are managed properly.

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**FIRST RCT OF A NOVEL MINIMALLY INVASIVE BCHI SURGICAL TECHNIQUE**

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**Keywords:** Bone conduction hearing implant, MIPS surgery, Minimally invasive

**Purpose:** Soft tissue reduction surgery in bone conduction hearing implants (BCHI) is being abandoned after promising results from several investigators with soft tissue preservation surgery. The current advocated soft-tissue preservation technique as pioneered by Hultcrantz has shown to be beneficial in terms of peri-implant infection rate, loss of sensibility and aesthetics. These outcomes could further be improved by alleviating the need for a linear incision. Currently, surgeons in the field are already experimenting with punch-only surgical techniques. However there are substantial drawbacks relating to insufficient cooling, soft tissue damage and surgical control to consider. A new standardized surgical technique for Ponto placement (Oticon Medical AB, Askim, Sweden), the minimally invasive Ponto surgery (MIPS) technique, aims to address these drawbacks and minimize soft-tissue trauma by using a novel surgical instrumentation kit. This study reports preliminary findings from the first multi-center, randomized, controlled clinical trial of this novel technique.

**Methods & Materials:** For MIPS surgery, skin-thickness is measured and the appropriate abutment-length is determined. After local anesthesia, a hole is punched, in which the MIPS cannula is inserted and filled with saline. The drilling procedure is performed via the cannula with specially designed guide and widening drills. The cannula is removed and the implant is placed. A qualitative analysis is performed of 10 patients during their clinical follow-up after MIPS surgery. Aspects assessed are intra-operative complications and surgical procedure time as well as post-operative complications including wound healing, inflammation, presence of dehiscence after surgery, loss of sensibility, pain, soft tissue overgrowth, extrusion rate, and the aesthetic result.

**Results:** The MIPS technique is a clear, simple and fast procedure which is easy to learn. The modified surgical instruments ensure irrigation and aid in stanching bleedings of the skin during surgery. There is no need for sutures and therefore no incisional scar, resulting in favorable cosmetic results. Surgery times are further improved

**Conclusion:** Based upon the qualitative analysis, the technique has been finalized and is now under a formal evaluation in a multicenter Randomized Controlled Trial.
COST-EFFECTIVENESS OF THE BONE CONDUCTION HEARING AID AND BAHA

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Keywords: BAHA, QALY

Purpose: The bone conduction hearing aid (BCHA) is a well recognised device to support patients with conductive or mixed hearing loss and where air conduction hearing aids (ACHA) may not be suitable. They are often trialled prior to the insertion of a BAHA to gauge the hearing gain they might expect following the procedure. To perform a cost-utility analysis for BCHAs using the validated Health Utilities Index (HUI version 3), in which hearing function constitutes an independent component. This is then used to determine QALYs and combined with cost data to generate a cost per QALY gained.

Methods & Materials: All adult patients referred for a BCHA trial prior to considering BAHA insertion were invited to take part. HUI3 questionnaires were completed based on their current hearing aid (if used) and again 4 weeks later after the trial of the BCHA. The cost data was determined from hardware costs and appointments with accessories. This was then combined with life expectancy data and HUI3 scores to yield a cost per QALY gained.

Results: Complete data was available for 69 patients, of which 49% were male. 48% had unilateral or bilateral mixed hearing loss and 24% had unilateral or bilateral conductive loss. 45% of patients were not wearing or were unable to wear an ACHA and 55% were wearing an aid. The median number of hours of wear was 1-4. The mean baseline HUI3 score was 0.56 and after 4 weeks was 0.63. The mean gain per patient in health utility was 0.071 (p=0.01). After the trial, only one patient elected to continue with a BCHA. Cost per QALY was estimated to be less than £1000, however further analysis of the data is underway and will be presented. This data will also allow for estimation of BAHA cost-effectiveness.

Conclusion: This study shows that a majority of patients were wearing BCHAs for conductive or mixed hearing losses, but were only wearing them for a small proportion of the day, possibly due to comfort levels. Overall improvement in health utility was demonstrated which translated into a cost-effective option for these patients, although in practice an unpopular one.

AN ANALYSIS OF THE CODACS™ DIRECT AND BONE CONDUCTION THRESHOLDS

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Keywords: Direct Acoustic Cochlear Implant, Codacs, bone conduction

Purpose: The Cochlear™ Codacs™ direct acoustic cochlear implant (DACI) is a new treatment option for patients with severe to profound mixed hearing loss. It stimulates the cochlea directly via an implanted actuator which is connected to a conventional stapes prosthesis. The results obtained with the Codacs system show stable bone conduction thresholds and a significant benefit in speech discrimination in quiet and in noise post-operatively. To fit the Codacs sound processor to the patient’s hearing loss, stimuli from the implant are used to assess the patient’s hearing thresholds, which are referred to as Codacs Direct Thresholds (CDT). It was hypothesized that these thresholds would be in line with the patient’s bone conduction thresholds (BCT), but a significant discrepancy between both threshold values was reported. The aim of this investigation was to quantify and analyze the difference between the BCT and the CDT based on a large set of data from the different implanting centers. The ultimate goal is to understand and to develop a model that will provide a better match between the two thresholds.

Methods & Materials: The Codacs system has been used in several clinical trials and commercially, since obtaining CE mark in 2013. The data from all global implanting centers was compiled and analyzed. For this research question the focus was on the CDT and BCT data.

Results: The Codacs Direct Thresholds differ significantly from the bone conduction thresholds in all measured frequencies (0.25 – 4 kHz). The differences are highest in the low frequencies and lowest in the high frequencies.

Conclusion: The presentation of the CDT is in dB HL, a physical unit familiar for audiologists and otologists, and certain assumptions were made and average data was used as a reference. These values have to be re-evaluated to ensure a better match between the BCT and CDT. The data and first interpretations will be discussed.

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A NEW MINIMAL INVASIVE PERCUTANEOUS SURGERY, MIPS, FOR OSSEOINTEGRATED HEARING DEVICES

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Keywords: MIPS, osseointegrated surgery, abutment surface

Purpose: To investigate skin reaction around 2 different abutment surfaces, one original and one polished, after a new minimal invasive percutaneous surgery (MIPS) for osseointegrated hearing devices.

Methods & Materials: Seven patients in each group were followed up to 6 months after implantation according to the new minimal invasive surgical procedure (MIPS) with 2 different abutment surfaces (Oticon Medical).

Results: The new surgical procedure is quick, safe and easy to perform but require new surgical tools. The surgery takes today 5-10 minutes to perform and is done in local anesthesia which can help also older and more severely affected patients. They can also be sent home almost directly after surgery. Postoperative pain is reduced and healing is quick with no numbness of the skin. The 2 different surfaces of the abutments did not change the postoperative healing period.

Conclusion: MIPS is easy to perform and new tools for the surgery has been developed. There seem to be no difference in healing time depending on what surface of the abutment has been used. Skin reactions will be discussed.
THE HYDROXYAPATITE COATED ABUTMENT INTEGRATES WITH THE SURROUNDING SKIN

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Keywords: hydroxyapatite coating, abutment, skin integration

Purpose: Percutaneous implants such as bone conduction hearing implants suffer from complications which include inflammation of the surrounding skin. Recently, a hydroxyapatite (HA) coated abutment was introduced. It was hypothesized that the hydroxyapatite coating should enable integration with the adjacent skin when used in combination with soft tissue preservation surgery. Research has shown that such integration is not achieved with titanium, which is the abutment material used since the origin of bone conduction hearing implants. In comparison, a sealed skin-abutment interface should prevent bacterial colonization and reduce peri-abutment dermatitis. Until now, only evidence from animal research or research in related fields was available to support the primary theory. Here we investigate, in vivo, if skin integration is possible in patients using a HA-coated abutment.

Methods & Materials: One titanium abutment and one HA-coated abutment together with the surrounding skin were surgically retrieved from two patients who had a medical indication for this procedure. The abutments and surrounding tissue were directly fixated and processed for analysis. Histological sections of the skin were investigated using light microscopy. The abutment was qualitatively analysed using scanning electron microscopy (SEM).

Results: The titanium abutment only had a partial and thin layer of attached amorphous biological material which seemed to be mainly constituted of a combination of proteins, sebum, keratin, biofilm and unorganized non-viable skin cells. The HA-coated abutment was almost fully covered by a pronounced thick layer of skin which seemed to be organized and composed out of different interconnected structural layers.

Conclusion: These results show that the HA-coated abutment, in contrast to the titanium abutment, can integrate with the surrounding skin. A follow up study using two photon microscopy has started to elucidate how the skin adheres to the abutment.

INTERNATIONAL MULTICENTER CLINICAL INVESTIGATION OF A MAGNETIC BONE CONDUCTION SYSTEM

Cochlear Bone Anchored Solutions AB
Research
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Keywords: bone conduction, Attract, magnetic connection

Purpose: A new magnetic bone conduction implant that relies on transcutaneous transmission of sound has been developed. The implant relies on the proven principles of osseointegration to obtain a stable foundation for the implanted magnet. The external magnet uses new technology to evenly distribute the pressure on the skin in order to minimise pressure-related complications. A multi-centre clinical investigation was undertaken to evaluate the safety and efficacy of the device.

Methods & Materials: The test device was the Cochlear™ Baha® Attract System (Cochlear Bone Anchored Solutions AB,
Mölndal, Sweden). Instead of the skin-penetrating abutment of traditional bone conduction implants, the test device uses an implantable and an external magnet to transmit sound from the sound processor through intact skin to the skull bone. Twenty-seven adult patients with a conductive or mild mixed hearing loss or single-sided sensorineural deafness were included in the clinical investigation across four investigational sites. The patients were followed for 9 months post-implantation. The study evaluated efficacy in terms of hearing performance compared to unaided hearing and to hearing with the sound processor on a softband. Patient benefit, soft tissue status, device retention and safety parameters were monitored continuously throughout the investigation.

**Results:** Surgery and healing was uneventful. After 9 months of follow-up, statistically significant improvements in speech understanding in noise were recorded for the test device compared to unaided hearing (p<0.0001) and compared to results with the sound processor on a Softband (p=0.01). Speech tests in quiet showed statistically significant improvements with the test device compared to unaided hearing (p<0.0001), and similar results as with the sound processor on a Softband. The reported average daily usage time was 7 hours/day. Good soft tissue outcomes were reported, without major pressure-related complications; only two cases of mild redness were recorded which resolved without medical treatment. At 9 months, all patients continued to use and benefit from the device.

**Conclusion:** The Baha Attract System provides good hearing performance in subjects with a conductive hearing loss or single-sided sensorineural deafness, with good wearing comfort and minimal soft tissue complications.

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**BAHA SURGERY WITHOUT SOFT-TISSUE REDUCTION (WoSR) - FIVE YEAR RESULTS**

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**Keywords:** Soft-tissue, Preservation, WoSR

**Purpose:** Soft tissue preservation techniques in BAHA surgery have gained in popularity over the last few years, this decreasing operating time and patient morbidity. We, from Torbay, UK, present five year results of our technique without soft tissue reduction (WoSR), in adult patients.

**Methods & Materials:** All patients undergoing surgery were operated by a single surgeon, using the same technique, which involved using a 6mm skin punch and a small vertical incision running through, for access. Bone work was performed in the traditional way, and all patients had a 4mm fixture on one of the longer abutment (8.5, 9 or 12mm) inserted. Sutures were removed in one week and the aid loaded at six weeks. All patients are followed up at weeks 1, 2, 12 and then, 6 monthly thereafter.

**Results:** We discuss the pros and cons of this technique, at various stages from indications, the surgical procedure, postoperative period, loading, patient feedback and lessons learnt along the way, over the last 5 years. This involved 45 patients, 43 of whom use their bone anchored hearing aids regularly. Six patients had soft tissue inflammation, with three of them needing soft tissue reduction.

**Conclusion:** In our experience, this technique results in a significant reduction in operating time, decreased patient morbidity, a generally uneventful postoperative period with consistently good results so far. Meticulous attention to detail is still needed to obtain good and consistent outcomes and long term follow up essential.
Invited Speaker

GROWING UP WITH BONE CONDUCTION. LESSONS LEARNED, LOOSE ENDS AND LOTS MORE QUESTIONS THAN ANSWERS

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The evolution of bone conduction hearing devices presents a relatively contemporary story. Most of the audience here today will share my sense of amazement when pondering the considerable changes that have occurred in this field over the past two decades, be they surgeons, nurses, audiologists, engineers, product developers or sales personnel from industry. In this short talk I would like to reflect on areas where personal observations and, in a few cases, evidence-based experience have lead to a change in my practice.

I will consider observations regarding skin and soft-tissue handling, the role that bone conduction devices might reasonably play in the rehabilitation of single-sided deafness, the contentious issue of ‘bone curve preservation’ as a mantra to guide all otologic surgery. The arrival of transcutaneous devices has been widely anticipated and much welcomed. I would like to present some lessons learned from headband testing with the Bonebridge device and also our experience of placing this device with some latitude in the temporal bone to accommodate individual topography. In closing I salute the multidisciplinary team which has been enshrined in the philosophy of the OSSEO meetings since we first got together in Halifax, Nova Scotia 2007. It is a pleasure to see so many teams attending en masse and I look forward to catching up with you again, down the line.

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TRIBUTE TO PROFESSOR PER-INGVAR BRANEMARK
1929-2014

Anders Tjellström, M.D., Ph.D., D.Sc.hc

Professor Brånemark grew up in southern Sweden and got his medical training in Lund. In 1959 he defended his Ph.D. thesis on the microcirculation in bone tissue. In 1960 he moved to Göteborg and soon became one of the leading scientists at our University. He guided more than 40 Ph.D. students to their dissertation and he was honorary doctor at 28 universities.

He introduced the concept of osseointegration. In 1965 after extensive animal studies the first edentulous patient got titanium implants in the jaws for bone anchored dentures. This is today the golden standard. Brånemark tried to find an acoustic way to evaluate implant stability. This became one of the starting points for hearing through direct bone conduction – the basis for our meeting here in Lake Louise.

Through Brånemark’s interdisciplinary web Bo Håkansson at Chalmers University of Technology was recruited and became a key person in close cooperation with the ENT-Department. The first prototypes of the BĀHA were made and tested on patients in 1977.

Brånemark’s concept of osseointegration has also been used for retention of facial prostheses and he took an eager interest in patients with facial defects. His bedside manner with these patients was extraordinary. Those of us who had the fortune to have Per-Ingvar Brånemark as our mentor will miss his creativity and enthusiasm but also a good friend.
THE BONE CONDUCTION IMPLANT - TECHNICAL DEVELOPMENT AND BRIEF RESULTS

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Keywords: Bone Conduction Implant, BAHA

Purpose: Today the bone-anchored hearing aid (BAHA) has been successfully developed and is used by more than 150,000 patients worldwide. Beside the BAHA system, some other applications have been developed by our research group including communication headsets, audiometric bone conductors and a transcutaneous Bone Conduction Implant (BCI). The BCI shown by enclosed figure is a recent and promising development of the BAHA where the skin can be kept intact by implanting the transducer under the skin and transmitting the sound wirelessly. The purpose with this presentation is to present the technical development of the BCI and to discuss some of the results obtained in an on-going clinical study.

Methods & Materials: The technical development of the BCI started for more than 15 years ago and today we have ended up in a solution where a miniaturized implantable unit, called the Bridging Bone Conductor (BBC), uses a flat surface attachment to the bottom plane of a recess in the temporal bone. A versatile external audio processor that uses an amplitude modulated signal to drive the passive electromagnetic link has been developed. The implanted transducer is of balanced electromagnetic type and has a high frequency boost in range of 3-6 kHz. Extensive pre-clinical studies have been made on Skullsimulator, dry skull, cadavers and on normal hearing subjects. Finally, the BCI system was approved for a clinical study where the first 6 patients have been followed for an accumulated time of 10 years (range of 18-30 months on an individual level).

Results: The positive results found in the pre-clinical studies of the BCI are confirmed by the clinical results in the on-going clinical study on real patients. It was also verified on these first patients that the BBC was easy to install with a safe and uncomplicated surgery and that the full BCI system is comfortable to use in the daily life.

Conclusion: The BCI system is effective for the treatment of indicated patients with conductive or mixed hearing loss and can be a competitive alternative to other solutions.
AURONET: IMPROVING PATIENT-CENTERED OUTCOMES IN BONE CONDUCTION HEARING IMPLANTS

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Background: The outcome measures used to report results of bone conduction hearing implants (BCHI) vary widely and are often clinician rather than patient-centered.

Objectives: To develop patient-centered outcome measures that can be used both to audit individual practices and as a standard of reporting in clinical trials.

Methods: AURONet was formed as an international group of clinicians interested in improving the outcomes of patients with BCHI. Utilizing a model developed in rheumatology, the group assessed outcome measures in the literature and established the key domains for development.

Results: The core areas identified were audiological outcomes and quality of life, in order to determine the physical, psychosocial and economic effects on BCHI on patients.

Conclusions: AURONet has developed a framework to systematically review and assess patient-centered outcomes in BCHI. These will be reported over the next few years.
Poster Presentation Abstracts
Poster # 1

UNILATERAL PLUGGED LISTENERS LOCALIZE SOUNDS WITH A B-71 BONE-CONDUCTOR

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Keywords: sound localization, bone-conduction

Purpose: The aim of the present study is to investigate whether it is possible to localize sounds while listening with a unilaterally applied bone-conduction device (BCD). Sound localization is deteriorated in listeners with unilateral conductive hearing loss (UCHL). Directional hearing in patients with UCHL can be improved with a BCD. However, it remains unclear whether these aided listeners are able to process ILDs and ITDs. Processing time delays in the BCDs and cross hearing (referring to the additional stimulation of the cochlea contralateral to the BCD) might affect their localization abilities. In the present study the ability to localize sounds while listening with a B81 bone-conductor is tested in unilaterally plugged normal hearing control listeners.

Methods & Materials: UCHL is mimicked by plugging one ear of normal hearing listeners (thresholds 0.125 – 8 kHz <20 dB HL). Narrow band 1 KHz noises are presented in free field in a completely dark, sound-attenuated room. At the plugged side the arrival time of the stimuli is recorded. During the localization experiment double stimuli are presented in free field and with the B81 bone conductor positioned at the plugged side. Listeners point with a head-fixed laser in the perceived sound direction. Head-movements are recorded with the magnetic search coil induced technique.

Results: Preliminary results of the localization abilities of unilaterally plugged listeners are presented.

Conclusion: Our data indicate that adjustment of the sound levels provided with the BCD highly effect the sound localization abilities. Furthermore we present how additional delays of the stimuli presented through the B81 bone-conductor effect the sound localization abilities.

Poster # 2

SOPHONO OUTCOMES ON THE BIRMINGHAM ADULT IMPLANT PROGRAM

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Purpose: Bone anchored hearing implants (BAHI) have been used for audiological rehabilitation for over 30 years. The traditional percutaneous device can be associated with skin problems and can be cosmetically unappealing. The SophonoTM is a passive transcutaneous device that provides an intact skin solution and thus is thought to reduce any skin related complications. Our aim was to report patient experience with SophonoTM on the adult BAHI program at the Queen Elizabeth Hospital Birmingham.

Methods & Materials: All patients that underwent implantation with the SophonoTM device were identified from a departmental database. A retrospective analysis of case notes was carried out. Outcome measures included demographic data, complications, patient satisfaction and usage.

Results: 13 devices were implanted in 12 patients. The mean age was 35 years with a range of 19-70 years. 42% of patients were female (5 female and 7 male). The minimum follow up period was 2 years with a range of 2 to 3.5 years. No major intra-operative complications occurred. 33% (4) of patients had post operative complications documented including 2 local abscesses and 1 superficial wound infection. 8.3% (1) of patients required a long screw intra-operatively. 25% (3) of
patients reported difficulties with the SophonoTM aid ranging from discomfort around the scar and problems with background noise. 16% (2) patients have gone on to have the device explanted.

**Conclusion:** Transcutaneous devices such as the SophonoTM, provide an alternative to more commonly used percutaneous bone anchored hearing aids, however the patients must be very carefully selected and counselled in order to manage patient expectations. References: 1) Bone Conduction Hearing Devices By SophonoTM http://sophono.com/Acessed 15/01/15.

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**Poster # 3**

**EVALUATING THE EFFICACY OF THE ADJOIN PLASTER**

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Nijmegen, Netherlands

**Keywords:** Adjoin, soft band, bone-anchored hearing

**Purpose:** Recently, the Adjoin plaster was introduced as an alternative to headband or soft band when testing bone-anchored hearing devices. In essence, the Adjoin is a medical grade plaster with an integrated plastic connector for a mechanical coupling of a sound processor, and the version we used allowed for a connection of a Ponto sound processor from Oticon Medical. The Adjoin may prove valuable in adults for short-time trials with a bone-anchored hearing device and in children as an alternative to the soft band.

**Methods & Materials:** Sound transmission with the Adjoin, headband and soft band will be evaluated in 10 normal-hearing adults. The Adjoin will also be tested with 20 adult candidates applying for a bone-anchored device. Data on subjective appraisal of both wearing comfort and real-life speech perception will be collected both for the Adjoin and headband.

**Results:** Preliminary results in normal-hearing adults show that sound transmission with the Adjoin and the soft band are quite similar. Preliminary patient data show favorable results on wearing comfort and cosmetics for the Adjoin over the headband, at the cost of (some) poorer speech perception with the Adjoin relative to the headband.

**Conclusion:** As the pressure on the skin with a headband is higher than with a soft band, speech perception with an Adjoin may be comparable to that of a soft band. In that case the Adjoin with its better cosmetic appearance may indeed be a viable alternative to a soft band.

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**Poster # 4**

**BAHA ATTRACT IN SSD PATIENTS – SURGICAL AND AUDIOLOGICAL RESULTS**

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**Keywords:** Baha Attract, Single-sided deafness

**Purpose:** Since September 2010, 23 patients with single-sided deafness (SSD) have been implanted with the Baha (bone anchored hearing aid) system. During the year 2014 the last generation of Baha – Attract – was used with four patients. Prior the surgery they had tested Baha with the softband for at least one week. After the surgery, surgical complexity and audiological results were compared with the Dermalock generation.
Methods & Materials: Surgical patients' data, duration of the procedure, necessity to polish the bone or skin reactions were collected and compared between the Attract and Dermalock groups. Patients underwent testing of speech comprehension without Baha, 6 weeks and 12 month after the Baha setting (Attract group only 6 weeks). Score of understanding of sentences in the noise background was calculated in three different situations: 1) SnhNssd - signal from the normal hearing side, noise from the deaf side, 2) S0N0 - signal and noise from the front, 3) SssdNnh - signal from the deaf side, noise from the normal hearing side.

Results: During the surgery of Baha Attract we didn’t have any complication, the duration of the procedure was significantly longer than the Dermalock surgery (43 min, SD = 12; resp. 28 min, SD = 8; p=0.02). The main reason for prolongation of the Attract surgery was necessity to polish the bone under the implanted magnet, which happened in three out of four cases. There was no skin reaction during the six month long follow-up. The external magnet caused no skin irritation. Statistically, the most significant difference was in SssdNnh condition where patients reached improvement for 65dB:70dB configuration after 6 weeks (Dermalock p<0.0001; Attract p=0.04).

Conclusion: We can conclude that Baha Attract is excellent solution for SSD patient, especially for non-tumoric etiology of SSD. Our data proved no surgical complications and no skin reaction after the Attract surgery and statistically significant improvement of a speech comprehension in a background noise. Acknowledgments: The research was supported by IGA MZ CR (grant No. NT/11543-6).

Poster # 5

REVIEW OF ATTRACT IMPLANTATION AT ONE YEAR

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Purpose:
Freeman hospital is a tertiary referral centre for BAHA in the northeast of England and commenced ATTRACT surgery in January 2014. This review aims to present the surgical and audiometric outcomes of the Attract system with Twelve months of follow up.

Methods & Materials: Twelve patients have undergone Attract surgery, the male to female ratio is one to one. The age range is 12-61 years with a mean of 40.9 years. All patients were within the manufacture's defined audiometric criteria for the ATTRACT. Two patients were Dermalock transcutaneous BAHA wearers, and wished to convert to the percutaneous system, this was mainly because of inflammation around the abutment site, and occupational considerations. One patient suffered from Klippel-feil syndrome. Patients all had a trial pre-operatively, with a processor on a soft band. All patients underwent surgery as a day case, and were reviewed at six days post operation. The fitting of the magnet was performed at a minimum of four weeks.

Results: No immediate surgical complications were noted. Half the patients were fitted with the processor and magnet at four weeks. The klippel-Feil patient had a delay fitting, up to two months because of the edema and lack of contact with the magnet. The two patients undergoing the conversion from the transcutaneous to the percutaneous system also required delayed fitting, this was to allow the soft tissue to settle. Half of the patients experienced a reduction in magnet strength; this was during the three to four months following surgery.

Conclusion: Two thirds of the patients required the use of the BP110 processor, the remaining third used the BP100 despite being within the defined recommendations. The patient view was that having undergone conversion from the Dermalock, to the ATTRACT, liked the clarity and definition, but noticed a decline in a background noise. The trial on a soft band gave the most accurate prediction of the audiological outcome and prediction of processor required.
**Poster # 6**

**PONTO SYSTEM: CLINICAL RESULTS WITH TISSUE PRESERVATION**
**GRUPPO OTOLOGICO EXPERIENCE**

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**Purpose:** To evaluate the clinical results using the new technique with tissue preservation for Ponto surgery.

**Methods & Materials:** From January 2013 till now 50 patients have been operated on using the new surgical technique with tissue preservation. The inclusion criteria for the study were patients eligible for treatment with bone ancored hearing aid and aged 18 years or more. The exclusion criteria were skin disease in the surgical area and inability to participate to the follow-up.

**Results:** We have not recorded any major complication. We don’t perform any revision surgery or implant loss.

**Conclusion:** The clinical results showed that this surgical technique is less invasive and faster. It reduces the hair loss around the abutment and accelerates the wound healing.

**Poster # 7**

**COCHLEAR INPUT SIGNAL WITH BILATERAL STIMULATION OF BONE-CONDUCTION IMPLANTS**

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**Keywords:** intracochlear pressures, bone-conduction implant

**Purpose:** Bone-conduction implants (BCI) utilize bone conduction to deliver sound directly to the inner ear, and can be used to treat conductive/mixed hearing loss and single-sided deafness (SSD). Current BCIs utilize an osseointegrated titanium implant with a sound processor either directly connected to a skin-penetrating abutment (DCBCI) or stimulated transcutaneously with magnets (TCBCI). However, it is unclear how the intervening soft tissue affects the transfer of sound from the processor to the osseointegrated fixture, and if any attenuation is exaggerated when stimulated contralateral to the normal hearing cochlea. This is especially important for those relying on contralateral routing of sound, such as with SSD and bilateral implantation. Our goal, then, is to compare cochlear input signal between a DCBCI and TCBCI using intracochlear sound pressures (PIC), and if any attenuation between the two devices is exaggerated when stimulated contralateral.

**Methods & Materials:** Four full-cephalic human cadaveric specimens were prepared, and PIC was measured in the scala vestibuli and tympani with fiber-optic pressure sensors. Titanium implants were placed bilaterally connected to a DCBCI or TCBCI. Soft tissue flaps with varying thicknesses (no flap, 3, 6, and 9 mm) were placed successively between the magnetic plate and sound processor magnet for the TCBCI. A bone-conduction transducer coupled to custom software provided pure tone stimuli both contralateral and ipsilateral to the normal hearing cochlea between 20 Hz–15 kHz.

**Results:** Transfer functions were generated from the fast-Fourier transform of each measure. Results indicate attenuation of the signal with a TCBCI in comparison to a DCBCI, which increased with thicker intervening soft tissue in TCBCIs. This reduction in magnitude appears non-linear and frequency dependent, and exaggerated when stimulated contralateral to the normal hearing cochlea.

**Conclusion:** These results illustrate the importance of soft tissue management during TCBCI patients. Further, for those patients relying on stimulation contralateral to the normal hearing cochlea and with higher baseline levels of transcranial attenuation, the additional signal attenuation from the TCBCI may result in significantly poorer audibility than expected.
Poster # 8

WIRELESS HEARING ASSISTANCE TECHNOLOGY WITH BONE ANCHORED HEARING SOLUTIONS

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Keywords: Wireless, 2.4 Ghz, Hearing Assistance Technology

Purpose: To expose audience to various options now available to interface various hearing assistance technology with Bone-Anchored Sound processor to enhance overall hearing experience to recipients of Bone-Anchored Implant treatment for hearing loss

Methods & Materials: Historic overview of the evolution of assistive technologies used in tandem with amplification devices. Coverage of "new" wireless methods will be covered

Results: Data will be presented showing the improvement level seen in typical application of HAT devices coupled wirelessly to Bone Anchored sound processors in test of hearing in noise.

Conclusion: This talk will allow the audience to gain exposure to various hearing assistance technologies that have now evolved to wireless connectivity with demonstration of typical performance results to be expected when such technology is deployed with patients using Bone Anchored hearing treatment.

Poster # 9

CLINICAL SURVEY OF A SURGICAL TECHNIQUE WITH TISSUE PRESERVATION

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Keywords: Tissuepreservation

Purpose: To compare the outcome after a surgical procedure with soft tissue preservation and a surgery with soft tissue reduction for placing Bone Anchored Hearing Implants.

Methods & Materials: Twenty-five patients were included in the prospective cohort with soft tissue preservation. The control group consisted of the last 25 patients implanted with a wide implant and included in the randomized controlled clinical trial: Stability, survival, and tolerability of a 4.5-mm wide bone-anchored hearing implant. Follow-up visits were scheduled at 7 days, 21 days, 12 weeks, and 6 months. At every visit, implant stability quotient (ISQ) values were recorded by means of resonance frequency analysis (RFA) and a range of outcome measures related to skin status were collected, including Holgers scores. Implants were loaded with the bone conduction device at three weeks. Hearing related quality of life was evaluated by means of the Abbreviated Profile of Hearing Aid Benefit (APHAB), the Glasgow Benefit Inventory (GBI), and the Glasgow Health Status Inventory (GHSt).

Results: Results will be presented on all the main outcome measures: numbness around the implant, length of surgery, BC in-situ threshold, Implant stability quotient, Implant loss, soft tissue reactions according to Holgers score, hearing related quality of life. A special focus will be on the primary outcome measure numbness around the implant.

Conclusion: The objective of the study is to compare the outcomes after a surgical procedure with soft tissue preservation and a surgery with soft tissue reduction for placing Bone Anchored Hearing Implants. A strength of the current study is that only the surgical technique is varied between the test and control group.
SOUND LOCALIZATION IN BAHA® PATIENTS WITH A UNILATERAL AIR-BONE GAP

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Keywords: localization, analogue, digital

Purpose: Sound localization in the horizontal plane is mainly based on interaural level differences (ILDs) in the high frequencies (> 3 kHz) and interaural time differences (ITDs) in the low frequencies (<1.5 kHz). These cues are highly distorted in patients with a unilateral hearing loss. Several studies have shown that bone anchored hearing aids (Baha®) can improve the localization abilities of this group of patients. However, digital Baha sound processors have a processing delay of 3 milliseconds while ITDs are in the order of microseconds. This might affect the localization abilities of a patient in the aided condition. The current study aims to verify if there is a difference in performance between analogue and digital Baha sound processors.

Methods & Materials: Testing was done in 11 patients with a unilateral ABG and normal hearing in the contralateral ear. All patients were implanted with a Baha at least one year prior to the test moment. Sound localization skills were tested using 9 loudspeakers located in a frontal semicircle at a distance of 0.8 m from the listener’s head. Stimulus coordinates ranged from -90° to +90° in azimuth at intervals of 22.5°. Three different localization stimuli were used: broadband noise (BB; 0.5 – 20 kHz), low-pass noise (LP; 0.5 - 1.5 kHz) and high-pass noise (HP; 3 – 20 kHz). Performance was assessed for the unaided condition as well as for the aided condition with both an analogue (ABaha) and a digital Baha sound processor (DBaha).

Results: The majority of patients perform better than chance level in both aided conditions. There is a statistically significant advantage with the Baha in the high frequencies (ILD) (p < 0.05). No difference in performance between ABaha and DBaha has however been found.

Conclusion: The current study could not demonstrate a difference in performance between analogue and digital Baha sound processing. Interindividual differences could be possibly explained by loudness of the device (fitting), cross-hearing in the higher frequency range and the processing delay of the DBaha.

OSSEOINTEGRATION OF A FLAT SURFACE BONE CONDUCTION IMPLANT


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Keywords: Bone Conduction Implant - BCI, Osseointegration, Histomorphometry

Purpose: The Bone Conduction Implant (BCI) is a new active transcutaneous bone conduction hearing device implanted under intact skin. Sound signals are transmitted over the skin and soft tissues to the implanted part of the BCI using magnetic induction. The transducer has a flat direct contact to the mastoid part of the temporal bone and no screws are used. In this study osseointegration at the interface between the transducer and the underlying bone was assessed.
Methods & Materials: Three sheep were on both sides of the head implanted with a circular 2 mm thick titanium cylinder with the same diameter as the bottom of the BCI transducer in contact with bone. Mechanical measurements of skull sound transmission and the bone stiffness at the bone-to-implant interface, was done at the time of implantation. After a period of 8 months the mechanical measurements were repeated, and osseointegration was assessed using histological methods as well as Computed Tomography (CT) and Cone Beam Computed Tomography (CBCT).

Results: Histological results confirmed condensed bone formation and osseointegration in the interface between the transducer bottom surface and the underlying bone. Neither CT nor CBCT had enough resolution to visualize the bone-to-implant interface in detail. The mechanical measurement indicated stiffer bone-to-implant interface and unchanged skull sound transmission.

Conclusion: A titanium bone conduction hearing implant with a flat contact to the temporal bone, like in the new BCI, can promote bone remodeling and osseointegration with retained skull sound transmission over time.

Poster # 12

OTITIS EXTERNA:
COMBINED BAHA/HA STRATEGIES IN MODERATELY SEVERE SNHL
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Purpose: We review the use of combination strategies using both BAHA and conventional hearing aids (cHA) in established HA users who progress to the intercurrent development of intractable Otitis Externa (OE).

Methods & Materials: A prospective review of a series of patients who were obligate HA users. Their 2 frequency thresholds at 0.5 / 1kHz were 50-55dB placed them at the limits of BAHA fitting range, though they were performing adequately with conventional HAs. We reviewed our standard audiometric protocol (PTA, Speech Discrimination and Speech in Noise) but supplemented this with self administered quality of life assessment questionnaires, the Glasgow Benefit Inventory (GBI) and the BAHA specific Tullamore Lifestyle Descriptor (TuLiD).

Results: Our strategy recognised that the patients derived better audiometric performance from cHA usage. However severe OE impacted heavily on general quality of life and harboured future difficulties with development of External Auditory Meatal (EAM) stenosis. A dual strategy of general day to day BAHA usage permitted ventilation and stabilisation of EAM skin, whilst conserving the stable meatus for interval cHA use when hearing performance and speech discrimination needed to be optimised. Monitoring the patient’s performance using TuLiD captured quality of life data justifying the use of this strategy whilst facilitating identification of optimised sound processor mapping.

Conclusion: In a national health service setting, where fund holders are not as yet supporting the provision of middle ear implantable hearing systems, there is a hiatus in rehabilitation for patients who for medical reasons may not be ideal cHA candidates but whose sensorineural hearing reserve may approach or exceed the limits of current BAHA sound processor performance. Our strategy provides a stop gap until funding, technology or hearing loss progression dictates other approaches.
THE WIDE IMPLANT –
PROSPECTIVE ONE-YEAR DATA ON IMPLANT STABILITY

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Keywords: osseointegration, implant stability quotient, linear incision

Purpose: To investigate a new wide bone-anchored hearing implant considering initial stability, stability over time, implant loss and skin reaction with two different surgical techniques.

Methods & Materials: Study Design: Consecutive, prospective case series. Setting: Tertiary referral center. Patients: Two groups of more than twenty adult patients were enrolled. First group (n = 24) were operated with linear incision and subcutaneous reduction, and the other group (n = 21) were operated with linear incision and no subcutaneous reduction. Main Outcome Measure(s): Implant Stability Quotient (ISQ) values were recorded using resonance frequency analysis at the time of implantation and at 10 days, 6 weeks, 6 months and 1 year after surgery. Skin and soft tissue reactions according to Holgers grading system.

Results: Implant stability quotient measurements revealed a significant increase in ISQ during the first 10 days after operation and the ISQ values continued to rise throughout the one-year observation period (two years data are presented for group one). No implants were lost. Skin and soft tissue reactions were rare and minor. No differences were observed between the two groups.

Conclusion: The wide implant showed good stability at surgery. Implant stability increased throughout the one-year observation period. No implants were lost. Skin and soft tissue reactions were rare and minor. The wide implant seems to achieve good osseointegration with both kinds of operation techniques. Given the high initial stability, and the fact that ISQ values are increased already at 10 days following implantation, earlier loading seems feasible, at least for patients with normal bone quality.

WHAT WE KNOW ABOUT THE LONG-TERM OUTCOMES OF PONTO IMPLANTS

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Keywords: Ponto implant, implant loss, skin reactions

Purpose: Objective: To summarize the first five years of experience in our center with the Ponto implant system (Oticon Medical AB, Askim, Sweden). More specifically, to determine the occurrence and type of perioperative and postoperative complications in patients implanted with Ponto implants and 1) compare results to a complete retrospective dataset with all types of bone anchored hearing implants recently published from our center; and 2) compare results in children, adults, and elderly and for different surgical techniques. This is to our knowledge the dataset with longest follow-up times on the Ponto system that was commercially introduced in 2009.

Methods & Materials: Retrospective case file review at our tertiary referral center. Main Outcome Measures: Implant loss, adverse skin reactions (Holgers’ score, ≥2), skin overgrowth, and discomfort resulting in abutment and/or implant removal.
Results: One hundred twenty one Ponto implantations were reviewed. The exact results will be presented in a revised abstract, and include
- Implant loss and reason for implant loss
- Adverse skin reactions
- Partial or total skin overgrowth
- Abutment and implant removals
Results will be divided into subgroups based on 1) age of patients (adult, children, and elderly), type of implant, and surgical technique used.

Conclusion: Bone anchored hearing system implantation is a procedure with few major complications. The Ponto implants show at least as good outcomes as previous implants. Adverse skin reaction is the most common complication. Children lose the implant more frequently than adults. Linear incision technique showed fewest complications.

Poster # 15

TULLAMORE LIFE STYLE DESCRIPTOR TULID: A DUAL CENTRE EVALUATION
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Purpose: The TuLiD is a BAHA specific quality of life assessment tool developed to evaluate the qualitative benefits derived from BAHA. A previous pilot study has been reported and now the results of a dual centre review are presented. Patients were asked to complete both the TuLiD, and the Glasgow Benefit Inventory (GBI). Whilst the two tools are not similar, the evaluation of two tools within two centres was designed to increase the reliability and validity of the TuLiD as an appropriate qualitative tool to evaluate patient outcomes following BAHA surgery.

Methods & Materials: All patients with conductive, unilateral sensorineural and mixed hearing loss, implanted with BAHA, within two centres, were asked to simultaneously complete both the TuLiD and Glasgow Benefit Inventory (GBI). Frequency distributions will be used to present quantitative data and personal comments to illustrate emerging themes from qualitative data.

Results: All patients reported some benefits from BAHA. Whilst the two tools are not directly comparable the results from the GBI subscales including general, social support and physical health are similar to the subsections of communication and hearing, work/school, social life and health and safety identified within the TuLiD. This tool moves beyond quantifiable data to provide personal comments that are beneficial to the patient and service providers.

Conclusion: The TuLiD provides reproducible evidence for the benefits of BAHA. It also helps identify patients who may require enhanced rehabilitative support to optimise their use of BAHA.

Poster # 16

ELECTRO-ACOUSTIC PERFORMANCE OF THE NEW BONE VIBRATOR RADIOEAR B81
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Keywords: Balanced Electromagnetic Separation Transducer, Bone Vibrator, Electro-Acoustics
**Purpose:** The objective is to evaluate the electro-acoustic performance of a new audiometric bone vibrator B81 from Radioear Corporation, USA. A comparison was made with the widely used B71 which has well-known limitations at low frequencies.

**Methods & Materials:** The B81 is based on the balanced electromagnetic separation transducer (BEST) principle where static forces are counterbalanced so that nonlinear distortion forces are reduced and maximum hearing levels can be increased. Maximum hearing level, total harmonic distortion (THD), frequency response and electrical impedance were measured for six devices of each bone vibrator type on an artificial mastoid.

**Results:** It was found that B81 reaches 10.7-22.0 dB higher maximum hearing levels (@ THD=6% or Vin=6 VRMS) than B71 for frequencies below 1.5 kHz and had significantly lower THD up to 1 kHz. There was no statistically significant difference between their frequency response, except for a deviation at the mid frequencies (a=0.01) where B81 was more efficient and the electrical impedances were substantially the same.

**Conclusion:** In general, B81 showed an improved electro-acoustic performance compared to B71. In particular, B81 allows for sensorineural hearing loss measurements at considerably higher hearing levels than with B71 below 1.5 kHz. Furthermore, it is compatible with same audiometers as is used for the B71.

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**Poster # 17**

**CLINICAL AND AUDIOLOGICAL EVALUATION OF NEW BAH A ATTRACT IMPLANTATIONS**

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**Purpose:** To evaluate surgical and audiological results of Baha Attract implantations.

**Methods & Materials:** In ENT department of Poznan University of Medical Sciences till the end of 2014 more than 200 bone anchored hearing aids were implanted. In this study we have analysed the results of last 17 patients implanted with Baha Attract system between September and December 2014. Most surgeries were performed under local anaesthesia. We have analysed the surgical results (time of surgery, surgical complications, cosmetic effects), changes in quality of life (GBI scale) and audiological results by performing speech audiometry in noise in free field 3-6 months after implantation with and without sound processor. Because of different types of hearing loss of implanted patients we performed speech audiometry in different acoustic situations (signal from front, from side of implanted ear or from side of contralateral ear) to examine head shadow effect.

**Results:** The mean time of surgery was 40 minutes. In one case there was a hematoma at first day after surgery which was successfully treated by drainage and pressing dressing. In 3 cases there was a mild pain and in 4 cases some numbness in operated area. In all cases cosmetic effect was very good. In most of patients the quality of life improved significantly. Speech audiometry in noise showed good speech understanding in noise after implantation in all group of implanted patients.

**Conclusion:** Baha Attract is effective, save and cosmetically highly acceptable method of treatment of conductive and mixed hearing loss and single sided deafness.
OUTCOMES OF PERCUTANEOUS AND TRANSCUTANEOUS BONE CONDUCTION HEARING IMPLANT SYSTEMS

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Keywords: Bonebridge, BAHA Attract, BAHA connect and Ponto

Purpose: Bone conduction hearing implant systems (BCHIS) such as, BAHA, Ponto, Bonebridge and BAHA Attract system can be used to improve hearing situation for patients, with chronic middle ear or ear canal disorders. BAHA and Ponto are Percutaneous BCHIS. In percutaneous transmission, the transducer is directly coupled to the bone by means of a permanent skin penetrating abutment. Bonebridge and BAHA Attract systems are transcutaneous BCHIS. In transcutaneous transmissions, one part of the transducer is implanted and the other part is kept outside the intact skin and soft tissue. Our patients go through comprehensive audiological assessment prior to implantation. The aim of this study is to evaluate performance of; BAHA Attract, BAHA, Ponto and Bonebridge against a BAHA on the softband. Our aim is to evaluate performance of; BAHA attract against BAHA on the softband, performance of Bonebridge against BAHA on the softband and performance of BAHA/Ponto against BAHA on the softband

Methods & Materials: Method Pre implantation • Aided Soundfield Audiometry with BAHA Intenso on the softband • Adaptive speech perception test in noise test with BAHA Intenso on the softband • APHAB questionnaire (pre implantation) Post implantation • Aided Soundfield Audiometry with BCHIS (e.g BAHA, Bonebridge, BAHA Attract) • Adaptive speech perception test in noise test with BCHIS (e.g BAHA, Bonebridge, BAHA Attract) • APHAB questionnaire (post implantation)

REHABILITATION OF SINGLE SIDED DEAFNESS WITH A BCHIS

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Purpose: Does BCHIS improve speech perception in noise in the single sided deaf (SSD) population? Bone conduction hearing implant systems (BCHIS) are a type of hearing device that can be used to rehabilitate SSD. BCHIS take sound from the ear with poorer hearing and transmit it to the normal hearing ear. This provides audibility and awareness of signals from the un-aidable side of the head. Research has shown varied outcomes and expectations by BCHIS users. This study evaluates the performance and satisfaction of the digital BCHIS systems.

Methods & Materials: Approximately 20 BCHIS users participated, in this within-subjects design study. Evaluations included the Coordinate response measure (CRM) test. CRM test (speech in noise test) is part of the AB-York Crescent of Sound test battery. This system uses a 1800 nine speaker array to measure spatial hearing. BCHIS users’ were tested in unaided and aided conditions. The SSQ questionnaire (Gatehouse and Nobel, 2004) was also used to assess BCHIS users’ speech, spatial and quality of sound benefits.

Results: Results showed that BCHIS significantly improved users’ speech perception in noise. Evaluation from the SSQ questionnaire shows improvement in speech, spatial and quality of sound benefits.
FIRST CASE SERIES WITH A NEW MINIMALLY INVASIVE SURGICAL TECHNIQUE

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Purpose: This presentation focuses on the surgical aspects of the modified tissue preservation technique, as well as the short-term outcomes in terms of skin healing and Holgers scores.

Methods & Materials: Minimally invasive Ponto surgery (MIPS) is a punch technique and a further development of the tissue preservation surgical technique where no incision is needed and the soft tissue trauma is minimized. Additional instrumentation has been used to protect the soft tissue during drilling, and to ensure safe, standardized, and predictable surgical technique. This study reports the results from the first cases in our clinic, with up to 6 months follow-up time. These results will be compared to a control group of patients operated with the same implant and abutments, but with a classic tissue preservation technique with a linear incision.

Results: Patients treated with this new technique showed the best results in terms of healing and cicatrization of the skin, as well as the Holgers score. Moreover, the technique is reliable and easily consistent.

Conclusion: In conclusion, we can assume that the MIPS technique can replace the tissue preservation surgical technique with linear incision at least in the ordinary cases.

CONVERTING PATIENTS FROM BODY-WORN CORDELLE PROCESSOR TO BE PROCESSOR

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Keywords: Cordelle, bone-conducting implants

Purpose: There are patients with analogue body-worn processor (Cochlear Cordelle) attached to a Bone Conducting Hearing Implant because of high BC thresholds and inability to use a post-auricular attached processor. With major technological advances in the past few years we trialled all our patients with new and more powerful post-auricular digital processors to see how many can be converted to using the better hearing aid processor.

Methods & Materials: 17 patients wearing body worn bone-conducting devices were identified for the study. 7 patients were trialled with the Oticon Ponto Power Plus processor and 1 patient with Cochlear BP110. The remaining 9 patients will be trialled within the next 30 days.

Results: Initial results show that 5 patients were able to convert to the post-auricular digital bone-conducting processor. We hope to show that there will be further patients who are able to convert, within the next 30 days when our data will be complete (within the time limit of editing this abstract).

Conclusion: A significant proportion derive the same benefit from a post-auricular bone-conducting processor to be able to convert to a better, digital and cosmetically more acceptable aid. With further advances in technologies there may be more patients able to covert to this type of post-auricular processor.
Poster # 22

THE SOUNDBITE™ HEARING SYSTEM IN CHILDREN. EARLY RESULTS
BIRMINGHAM, UK.

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Keywords: Soundbite, Hearing aid, Non-surgical

Purpose: The Bone Anchored Hearing Implant is a very successful form of hearing rehabilitation for children with a conductive hearing loss. Over recent years the criteria for children undergoing surgery have expanded and the surgery is now offered to many more children previously considered unsuitable. There are still children who are audiologically appropriate for a BAHI but their medical co-morbidites provide an obstacle to achieving their audiological potential. The Soundbite™ is a non-surgical and removable bone conduction hearing alternative The purpose is to evaluate the child and carer experience and the audiological results of the Soundbite™ in two children who had failed with all other forms of audiological rehabilitation. The Soundbite™ has been described in adults.

Methods & Materials: Two boys previously failed with conventional hearing aids, and traditional bone conduction aids. Bone anchored hearing implant surgery had been attempted but failed due to a CSF leak in one case. Both boys were fitted with a Soundbite™ Hearing aid. Adaptations were made for the intraoral Soundbite™ component to be fitted to the orthodontic appliance in one case.

Results: The boys were aged Xyrs and Xyrs. One child had undergone radiotherapy and neurosurgery to both temporal bones and required a surveillance MRI scan every 6 months. Bone anchored hearing implantation failed in one case due to a CSF leak. This was believed to be due to previous radiation therapy and surgery to the temporal bone region. The second child had a complex cleft lip and palate and had undergone numerous procedures and had severe chronic suppurative otitis media. The Soundbite™ was easily fitted to both children. Adaptations were made to accommodate the orthodontic appliances. Patient and carer satisfaction was overwhelmingly good. The GCBI showed high levels of satisfaction. The audiological results revealed successful rehabilitation.

Conclusion: The Soundbite™ is an alternative form of bone conduction that has proved to be successful in our paediatric cases. The cost of the device was initially found to be a prohibiting factor. When faced with failure from all other forms of hearing rehabilitation the Soundbite™ should be considered. Acknowledgments: Lars Enocson, Konstance Tzifa.

Poster # 23

BONE ANCHORED HEARING AIDS FOR SINGLE-SIDED DEAFNESS:
14 YEARS EXPERIENCE

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Keywords: BAHA, single-sided, deafness

Purpose: It has been recognized for many years that Bone Anchored Hearing Aid (BAHA) surgery can offer significant benefit to patients with single-sided deafness (SSD). In recent years, however, there has been a trend in some areas within the UK to label BAHA under the banner of ‘procedures of limited clinical effectiveness’. In response, the ENT-UK position paper of 2010, states that “the assumption that one good ear is enough is no longer acceptable” and that there is now “good evidence that a BAHA mounted on the side of a profound or total hearing loss will stimulate the opposite, normal inner ear, with considerable improvement in speech discrimination in noise, and in sound localisation”. They estimate that 800 BAHA are performed in the UK per year (for all indications) with the minority of these for SSD. In North Wales, all BAHA surgery is performed at a single tertiary referral unit – Wrexham Maelor Hospital. We were keen to review our service, with particular reference to surgery for SSD.
Methods & Materials: Patients undergoing Bone Anchored Hearing Aid (BAHA) surgery at Wrexham Maelor Hospital for single-sided deafness (SSD) were identified from the surgical database of procedures. A review of the case notes was performed, and audiological records were reviewed for audiogram data and patient satisfaction outcomes using the IOI-BAHA measure.

Results: 198 BAHA procedures were performed between December 1997 and November 2011 for all indications. 9 were for SSD (4.6% of total BAHA procedures). There were few complications, with most being related to the soft tissues, and minor only. Eight patients (88.9%) completed at least one post-operative IOI-BAHA score. Mean scores were 4.22 under 2 years post surgery, 3.98 at 2-4 years post surgery and 3.96 after 4 years post surgery.

Conclusion: Our experience suggests that patients with SSD value BAHA surgery and the benefits, despite any complications, as these are typically relatively minor. This satisfaction is consistent over time, and is by no means of ‘limited value’ to the patients.

Poster # 24

USING THE ‘SSQ FOR CHILDREN’ IN PAEDIATRIC BCHD ASSESSMENTS

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Keywords: Outcome measures, Paediatrics

Purpose: The Speech, Spatial and Qualities of Hearing Scale (SSQ) is used extensively with adult bone conduction hearing device (BCHD) patients. However many of the situations are not representative of children’s typical listening environments. In 2013, Galvin and Noble released the ‘SSQ for Children’ (or SSQ-C) to enable the use of this questionnaire with younger patients. This pilot study aimed to compare outcomes as measured by the SSQ-C for children with different configurations of hearing losses, as part of a BCHD assessment. It is hoped that in the future these data will help clinicians to guide children to the most appropriate interventions for their particular needs.

Methods & Materials: All children referred for a BCHD assessment aged 10–18 years and able to understand the questionnaire were invited to complete an SSQ-C before and after one of the following interventions: i) BCHD on softband; n= 9 or ii) BCHD with transcutaneous implant; n=3. A range of aetiologies were present. Descriptive statistics were performed.

Results: SSQ-C scores were compared pre and post hearing intervention. Children who proceeded with BCHD surgery demonstrated the biggest improvement in all subsections of the SSQ-C (Speech: 2.8, Spatial: 3.7, Quality: 3.1). Children who chose not to proceed with a BCHD (softband or surgery) showed more modest improvements (Speech: 1.7, Spatial: 1.8, Quality: 0.8). In regard to aetiology, the children with a bilateral conductive loss demonstrated the biggest improvements across all 3 domains. Children with a unilateral conductive loss showed the smallest improvement in the speech section, while the smallest improvements in the spatial and quality domains were for children with a unilateral profound loss.

Conclusion: These results suggest there may be different profiles of listening difficulty for different configurations of hearing loss. Therefore, the SSQ-C may help predict which children may benefit from particular interventions. We hope to expand this study to provide further evidence to support these hypotheses. References Galvin KL, Noble W. Adaptation of the speech, spatial, and qualities of hearing scale for use with children, parents, and teachers. Cochlear Implants International. 2013. 14:135-141.
**Poster # 25**

**SOUND LOCALIZATION WITH AN OSSEOINTEGRATED DEVICE: OBJECTIVE AND SUBJECTIVE OUTCOMES**

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**Keywords:** localization, osseointegrated devices, clinical outcomes

**Purpose:** Sound localization is one of the major challenges reported by osseointegrated (OI) device users with single sided deafness (SSD). Indeed, horizontal sound source localization is inherently a binaural processing phenomenon. As such, it is not surprising that SSD OI patients are at a disadvantage. Anecdotally there are, however, subjective reports of patients indicating that OI devices are beneficial for sound localization, yet research has failed to show any specific benefit for such tasks. Here we sought to understand the disconnect between patient report and objective evidence of sound localization by evaluating these facets in the same individuals.

**Methods & Materials:** Adults with single sided (sensorineural) deafness who had been using an osseointegrated (OI) device for at least 6 months were recruited from the greater Seattle area. Participants were asked to localize sounds from an 8 loudspeaker surround array both with the OI device on (OI on) and OI device off (OI off). Participants also completed questionnaires which addressed their subjective rating of sound localization performance.

**Results:** Distinct patterns of sound source localization performance were seen for the OI on compared to the OI off conditions. Greater localization errors were noted when sounds were presented contralaterally to the device (ie., the normal hearing ear) relative to the OI off condition (p < 0.05). In the OI on condition, analysis of confusion matrices indicated a positive benefit for sound source localization for sounds presented from frontal positions contralateral to the device rather than ipsilateral (p < 0.05). Questionnaires assessing subjective reports of benefit confirmed that subjects who frequently use the device report an overall improvement with their hearing post-implantation.

**Conclusion:** Sound source localization remains a challenge for OI users although OI patients indicate subjective benefit with the device. Future work addressing whether localization abilities can be improved with training will be key in furthering our understanding of these clinical issues.

**Poster # 26**

**COMORBIDITY INFLUENCING SOFT TISSUE AND IMPLANT LOSS IN BAHI**

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**Keywords:** Comorbidity, bone anchored hearing implants, soft tissue

**Purpose:** To identify risk factors for complications after bone anchored hearing implant (BAHI) surgery

**Methods & Materials:** All adult patients who received titanium bone-anchored hearing implants at our clinic between September 1, 1988, and December 31, 2007, were approached to fill out a questionnaire on comorbidity factors. A total of 581 patients with 669 implants were included in the analysis.

**Results:** Skin disease and profound learning difficulties were risk factors for time to first soft tissue reaction, hazard rate
ratio of 3.41 (95% CI 1.45-8.01) and 3.42 (1.03-11.39) respectively. Female gender showed a trend toward a negative risk for time to first soft tissue reaction, hazard rate ratio 0.60 (0.35-1.03). In multivariable analysis skin disease and female gender were observed as independent associative factors, adjusted hazard ratio 3.08 (1.32-7.16) and 0.56 (0.33-0.94). For revision surgery, female gender and cardiovascular disease were identified as negative risk factors in univariable analysis and smoking showed a trend toward a negative risk, with hazard ratios of 0.15 (0.07-0.32), 0.07 (0.03-0.20) and 0.51 (0.24-1.07) respectively. In multivariable analysis smoking and female gender were observed as independent associative factors, adjusted hazard ratio 0.45 (0.22-0.95) and 0.14 (0.06-0.30). Smoking could be identified as a risk factor for implant loss with a hazard ratio of 3.32 (1.36-8.09).

Conclusion: Retrospective analysis of comorbidity factors and clinical outcomes revealed risk factors for postoperative complications after BAHI surgery.

Poster # 27

**BAHS IMPLANTS INSTALLED WITH SOFT-TISSUE PRESERVATION TECHNIQUES: A SYSTEMATIC REVIEW**

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**Keywords:** soft-tissue, preservation, review

**Purpose:** To summarize the peer-reviewed literature on bone anchored implant surgery with limited or no skin thinning, and compare complication rates from these procedures with published data on traditional techniques involving soft tissue reduction around the implant.

**Methods & Materials:** A systematic literature review was performed by searching PubMed. The search strategy aimed to find all peer-reviewed articles discussing clinical outcomes of the installation of percutaneous bone anchored hearing implants with limited or no soft tissue reduction.

**Results:** After excluding articles not adhering to the inclusion criteria, twelve papers were left for review. The total number of implants installed with tissue preservation techniques in these articles was 256 (control groups with other techniques excluded). The average follow-up times for the studies varied between 12 months and five years. The precise surgical technique differs between the studies, but generally the surgery falls into two main groups. Implants from different vendors are included in the results. From an implant system perspective, the most important aspect is that abutments with sufficient length are available. The vast majority of published results are related to abutments with a titanium surface. One study (n=30) reports using coated abutments.

**Conclusion:** Based on this systematic review, we conclude that tissue preservation techniques are a safe way to install percutaneous bone anchored hearing aid implants with titanium abutments. Complication rates are as low or lower compared to the traditional skin thinning methods. In addition, several other important patient improvements, such as less peri-abutment numbness, better cosmetic outcome, and shorter surgery time have been identified. Importantly, no new intra- or post-operative risk factors or complications were identified or reported.
Poster # 28

AUDIOLOGICAL RESULTS ON BAHA ATTRACT
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Keywords: BAHA ATTRACT, transcutaneous BAHA

Purpose: To investigate different audiological outcomes with the new transcutaneous BAHA Attract solution.

Methods & Materials: Multi-center prospective clinical trial of patients older than 8 years eligible for a bone anchored hearing system. Patients with single-sided-deafness and conductive hearing losses were included. Patients with a mixed hearing loss were excluded from this study. Patients had audiological testing done prior to implantation and at fitting. We also did audiological measurements 1, 3, and 6 months postfitting. Audiological testing included free field measurements with and without noise as well as with and without the bone anchored hearing aid in place. We also registered if any change of magnet strength was necessary. Signs of infection along with adverse events were also thoroughly registered. 6 months after fitting we also did even more extensive audiological measurements.

Results: A total of 23 patients were included as part of a pre market release. Two experienced surgeons at two different ENT Departments in Denmark did the BAHA surgery. All audiological data is yet not available. There is a trend towards an increase in FF measurements in noise with the BAHA Attract in place both after both 1 and 3 months postfitting. FF measurements in quiet are indifferent with or without the BAHA Attract attached. The extensive audiological dataset is yet not available, but will be at Osseo 2015.

Conclusion: The BAHA Attract is a fairly new transcutaneous BAHA with relative few audiological data published. With this study we hope to provide a set of data that will show what to expect from this new device in terms of audiological benefit. We also hope to present data that will improve future preoperative counseling.

Poster # 29

TOWARDS DIRECT LOADING:
PONTO, NEW HEALING CAP AND EARLY LOADING
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Keywords: Implant stability, Early loading, Healing cap

Purpose: To investigate the use of a newly developed healing cap made of a more flexible and soft material. The healing cap interface allows simultaneous use of the healing cap and the sound processor. The second objective was therefore to investigate implant stability following loading (i.e. use of the sound processors) at the first surgical follow-up visit 7-14 days after surgery.

Methods & Materials: Multi-center prospective clinical trial of adult patients eligible for a bone anchored hearing system. The implant stability of the wide Ponto implant was assessed using ISQ measurements. Measurements were done perioperatively, at the time of loading, as well as postoperatively. After inclusion patients were enrolled in a 12 months follow-up programme with three postoperative visits at 4-8 weeks, 6 months and 12 months postoperatively. Loading of the implant was done 7-14 days postoperatively. Additional parameters included pain, numbness and wound healing, as well as Holger’s classification. Per- and postoperative adverse events, if any, were registered.
Results: Currently approximately 20 patients have been enrolled in this study which is ongoing. A single soft healing cap fell off. Early loading was possible for all patients included to this date. No implant loss was encountered and there seems to be no hampering of the development in implant stability after loading. We expect to enroll at least 30 patients.

Conclusion: The preliminary results indicate that the flexible healing cap is better than previous designs. Loading as early as seven days post-surgery or possibly even earlier seems feasible using the wide Ponto implant, at least for adult patients with normal bone quality. We will discuss the resulting flexibility in loading time and potential implications for future follow-up schemes after Ponto surgery.

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Poster # 30

EXPERIENCE WITH A MAGNETIC BONE CONDUCTION DEVICE, BAHA ATTRACT SYSTEM

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Keywords: Magnet, Hearing aid, bone conduction

Purpose: In this study, we reported our experience with a new transcutaneous bone conduction hearing device, the Baha® Attract System.

Methods & Materials: The study included 30 patients (16 females, 14 males; mean age 24.5 years; range 5 to 58 years) in whom a new transcutaneous bone conduction system was implanted in Kocaeli University.

Results: The mean air-bone gap was 42.4 dB, pre-operatively. Mean speech reception threshold gain and mean frequency specific hearing threshold gain was 23.5 dB and 29.1 dB, respectively. Two of the patients had hyperemia over the implant side and four of them had hyperemia with crusting. These problems were solved with decreasing the magnetic strength and usage time.

Conclusion: Our study results suggest that although the new bone conduction implant system has some minor complications it is promising for the patients with conductive or mixed hearing loss who are unable to wear conventional air conduction hearing aid.

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Poster # 31

EVALUATION OF A NOVEL DRILLING SYSTEM FOR INSTALLATION OF BAHS

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Keywords: minimally invasive surgery, drilling protocol, heat generation
Purpose: When installing implants in cortical bone, the drilling protocol must be designed to prevent heat induced damage to the bone. A new sutureless surgical technique, Minimal Invasive Ponto Surgery (MIPS), for implanting BAHS has been developed, including a new drilling guide and twist drills. The purpose of this bench study was to evaluate the new MIPS drilling protocol with respect to heat generation, drill force and drill torque. A comparison was made with a conventional drilling system.

Methods & Materials: Drilling was performed in polyurethane blocks (Sawbones, Sweden). The temperature changes were measured during drilling by thermocouples (type K, RS Components, Sweden). Two different drilling protocols were employed for each of the two drill systems (test and control); direct drilling with a constant feed rate and intermittent drilling where the drilling was performed with an up and down pumping motion. Continuous irrigation was applied during the drilling procedure with 20 °C saline. Fifteen drilling procedures were performed in each group. As a third worst-case condition, direct drilling without irrigation was performed for the two drill systems (n=10). The force and torque needed to produce an “osteotomy” in polyurethane block was measured.

Results: The mean maximum temperature rise with the new drilling system was 5.7 °C (SD 2.4) and 2.9°C (SD 0.6) with direct or intermittent drilling, respectively, whereas for the conventional system they were 3.5 °C (SD 0.8) and 1.7°C (SD 0.6). There were statistically significant differences between the four groups (p<0.05, Student T-test). Drilling without irrigation led to a mean temperature increases of more than 16 °C for both systems. Furthermore, the mechanical evaluation demonstrated that less force was required to drill in artificial cortical bone with the new drill system adapted for MIPS.

Conclusion: The present bench results show that the absolute temperatures generated using conventional and novel drilling system are similar. For the purpose of efficient drilling in association with MIPS the results demonstrated less drilling force and a temperature increase well below what is needed to induce heat trauma to the bone. It is concluded that under bench conditions, this new drill system is compatible with a minimally tissue invasive approach.

Poster # 32

ASIST - A BLUETOOTH REAL-TIME IMPLANT/BONE INTERFACE STABILITY MEASUREMENT DEVICE
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Keywords: Stability, Implant, Wireless

Purpose: The current systems for evaluating the stability of implants and implant systems attempt to monitor this stability (stiffness) by measuring the dynamic response of the implant system without any regard to the effect of the physical and mechanical properties of the implant system under test. The new ASIST (Advanced System for Implant Stability Testing) evaluates the stability of the implant/bone interface independent of the size, shape and mechanical properties of the implant and/or abutment. To accomplish this, requires that the complete signal from the accelerometer monitoring the dynamic response after excitation be sampled and transmitted to a computer algorithm that evaluates the interface stability. This study reports a Bluetooth-based handheld device for evaluating the osseointegration of percutaneous implants. The device, which uses an impact excitation, evaluates the interface stiffness by wirelessly transmitting and analyzing the complete response signal using an analytical model of the implant and abutment system.

Methods & Materials: The block diagram for the ASIST is shown in Figure 1. At present, the ASIST uses the same handpiece as an existing stability measurement system, the Periotest. This handpiece contains the accelerometer and the impact rod. On each test, sixteen impacts are performed on the implant and the raw acceleration information from the dynamic response is automatically transmitted to a computer using Bluetooth v4.0. Custom hardware and software were developed to optimize the performance. Laboratory experiments were conducted to validate the system.

Results: The key hardware features of ASIST were the high speed signal acquisition (294K samples/second), power optimization, and miniaturization. The ASIST’s battery could last for 7 hours without requiring any attention. Furthermore, the custom software allowed a Windows-based computer to receive and analyze the acceleration waveforms in real-time.
Conclusion: The ASIST can measure the accelerations from an impact rod striking a percutaneous implant, and it can wirelessly transmit the waveforms to a computer for analysis. Laboratory measurements have confirmed the ability to measure the stiffness of the implant/bone interface independent of the actual components between the response measurement location and the interface.

SPEECH UNDERSTANDING WITH BAHAA CONNECT AND A SIMULATED BAHAA ATTRACT

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Keywords: Baha Attract, Bahao connect, speech understanding

Purpose: To compare hearing and speech understanding between the new, non-skin-penetrating Baha Attract system and the current Baha system using a skin-penetrating abutment before the first patients received a Baha Attract system.

Methods & Materials: Hearing and speech understanding were measured in 16 experienced Baha users. The transmission path via the abutment was compared to a simulated Baha Attract transmission path by attaching the implantable magnet to the abutment and then by adding a sample of artificial skin and the external parts of the Baha Attract system. Four different measurements were performed: bone conduction thresholds directly through the sound processor (BC Direct), aided sound field thresholds, aided speech understanding in quiet, and aided speech understanding in noise.

Results: The simulated Baha Attract transmission path introduced an attenuation starting from approximately 5 dB at 1000Hz, increasing to 20–25 dB above 6000Hz. However, aided sound field threshold shows smaller differences and aided speech understanding in quiet and in noise does not differ significantly between the two transmission paths.

Conclusion: The Baha Attract system transmission path introduces predominately high frequency attenuation. This attenuation can be partially compensated by adequate fitting of the speech processor. No significant decrease in speech understanding in either quiet or in noise was found.
THE NEWCASTLE BAHA CENTRE TECHNIQUE
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Purpose: The surgical technique used in the Newcastle Upon Tyne BAHA centre.

The patient is anaesthetised using a Laryngeal Mask Airway (LMA), then brought into the theatre. The patient’s hair is shaved where the implant is going to be placed. The area is marked with a marking pen, around a dummy block. The tissue thickness is assessed with a green needle and Cochlear ruler. Lidocaine 2% with Adrenaline 1:80,000 is then injected into the operative site.
A ‘C’ shaped incision is created, and a two pronged self-retaining retractor is then inserted to allow for view whilst drilling. A conical 3mm guide drill is used first followed by a 4mm widening drill.
The implant is then inserted. The implant can then be tightened with a unigrip screw driver. The ‘Bone Bed Indicator’ is then used to check for smoothness of the bone, before the magnet is inserted.
The tissue gauge is then used to assess the skin thickness over the implant A two layer Vicryl stich is used to
A pressure dressing is then applied for 24-48 hours.

Methods & Materials: as explained in the surgery technique

Results: this is a safe procedure that we have performed a number of time with very little complications.

Conclusion: This surgery is fast and total time is about 40 minutes.
BAHA IMPLANT SURGERY IN THE PHILIPPINES
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Keywords: Baha implant surgery, congenital aural atresia

Purpose: Bone anchored hearing aid implants were introduced in the Philippines in 2008 as an alternative hearing solution for conductive hearing losses and single-sided deafness. Around 3.6% of referrals to the university hearing center were patients with congenital aural atresia. As several innovations were continuously being introduced by leading BAHA centers in the world, these were consecutively applied to patients undergoing BAHA surgery with results presented.

Methods & Materials: Records of patients who underwent bone anchored hearing aid implantation were retrieved from 2008 to 2014. Data on age, gender, clinical diagnosis, unaided and aided audiometry, type of incision, skin reactions, revision surgery and other complications were determined.

Results: There were 10 patients who underwent BAHA implant surgery from 2008 to 2014. Mean age was 15 ± 5, ranging from 8 to 26, with 5 males and 5 females. Most had bilateral congenital aural atresia (CAA) (n=7), and 1 each with unilateral CAA, single sided deafness (SSD) and chronic otitis media. Majority of the patients had single stage BAHA surgery, with 1 undergoing 2-stage BAHA surgery. Most of the patients (n=8) were subsidized in the procurement of the BAHA implant and cost of surgery. The first 4 patients underwent standard circular incision, while for patients who had surgery in 2011 onwards, the Nijmegen linear incision was used. Incisions were healed from 2-4 weeks. All patients had significant improvement in free field aided thresholds after loading of the speech processor (Divino = 4, BP100 = 6), falling within the speech spectrum. Two patients had revision surgery, one in a known keloid-former patient after 1 year, while another, with an increased body mass index, who had overlying superficial soft tissue on the abutment. One patient had a malfunction of the BAHA Divino speech processor.

Conclusion: Baha implant surgery is one of the available hearing solutions considered for patients with congenital aural atresia and single-sided deafness, even in a developing country with limited resources.
Results: An inductive process of analysing the data propagated three evident main themes; Seeking Help, Deciding to proceed with BAHA surgery and Benefits versus Limitations of BAHAs, which collectively describe the phenomenon of BAHA users.

Conclusion: Transcripts detail participants individual, personal reflections of their experiences of their BAHA and throughout these personal histories emerge a central sense of control. The knowledge generated by this phenomenological investigation offers a foundation for future professional practice and outcome measures to be grounded in knowledge emerging from the BAHA users themselves.

Poster # 37

AN IN-SITU MEASUREMENT FOR THE ACTIVE BONE CONDUCTION IMPLANT BONEBRIDGE

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Keywords: Bone conduction implant, Direct bone conduction measurement

Purpose: The Bonebridge® (BB) is the first active bone conduction implant worldwide. The device received CE approval in May 2012 and is indicated for treatment of conductive and mixed hearing losses (CHL/MHL) as well as for single-sided deafness (SSD). The objective of this work was to develop an in-situ measurement for the BB, known as the Vibrogram. A similar procedure has already been implemented for the active middle ear implant Vibrant Soundbridge® and is available in the current SYMFIT® 6.1 fitting software. Similar to measuring an audiogram, pure tones are sent through the audio processor to the implant of the user. The hearing thresholds obtained can be used as a basis for the first fit of the audio processor.

Methods & Materials: Firstly, bench experiments were conducted to normalize the dB force level in equivalent dB HL in a laboratory setting. Then the feasibility of the newly developed BB Vibrogram was evaluated in 22 users implanted with a BB (12 C/MHL & 10 SSD cases).

Results: The results in the C/MHL group showed that the average PTA thresholds (0.5-4 kHz) using the Vibrogram were between 0 to 10 dB better than the clinical BC thresholds. This can be argued due to the closer placement of the BB transducer to the cochlea compared to the bone vibrator being positioned at the mastoid. On the contrary the Vibrogram PTA thresholds in SSD cases were shown to be about 9±6 dB worse than the BC thresholds at the contralateral mastoid. This differences lead back to the individual transcranial attenuation. All device fittings according to the Vibrogram thresholds outperformed the previous fittings based on BC subjectively.

Conclusion: In conclusion the BB Vibrogram enables the individual implant-related hearing thresholds for each user to be established. Vibrogram thresholds as a start point lead to better device fitting and consequently higher user satisfaction.

Poster # 38

AURICULAR PROSTHESES FIXTURES IN PATIENTS FOLLOWING TEMPORAL BONE RESECTION

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Keywords: auricular prostheses, implantsurvival, radiotherapy
**Purpose:** Reconstruction is a critical component in the management of patients with temporal bone and external auditory canal (EAC) cancers after resection of the malignancy. Following pinnectomy, patients are assessed for suitability for a prosthetic ear by means of an osseointegrated implant placed during tumor removal surgery. Although these implants in general have a high success rate in terms of osseointegration and skin infections, adjuvant radiotherapy treatment can pose a challenge towards osseointegration. The purpose of this study is to review these groups.

**Methods & Materials:** All patients listed for auricular prostheses following temporal bone resection between April 1999 and April 2014 were included.

**Results:** A total of 215 implants in 99 patients were reviewed. The average implant follow-up time was 4.52 years (range 0.01 year to 14.84 years). Seventy patients were using their auricular prosthesis. Twenty-one patients (46 implants) had received radiotherapy treatment. Implant loss was 6 (13%) in the non-radiated group and 6 (3.6%) in the radiated group (P=0.014). Implant-related problems including skin overgrowth, infection, delayed healing and bone problems were 5 (12.2%) in the radiotherapy group and 18 (11.9%) in the non-radiated group (P=0.435).

**Conclusion:** Radiotherapy poses a higher risk of implant loss.

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**Poster # 39**

**PLACEMENT CONSIDERATIONS FOR THE MEDEL BONEBRIDGE**

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**Purpose:** The MEDEL Bonebridge (Bb) is intended to be placed as close to the cochlear as possible, secured to the cortex with two screws. While CT scanning allows pre-operative planning, traditional mastoid placement is not always possible due to previous mastoid surgery or hypoplasia. Alternative placements such as retrosigmoid and ‘middle fossa’ approaches have been described both with pros and cons, while insuring that the ultimate position of the external processor is optimal.

**Learning objectives:**
Attendees will learn that
i) absence of a capacious or well-aerated mastoid is not a contraindication to Bb surgery.
ii) exposure of the dura, sigmoid sinus and or emissary veins is the rule rather than the exception in Bb insertion in our series.

Attendees will appreciate that
i) comfort in exposing these structures is a pre-requisite to performing such surgery.
ii) no complications arose from exposure of these structures during or after surgery.

**Methods & Materials:** We present experience with our first cohort of 10 implants. The presence of structures exposed in order to fully accommodate the device was recorded at primary surgery. The occurrence of early adverse events such as trauma to local structures was recorded at the time of surgery and delayed complications such as neuralgia or headache were captured by questionnaire during the first year of device use.

**Results:** Sigmoid sinus, middle and posterior fossa dura and emissary veins were encountered in our series. Secure and safe placement of a device was possible in every case with no undue trauma to exposed structures. In most of our cases the device was rested against exposed dura and / or sigmoid sinus. There were no immediate or intermediate complications arising from such placements, e.g. local pain, neuralgia or headaches.

**Conclusion:** There is considerable latitude as to where the Bb can be accommodated behind the ear. Through careful exposure of the dura and / or sigmoid sinus, the device may still assume a respectable position, close to the cochlea while resting on these structures without inducing the theoretical risks of local pain or headache. Lifts are now available to reduce the depth of the implant footprint and may reduce the frequency with which these deeper structures are exposed.
Poster # 40

LONG-TERM OBSERVATION OF SKIN REACTION IN PATIENTS USING Baha Implants

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Keywords: skin reaction, Bone Anchored Hearing Aids

Purpose: Our aim was to assess the effects of application of different surgical techniques in implantation of titanium fixtures (U-graft technique, Dermatome technique, Linear incision technique, and hydroxyapatite-coated fixtures usage) affecting postoperative wound healing and occurrence of early and late skin reactions.

Methods & Materials: Our method of choice in treatment of hearing impairments in presented cases of various defects of the ear was attachment of titanium implant to temporal bone with or without removal of subcutaneous tissue. Three skin incision techniques were used: U-graft technique, Dermatome, Linear incision technique and hydroxyapatite-coated fixtures (without collecting skin graft). Our material consists of 125 patients in the age of 3 to 67 y.o. Hearing aid fitting was performed after wound healing and osseointegration of the fixtures (6 weeks - 6 months – depending on bone thickness, length of the fixtures, one- or two-stage surgical technique and condition of wounds). Universally adopted Holger’s classification of skin reactions was used to determine soft tissue reactions around transcutaneous implants. In case of severe infection of soft tissue in the implant site (Grade 4, according to Holgers scale) tissue re-operation was performed.

Results: Results indicated that considering inflammatory tissue reaction in the implantation site (Grade 4) 17 re-operations, including 15 in patients after U-graft technique, one re-operation 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 re-operations (p = 0.00167). In the groups where Linear incision or U-graft techniques were used nearly 20% of patients required re-operation, and in the group operated using Dermatome technique re-operation was necessary in little above 2% of cases. Till now we haven’t performed any re-operation in patients with hydroxyapatite-coated fixtures.

Conclusion: Assessment of the effects of 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 hydroxyapatite-coated fixtures and/or Dermatome technique.

Poster # 41

IMPLANT LOADING AT THREE WEEKS: THREE-YEAR OUTCOME AND RFA INTERPRETATION

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Purpose: To ascertain the long-term safety of loading osseointegrated implants for bone conduction hearing at three weeks. A secondary purpose is to discuss the interpretation of resonance frequency analysis (RFA).

Methods & Materials: Thirty consecutive adult patients were included in this prospective clinical investigation in our tertiary referral center. The Baha BI300 was loaded with the sound processor at three weeks post implantation. Follow-up examinations were performed at 10 days; at 3, 4, 6, 8, and 12 weeks; at 6 months; and at 1, 2, and 3 years. At each follow-up visit, implant stability quotient (ISQ) values were recorded by means of RFA and soft tissue reactions were evaluated. ISQ trends, implant survival, and soft tissue reactions were compared to a population of 52 patients with the same type of implants loaded from six weeks post-surgery as part of another study. Subjective benefit was measured by means of the Glasgow Benefit Inventory (GBI). RFA interpretation in other studies was reviewed.
Results: After an initial dip in ISQ at 10 days after implantation, a gradually increasing trend in ISQ was found until six months in both populations, after which ISQ values remained above baseline values. Implant survival was 97% in the study population and 96% in the comparison population. Clinically relevant soft tissue reactions were found in 0.9% (study population) and 1.7% (comparison population) of all visits. Patients reported subjective benefit; the mean GBI score was 22.8. RFA seemed to be interpreted diversely in studies that applied this technique in implant research.

Conclusion: Loading these implants at three weeks post implantation is safe based on the current study as long-term results show high ISQ values and good implant survival and tolerability. RFA in an interesting additional tool in research and clinical observations, however, it is not yet possible to make decisions based on individual absolute values. Guidelines for interpretation were proposed.

Poster # 42

AUDIOLOGICAL OUTCOMES AFTER BAHAN ATTRACT SURGERY
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Keywords: Baha Attract, surgery, outcomes

Purpose: Baha Attract is a new type of bone conduction system, which is used in treatment of 3 groups of hearing loss-conductive, mixed and single side deafness. This device is an ultimate method of restoring the hearing in cases such as chronic otitis media and congenital malformations, posttraumatic damages of temporal bone. This system uses the transcutaneous way of transmitting the sound signals between the integral parts of the device. General aim of the research was to evaluate hearing results of the Baha Attract procedure.

Methods & Materials: Our study concerns all 32 cases of Baha Attract implantations, which were performed in the Institute of Physiology and Pathology of Hearing in Kajetany in Poland since 30 October 2013 to 25 January 2014. Main analyze focused on the results of the pure tone audiometry before and after surgery and speech audiometry 1 month after connection of the processor of speech.

Results: Our study showed a decrease of postoperative pure tone thresholds in the free field conditions in comparison to the preoperative results. Although revealed significant improvement of speech recognition in most patients. What is more Baha Attract procedure provided hearing preservation.

Conclusion: It is a safe, feasible and effective procedure, which allows to preserve the hearing and improve the level of speech understanding. It is important to underline that amplification of hearing level is little lower among Baha Attract users than in Baha. Baha Attract is a good alternative for other types of bone conduction systems, which cannot be applied because of the anatomical contraindications or skin reactions.
Poster # 43

BAHA ATTRACT IN SINGLE SIDE DEAFNESS
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Keywords: Baha Attract, single sided deafness

Purpose: Baha Attract is a new type of bone conduction system, which is used in treatment of 3 groups of hearing loss-conductive, mixed and single side deafness. This device is an ultimate method of restoring the hearing in cases such as chronic otitis media and congenital malformations, posttraumatic damages of temporal bone. This system uses the transcutaneous way of transmitting the sound signals between the integral parts of the device. General aim of the research was to evaluate hearing results of the Baha Attract procedure.

Methods & Materials: Preliminary we had 32 patients, who were implanted in the World Hearing Center, Institute of Physiology and Pathology of Hearing in Kajetany in Poland since 30 October 2013 to 25 January 2015. In this group we had 2 patients, who had single side deafness. Main analyze consists of the results of pure tone audiometry before and after surgery. Although we considered the speech audiometry 1 month after connection of the speech processor.

Results: Our research revealed significant improvement in speech understanding among Baha Attract users.

Conclusion: Baha Attract is a new alternative method of treatment of single side deafness. It allows to improve speech understanding and overcome effect of head shadow. It is necessary to underline that this system gives little lower amplification of the hearing, however in the opinion of patients it is preferred because of the maintenance advantages.

Poster # 44

OUR EXPERIENCE IN THE BAHA’ S COMPLICATIONS TREATMENT
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Keywords: Baha, complication

Purpose: The Baha is a solution that has the longest history and the largest number of implanted patients with conductive hearing loss. The new opportunities, certain wishes of the patients, the development of technologies cause continuous improvement of this method. If the principles of surgery remain the same, the focus for further improvement is to reduce the rehabilitation period, reduce the volume of surgical manipulations, minimize complications and improve the effectiveness of treatment.

Methods & Materials: The retrospective analysis of 30 implantation cases was performed. The cases of inflammatory complications around the abutment, the therapy and its effectiveness were reviewed.

Results: With the use of standard technique with the soft tissue reduction and using the dermatome almost the inflammatory changes were not obtained. One patient with a long period of the implant wearing had the keloid around the abutment. These changes were minimized by the injection of Triamcinolone acetonide. In two cases the inflammatory changes were due to the loss of fixation between the abutment and the implant. They were resolved after tightening the fixing screw and local therapy with antibacterial ointment under the healing cap. After BA 400 implantation the soft tissue reactions were noted more frequently, but were not worse than 3rd degrees on the Holgers scale. Periodic changes of 1st degree were noted approximately in a half of implanted patients, but still inflammation can be easily treated by the ointments containing antibiotics and corticosteroids. In one case the recurrent inflammatory changes of 1-2 degrees were solved after the injection of Triamcinolone acetonide. In two cases the formation of granulations, inability to treat the inflammatory process conservatively forced us to perform the excision of granulation with consequent injection of Triamcinolone acetonide.
Conclusion: The new Dermalock abutments often accompanied by the soft tissue reactions. But the analysis shows that most cases of grade 2-3 reactions were observed in patients with the location of the hydroxiapatite coat below the skin. When the abutment of greater heights is chosen, the complication is less common. In any case, the use of corticosteroids in the ointments or injection is accompanied by a good therapeutic effect.

Poster # 45

EAR DYSGENESIS: OSSEOINTEGRATED IMPLANTS IN CONDUCTIVE AND MIXED HEARING LOSS

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Keywords: Ear Dysgenesis, Osseointegrated Implants, Hearing Loss

Purpose: To describe Osseointegrated implants as a treatment option in children with moderate conductive or mixed hearing loss due to congenital aural and ear abnormalities in a tertiary care hospital.

Methods & Materials: Prospective case analysis of 223 consecutive patients with bilateral or unilateral aural and ear dysgenesis assisted in a first consultation or in a follow up from October 2013 to November 2014. Collected data included indication of bone conduction hearing aids, provision of the sound processor and number of patients operated.

Results: 150 children had unilateral congenital aural and ear abnormalities, with a median age of 7 years (range 1-16 years); and 73 patients had bilateral aural and ear dysgenesis with a median age of 2 years (range 1-14 years). Thirty one percent of the children with bilateral dysgenesis had genetic syndromes, prenatal infections or chromosomal underlying diagnosis. We indicated sound processor with soft band in eighteen infants under 18 months of life. Four of them had been provided with bilateral devices and five with unilateral sound processor with soft band and are using it. In the children older than four years of age we indicated surgery in 14 cases. In unilateral cases we indicated sound processor with soft band in six infants under 18 months of life. Five of them had been provided and are using it. In children older than four years of age we indicated surgery with Osseointegrated implants in 6 cases. During the study period 32 of the 73 patients with bilateral dysgenesis users of Osseointegrated implants were controlled in their follow up period.

Conclusion: Osseointegrated implants in children have a high success rate in restoring hearing and are specially indicated in bilateral aural and ear abnormalities. Early diagnosis, audiological equipment and surgical implant is essential for normal development of language in these children.

Poster # 46

USE OF ASIST FOR ASSESSMENT OF BAH A ABUTMENT SCREW LOOSENING

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Purpose: The success of bone-anchored hearing aids relies on proper integration between the implant and the bone as well as maintenance of the prescribed connections between the mechanical components of the system. The Advanced
System for Implant Stability Testing (ASIST) has been developed to assess and monitor the integrity of the bone-implant interface which uses an acceleration signal measured during impact with the abutment coupled with a mathematical model of the implant-abutment system. The ASIST has been shown to provide a reliable measure of interface stiffness that is independent of attached components. This study aims to determine the ability of the ASIST to detect loosening of the abutment screw for a bone-anchored hearing aid (BAHA) implant-abutment system.

Methods & Materials: BAHA implants were installed into a plastic material to simulate a well-integrated implant in bone and a BAHA abutment was attached with a clinically prescribed level of torque. The abutment screw was progressively loosened and ASIST measurements were recorded at each screw loosening increment. Changes in the measured acceleration signal during impact, along with the developed mechanical model, were used to assess the soundness of the mechanical connection.

Results: The ASIST system was shown to be sensitive to changes in attachment torque of the abutment screw for a BAHA implant-abutment system.

Conclusion: The ASIST system provides a quantitative measure of implant stability that can be used to monitor the integrity of the bone-implant interface throughout the life of the implant. The results of this work show that the ASIST can also be sensitive to changes in the implant system itself such as a loose connection between the implant and the abutment, allowing clinicians to take corrective actions when necessary.

Poster # 47

BONE-ANCHORED HEARING AIDS IN AN ELDERLY POPULATION
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Keywords: BAHA, Elderly, Hearing loss

Purpose: It is a well-recognised relationship between hearing loss and social isolation and cognitive decline in the elderly population, which hearing rehabilitation can overcome. BAHAs were considered to be associated with a greater risk of complications in the elderly and, therefore, not universally offered by all centres. However, BAHAs offer an ideal method of rehabilitation, which is paramount if the sequelae of hearing loss are to be prevented.

Methods & Materials: Retrospective case note review and postal questionnaire study of all patients aged 60 or over who underwent BAHA implantation between 2009 and 2013 for conductive, SSD or mixed hearing loss. Outcome measures were complication rates and quality of life assessment using the Glasgow benefit inventory. The influence of patient and surgical factors on the complication rate was assessed. Fifty-three per cent (27 patients) of those implanted were aged between 60 and 70 years of age with decreasing numbers in the 71-80 and 81-90 age groups with 18% (9 patients) and 10% (5 patients) respectively.

Results: The Glasgow Benefit Inventory was collected on these patients. The mean benefit, satisfaction and global scores were 70 (range 0-100%), 70 (range 0-100%) and 82% (range 38-100%) respectively, whilst the residual disability remained low at 18% (range 0-25%). Two patients reported that they didn’t receive any benefit from the bone-conduction device, one of which remained a partial user and one who was implanted for SSD underwent removal of the implant and referral for a cochlear implant. There was a higher complication rate in those patients in whom the dermatome was used compared to the Sheffield ‘S’ or linear incision techniques. The relationship between surgical technique and post-operative complication rate was not statistically significant (p=0.149; logistic regression).

Conclusion: The bone-conduction hearing aid is an ideal method of hearing rehabilitation on the elderly for all forms of hearing loss where ordinary amplification aids are not suitable. There is no increased rate of complications compared to other age groups and it provides significant benefit with reduced residual disability which is imperative if social isolation is to be avoided and cognition preserved in this growing ageing population.
A REVIEW OF RECENT DEVELOPMENTS IN BONE CONDUCTION DEVICES

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Keywords: Bone conduction device, implantable, transcutaneous

Purpose: The different kinds of bone-conduction devices (BCDs) available for hearing rehabilitation are growing. Because of some issues associated with the percutaneous implant, and to some extent because of esthetical reasons, transcutaneous BCDs with intact skin solutions are being developed today. Challenges in developing transcutaneous BCDs are mostly related to power, attachment, invasiveness, and magnetic resonance imaging compatibility. In this presentation, all BCDs currently available or in clinical trials will be described in categories according to their principles. Furthermore, a comparison of recently published results of these BCDs, and estimated recommended inclusion criteria are presented.

Methods & Materials: A literature review of articles published until August 2014 was performed with a focus on audiometric results for different BCDs. BCDs are basically divided between skin-drive and direct-drive devices. Skin-drive devices include conventional devices and passive transcutaneous devices (implanted magnets), where vibrations are transmitted through the skin. Direct-drive devices include percutaneous devices and active transcutaneous devices (implanted transducers), directly stimulating the bone. The percutaneous direct-drive device is known as the bone-anchored hearing aid (BAHA). By using maximum power output of the devices together with reference equivalent threshold force levels for their specific stimulation positions, recommended inclusion criteria were estimated.

Results: The comparison of audiometric results showed that the average pure-tone-average improvement over unaided condition was 31.4 dB HL (hearing level) for the Bonebridge, 31.0 dB HL for the BCI, 26.8 dB HL for the Sophono, and 19 dB HL for the Baha Attract. Study protocols are varying between articles. Estimated maximum recommended pre-operative bone conduction thresholds are varying slightly between the different devices, mostly around 35 dB HL, but with Sophono around 20 dB HL and Baha Cordelle around 50 dB HL.

Conclusion: In the future, the authors assume that the BAHA still will be an important rehabilitation alternative for patients with more severe conductive hearing loss, while the transcutaneous solutions will increase their part of the market, especially for patients with bone-conduction thresholds better than 35 dB HL. Furthermore, the active transcutaneous BCDs (direct-drive) appear to be the most promising systems, but more extensive clinical studies are needed to establish more definite inclusion criteria.

BONEBRIDGE FOR SINGLE SIDED DEAFNESS - FUNCTIONAL AND SUBJECTIVE RESULTS

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Keywords: Single sided deafness, bone conduction hearing aid, speech discrimination

Purpose: Single sided deafness (SSD) results in a decline in speech recognition in noise, due to the head shadow effect, and a decrease in sound localization. The majority of the affected patients perceive it as a hearing handicap. While some patients cope well with SSD and prefer no treatment, others are heavily disturbed. There is a growing number of different auditory rehabilitation options available such as: 1) Contralateral routing of signal (CROS) hearing aid systems, 2) Bone
anchored hearing aid systems, 3) Non-surgical removable bone conduction prosthetic hearing devices that transmit sound via the teeth, and 4) a cochlear implant. The aim of this study was to analyze functional and subjective benefit results after implantation of a Bonebridge (BB, MED-EL) transcutaneous bone conduction device in patients with SSD.

Methods & Materials: Nine Adults with SSD for more than one year and normal hearing on the contralateral side (PTA <30dB HL) underwent transmastoidal implantation of a BB. Aided and unaided speech discrimination scores in 3 different spatial settings were measured using the Oldenburger sentence test (OLSA). Quality of life was assessed by 2 questionnaires, the BBSS (Bern Benefit in Single Sided Deafness Questionnaire) and SSQ-B (The Speech, Spatial and Qualities of Hearing scale for benefit questionnaire).

Results: Speech discrimination scores measured by OLSA showed a mean signal to noise ratio (SNR) improvement of 1.64 dB SPL for the aided condition compared to the unaided condition in the setting where the sound signal is presented on the side of the implanted ear and the noise is coming from the front (p<0.05). In the other two settings (signal and noise from front; signal from normal hearing ear and noise from front) the SNR did not change significantly. This benefit became manifest after 6 months. Good satisfaction reporting was confirmed by positive results in the questionnaires.

Conclusion: Speech discrimination in noise for patients with BB is comparable to patients with other bone conduction hearing aids. A learning curve is clearly detectable. The subjective benefit was rated positively by the patients. With the advantage of intact skin conditions after implantation, the BB is an adequate option for patients with SSD.

Poster # 50

COMPARING DIFFERENT BRANDS OF BONE ANCHORED HEARING SYSTEMS, LITERATURE REVIEW
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Purpose: Since 2009, two brands of percutaneous bone anchored hearing systems are available. The aim of this study was to compare the audiological outcomes of the two systems by means of a systematic literature review.

Methods & Materials: We performed a systematic review of studies where sound processors of the two brands have been directly compared (within-subject test designs). Ten studies in total met the inclusion criteria. An overview of these studies will be given. The quality of the study design varied, as well as the generation of sound processors compared. When further restricting the data to only comparing the latest generation sound processors from both manufacturers and studies adhering to a balanced cross-over design, seven studies with a total of 84 patients remained.

Results: Results from laboratory-based speech tests as well as self-reported benefit based on standardized questionnaires are reported.

Conclusion: A general finding of the studies was that for the latest generation sound processors, there is a weak or no correspondence between results on speech tests in the laboratory and self reported results. For the studies where patient preference/choice of sound processor was reported at the end of the study (N=57) the Ponto Pro family of sound processors was rated significantly higher by the users than the BP100/BP110 family of sound processors.
**Poster # 51**

**MIPS - MINIMALLY INVASIVE PONTO SURGERY: EARLY DAYS EVALUATION**

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**Keywords:** MIPS, Minimally-Invasive, Surgery

**Purpose:** We evaluate the initial cohort of patients undergoing MIPS

**Methods & Materials:** Our 10 patients included in a pre-release assessment of the MIPS technique are assessed. The prospective study was conducted between January and March 2015 and was intended to examine the technical ease, speed, complication minima and patient acceptability of the procedure. The surgical technique incorporated the use of 3 new additional disposable instruments: a percutaneous cannula providing a portal for use of newly designed guide and widening-countersink drills. The protocol dictated the inclusion of adult patients only and our practice involves local anaesthesia / ambulatory day surgery.

**Results:** The surgical technique departs little from a standard linear scalp sparing approach other than in the use of the percutaneous cannula and the avoidance of a 2cm linear incision. Surgery takes <10 minutes and has strong patient acceptability. To date there have been no intra operative or early post operative complications.

**Conclusion:** MIPS provides a further surgical option for osseo-integrated implant delivery. It has already proven to be technically brisk, minimally traumatic and patient tolerated.

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**Poster # 52**

**INFLUENCE OF FORCE AND CONTACT AREA FOR THE SOUND TRANSMISSION**

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**Keywords:** sound transmission

**Purpose:** The aim of this experimental study was to measure the influence of pressing force and contact area for the sound transmission into the bone with the Sophono device.

**Methods & Materials:** In 10 volunteers with normal hearing the Sophono device was applied with an adjustable head band with forces between 0.5 N and 6 N onto the skin behind the ear. The contact areas varied between 2 and 8 cm². The device was stimulated electronically via the DAI with pure tones between 0.5 and 6 kHz and white random noise. The energy absorption was measured with an accelerometer at the teeth.

**Results:** The contact area had only an influence of less than 5 dB on the energy transmission. Higher pressing force up to 4 N increases the energy transmission by 10 - 15 dB, but higher forces led to an attenuation especially in higher frequencies.

**Conclusion:** In volunteers without surgical thinning of their skin we found a certain correlation between pressure and energy transmission. Forces above 4 N do not seem to be beneficial. Because the contact area does not have a substantial influence of the energy transmission it should be formed due to clinical requirements.
Poster # 53

BAHA IN CONDUCTIVE HEARING LOSS CAUSED BY CHOLESTEATOMA IN CHILDREN

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Purpose: To describe the use of BAHA on pediatric patients who underwent cholesteatoma surgery in a tertiary care pediatric hospital.

Methods & Materials: Retrospective study of ten pediatric patients who underwent cholesteatoma surgery and were implanted with a BAHA device. The following audiological parameters were assessed for each patient: mean preoperative air and bone conduction frequencies between 0.25, 0.50, 1, 2, and 4 KHZ. Threshold with conventional hearing aid, with vented mould; and threshold with BAHA system.

Results: Seven patients underwent bilateral and three unilateral ear surgery for cholesteatoma. Median age: 10 years, range (5-15 years). All of them had moderate conductive hearing loss (Bilateral or unilateral depending ears operated). The mean postoperative threshold air frequencies was 43 db. Threshold air frequencies with conventional hearing aid with vented moulds was 26 db. All of the patient report feedback and whisthing. Thershold with BAHA system was 5 db. All patients were implanted with unilateral BAHA device.

Conclusion: Many pediatrics patients can’t wear conventional hearing aids after median ear surgery for cholesteatoma because they cause infection and discharging ears and have to stop wearing it. This worse if both ears have been operated. BAHA system is a bone conductor hearing aid that showed audiological and medical advantages in treating unilateral or bilateral moderate conductive hearing loss in children after cholesteatoma surgery.

Poster # 54

BENEFITS AFTER APPLICATION OF BONEBRIDGE

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Keywords: Bonebridge, benefits, conductive and mixed hearing loss

Purpose: Bonebridge as a hearing device in group of bone conduction systems, allows to treat conductive, mixed hearing loss as well as single side deafness. Characterized as an active type of hearing device, it transduces sound signals into mechanical vibrations of the bone. Due to the limitations of other products such as persistent skin wound, everyday maintenance of the percutaneous abutment and social stigmatization in subjective opinion of the patients, this new partially implantable device should be considered in all group of patients with audiological indications. Main aim of the study was to asses the benefits after Bonebridge implantation.

Methods & Materials: Our study include all 41 cases of Bonebridge implantations, which were performed since the beginnings of this method in the World Hearing Center, Institute of Physiology and Pathology of Hearing in Kajetany in Poland- from 19 December 2012 to 28 November 2014.

Results: Our findings show significant improvement of speech recognition and hearing preservation among Bonebridge users.
Conclusion: Bonebridge system can be a good alternative for other types of bone conduction systems, because of the comparable hearing results, easy maintenance and aesthetic reasons. It causes less feedback effect, so it should be beneficial in cases of unilateral conductive or mixed hearing loss, where good separation of the ears is needed to receive binaural sound effects information.

Poster # 55

POSSIBILITIES OF USAGE OF BONEBRIDGE IN SINGLE SIDE DEAFNESS

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Keywords: single sided deafness, Bonebridge

Purpose: Bonebridge is a new transcutaneous hearing device, which uses the effect of bone conduction. This method is based on idea of transducing the sound signals into mechanical vibrations of the skull, which stimulate the cochlea. Bonebridge system is used in treatment of conductive, mixed hearing loss and single side deafness. In cases of single side deafness the sound signals are transmitted through the skull to the contralateral ear, which has the normal hearing. SSD patients complain of difficulties in speech understanding especially in noise and problems with recognition of the direction of sound. General aim of our study was to evaluate profits of Bonebridge implantation among SSD patients.

Methods & Materials: Preliminary study included 41 procedures of Bonebridge implantations, which were performed since the beginnings of this method in the Institute of Physiology and Pathology of Hearing in Kajetany in Poland. All the implantations were performed since 19 December 2012 to 28 November 2014. From this group we selected 9 patients who had single side deafness. Main analyze focused on the hearing results after surgery and their follow-up.

Results: We confirmed that users of the Bonebridge system improved speech understanding in noise and overcome effect of head shadow.

Conclusion: Bonebridge implantation procedure is safe and effective. It is a remarkable solution which gives the sense of natural sounds. In cases of single side deafness it provides little lower amplification of the sound signals, because of the head attenuation. Good cooperation during the fitting of the processor of speech is needed, seeing that bigger amplification is required in cases of single side deafness. Due to easy maintenance, aesthetic features, comparable hearing results, this new bone conduction system system should be widely concerned in cases of single side deafness.

Poster # 56

FIRST EXPERIENCES WITH THE Baha 4 Attract System in Freiburg

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Keywords: Baha 4 Attract

Purpose: The Baha 4 Attract System, first introduced in 2013, allows the rehabilitation of patients showing conductive or mixed hearing loss with a transcutaneous bone-anchored hearing aid which is easy to care and aesthetically
advantageous. We report on our first experiences with the Baha 4 Attract System in our hospital.

**Methods & Materials:** We present the results of 6 patients (4 children, 2 adults) provided with a Baha 4 Attract System. The subjective patient contentment, the duration of carrying and the functional hearing improvement have been evaluated after surgery. Mastoid cavities after cholesteatoma surgery, congenital microtia or atresia of the external auditory canal were the main medical indications for the application of a Baha 4-Attract-System.

**Results:** Patients with a Baha 4 Attract System showed a functional hearing improvement and were mainly satisfied with the postoperative outcome. The surgical procedure was completed in all cases without complication. Postoperative skin irritations were prevented through the use of the Baha SoftWear Pad and haven't been seen after surgery.

**Conclusion:** The transcutaneous Baha 4 Attract System provides an interesting alternative to percutaneous bone anchored hearing systems for patients with conductive or mixed hearing loss without causing cosmetical or hygienic drawbacks reported for percutaneous bone conduction implant systems.

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**Poster # 57**

**EARLY EXPERIENCE WITH MINIMALLY INVASIVE PERCUTANEOUS SURGERY (MIPS) FOR Baha**

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**Keywords:** tissue preservation, Baha

**Purpose:** The concept of tissue preservation has gained acceptance in Baha surgery with linear incisions commonly used without thinning of the skin. MIPS was developed byOticon Medical to further minimise the impact of Baha surgery on skin through the development of instruments and drills that allow safe percutaneous implantation through a 5mm hole. We report the initial experience of the author with MIPS for Baha.

**Methods & Materials:** 7 consecutive adult patients underwent Baha implantation using the MIPS technique under local anaesthesia over a 4 week period. All patients were selected for Baha after multidisciplinary assessment and a trial of Baha on a soft-band. Surgical time and intraoperative difficulties were assessed as well as patient experience and complications including skin issues at 1 and 4 weeks after surgery.

**Results:** The median operative time was 8 minutes (Range 6-16). No intraoperative complication were encountered. Patients reported little post-operative numbness or pain over the first 4 weeks after surgery. The skin of all patient was Holgers 0-1 at both 1 and 4 weeks after surgery.

**Conclusion:** MIPS for Baha results is a short operative time compared to standard Baha techniques. Early experience is encouraging with minimal skin problems.
EXPERIENCES OF PATIENTS WITH PERCUTANEOUS BONE CONDUCTION HEARING IMPLANT SYSTEMS

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Keywords: experiences, bone conduction hearing implant, qualitative research

Purpose: For potential adult bone conduction hearing implant (BCHI) patients and their caretakers it is complex to make an informed choice from the wide range of options in implantable and non-implantable hearing aids. The decision-making process includes many factors. How these are traded off by the patient, surgeon, audiologist and policy maker has not been investigated. The patients’ perspective has received attention in survey studies, but there is limited exploratory qualitative research available. For example, it is known that some of the patients reject the percutaneous BCHI, even if it is their most suitable option in the specialist’s perspective. Factors to be considered also include cosmetics and the breach of bodily integrity. The goal here is to elicit patient preferences and experiences with the percutaneous BCHI and to identify factors which need attention by the manufacturers and rehabilitation specialists in the field.

Methods & Materials: A qualitative study using semi-structured interviews was conducted in 2013. Adult patients who were eligible for or already had a percutaneous BCHI were included. Topics discussed included, but were not limited to the meaning of hearing impairment and the rehabilitation choices. The advantages and disadvantages, possible improvements, the cosmetic outcomes and perception by patients themselves and their environment were also explored in relation to the perceived rehabilitation options. All interviews were transcribed verbatim, coded and an inductive thematic analysis was performed.

Results: A total of 12 patients participated of which three rejected the option of a percutaneous BCHI. The interviews lasted on average 36 minutes. The audiological outcome was of an important concern in choosing the right solution. Moreover the concealability of the device, the associated stigmatization (“screw in the head”), the testing period and device feedback are factors to take into account. Experienced patients often minimized the importance of inflammation and cosmetics. Patients’ expectations regarding the rehabilitation outcome were not always met.

Conclusion: Results show several factors of importance to patients of which some have already been improved (e.g. loading time and local baldness). There is still room for improvement in several areas including patient counselling. Patient preferences should be further investigated in a discrete choice experiment.

MEASURING THE QUALITY OF LIFE IN TERMS OF CAPABILITIES

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Keywords: Quality of life, capabilities, bone conduction hearing implant

Purpose: Quality of life (QOL) in bone conduction hearing implant (BCHI) users is mostly measured using the HUI-III. BCHI users are a highly heterogeneous group because of their different hearing characteristics and device choices. This in turn leads to distinct usage patterns. Single sided deafness might only require aid in challenging listening situations while those with congenital atresia might be completely dependent on a BCHI. Conventional QOL questionnaires do not make any distinction but focus on the gross ability to hear. Moreover, these generic questionnaires disregard many other factors which determine wellbeing. Indeed, the cost-effectiveness of the BCHI has been scrutinized (Colquitt et al. 2011). An alternative QOL approach initiated by Nobel prize laureate Sen advocates the use of the capability approach. He set forth
that society should focus on increasing the capabilities people have in living their lives. Ensuring the ‘freedom to achieve’ and the ‘freedom to choose’ are essential in this regard. Considering that the hearing impaired and those who have to breach their bodily integrity to regain their hearing are especially affected in these areas, measuring their QOL using this alternative approach as well seems sensible. Coast et al. introduced the ICECAP-A which is a validated QOL questionnaire based on the capability approach. Here, a Dutch translation was created and the responses of percutaneous BCHI users were qualitatively analysed to assess its suitability.

Methods & Materials: First, the ICECAP-A was translated to Dutch using a ‘forward-backward translation’ protocol. A qualitative study using semi-structured interviews was conducted among 7 BCHI patients who were asked to verbalize their thoughts whilst completing the ICECAP-A. The interview focussed on the understanding of the questionnaire, the motivations for the answer and how the questionnaire was perceived. All interviews were transcribed verbatim and coded. Themes were identified using an inductive analysis.

Results: The elicited responses on the different ICECAP-A dimensions indicated perceived burdens associated with decreased hearing and the onset of change with rehabilitation.

Conclusion: The ICECAP-A is a brief and suitable measure and should be considered for intervention studies and health economic evaluations of BCHIs.

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**Poster # 60**

**SOUNDBITE: OUTCOME MEASURES IN PERFORMANCE AND QUALITY OF LIFE**

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**Keywords:** SoundBite

Purpose: Sunnybrook Health Sciences Centre is currently the only centre in Canada to offer the SoundBite hearing system. The SoundBite provides patients with a removable non-surgical hearing solution using bone conduction to transmit sound via the teeth to the inner ear. The device consists of one BTE microphone and two In-the-Mouth pieces The purpose of this study is to assess the effectiveness of the SoundBite in regaining spatial hearing ability in both single-side deafness (SSD) and conductive hearing loss patients.

Methods & Materials: Five subjects were fit with the SoundBite, four of whom have SSD and one a conductive loss. Assessments included Hearing In Noise Test (HINT) measurements in aided and unaided conditions, as well as quality of life questionnaires. Noise was presented at 0°azimuth, whereas speech was presented from the front, the left, and the right (0°, 90°, or 270°azimuth). Patients also completed The Hearing Utility Index Mark 3 (HUI-3), the Speech, Spatial and Quality of Hearing Scale (SSQ), and the Tinnitus Handicap Inventory (THI). Patients were assessed pre-device and at 1 and 3 months post-fitting.

Results: SSD results
There was a trend towards SNR improvement at the 1 month post-fitting time point with the speech presented to the SoundBite side and noise presented at 0°azimuth , $t (3) = 2.735$, $p = .072$. The other two conditions did not reveal any significant improvements.
No significant differences emerged from pre-fitting to 1 month post-fitting on the HUI-3, SSQ, or the THI.
Conductive Results
The patient with a conductive loss exhibited improvements at the 1 month post-fitting time point in all three speaker configurations, most significantly when speech was presented to the SoundBite side with noise presented from 0°azimuth, resulting in an improvement of 4.35 dB, from 70.82 to 66.47 dB. Marginal improvements were also reported in the patients’ Quality of Life measures (HUI-3, SSQ, THI).

Conclusion: The SoundBite is an effective option for those with appropriate indications, however listening in noise continues to pose difficulty for these patients. Dental issues have been minimal, and benefits are significant for improving SNR when the speech signal is presented to the deafened ear for SSD patients.

Poster # 61

BAHA ATTRACT: PEARLS FROM OUR FIRST FIFTY PATIENTS
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Keywords: Baha Attract, Outcomes, Complications

Purpose: To identify what we have learned, what we have changed, and evaluate our patient’s outcomes with Baha Attract.

Methods & Materials: A retrospective analysis was performed on our first cohort of 50 Baha Attract patients. We evaluated indications, demographics, outcomes and complications.

Results: The majority of patients had conductive/mixed hearing loss versus SSD. All patients initially chose the Baha4 sound processor and only 1 converted to the BP110. About 40% of patients decreased their magnet strength over time compared to approximately 10% that increased. All patients are successful users, although one is waiting for the ‘super power’. No patient had significant pain complaints or numbness. About 70% of patients had a flap thickness greater than 6mm but only half had to have their flapped thinned. A few patients had mild edema/slight fluid collection but all resolved by activation. Interesting, only the patients who had their flap thinned developed the edema. We will discuss the average gain as well. Finally, 2/3 of the patients would not have undergone a Baha Connect surgery.

Conclusion: The Baha Attract implant is a viable hearing solution for patients with conductive, mixed or single sided deafness.
SPEECH RECOGNITION IN NOISE IN UNILATERALLY DEAF SUBJECTS USING BONEBRIDGE

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Keywords: Bonebridge, directional microphone, speech recognition

Purpose: Acquired unilateral hearing loss reduces the ability to understand speech in background noise. The aim of this study is to compare speech recognition in noise performance in subjects with acquired unilateral deafness and near to normal hearing in the contralateral ear using the bone conduction implant Bonebridge as CROS device in unaided and aided conditions. Furthermore, the study aims at the evaluation of the effectiveness of the directional microphone of the Bonebridge audio processor Amadé in improving speech in noise recognition performance.

Methods & Materials: So far three adult subjects with acquired unilateral deafness and contralateral near to normal hearing have been enrolled into the study. Speech in noise recognition thresholds are assessed in unaided condition preoperatively and in aided condition six months post activation of the Bonebridge for three speech in noise presentation conditions: S0N0, S45N-45 and S-45N45. One month post activation aided speech in noise recognition thresholds are measured in the omnidirectional and directional microphone modes of the Amadé.

Results: For presentation of speech to the deaf and noise to the near to normal hearing ear, all subjects show lower (better) speech in noise recognition thresholds with the Bonebridge compared to unaided. Two out of the three subjects present with a lower speech recognition threshold for S0N0 in the aided condition. For presentation of speech to the near to normal hearing and noise to the deaf ear, aided speech recognition thresholds are slightly larger than unaided. In all subjects, speech recognition thresholds are lower with directional compared to omnidirectional microphone mode for presentation conditions with spatial separation of speech and noise.

Conclusion: Our first results indicate that adult subjects with acquired unilateral deafness and contralateral near to normal hearing benefit from the Bonebridge for speech recognition in noise particularly in very difficult listening conditions. The directional microphone is effective in improving speech recognition in noise performance in these subjects.
CLINICAL BENEFITS OF BONE CONDUCTION IMPLANT FOR SSD PATIENTS

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Seoul, Korea (South)

Keywords: Bone conduction implant, Single side deafness

Purpose: The bone conduction implant (BCI), such as Baha®, Sophono®, BonebridgeTM has been applied to single sided deafness. On account of clinically insufficient data and the pros and cons of those devices, it is required to be careful to select a candidate and device. We would suggest a guideline to choose BCI candidates in patients with SSD.

Methods & Materials: 28 out of 47 SSD patients with Baha®, 1 of 3 patients who had Sophono® Alpha 2, and 1 SSD patient from 2 patients with Bonebridge in our clinic were participated in this study. According to PTA in better ears (non-implanted ears), the participants were divided into two groups: group A (=30dB) and group B (>30dB, =50dB). All were tested pure-tone audiometry and speech audiometry before and after surgery. Hearing in noise test was also measured in signal to noise ratio 10 (signal 75dB HL, noise 65dBA). Their subjective satisfaction level and daily device using time were investigated by participating in Bern Benefit in Single-Sided Deafness Questionnaire.

Results: Postop. PTA at the worse ear was decreased that Group A for 41±11.4dB HL and Group B for 53.9±13.1dB HL, compared to the preop. PTA at the worse ear that Group A for 112±13.1dB and Group B for 115.9±5.9dB HL. Postoperative WRS and HINT scores for both groups were increased than preoperative scores. The subjective satisfaction level (SSL) for all the items of BBSS was appeared to be significantly improved when using BCI. There was no correlation between the SSL and daily device using time. Also, the correlation between SSL, daily device using time and PTA in the better ear was not found.

Conclusion: The results demonstrated that audiological benefits did not always lead to the best outcomes. Although BCI seemed to be a useful device for SSD, there still are risks to cause a failure if the careful preoperative evaluation is overlooked. It is clear that patients’ subjective satisfaction or willingness to rehabilitation should be considered. However, before implantation, counseling for purpose of use is required. Also, clinical-based guideline for choosing appropriate device for the patient is necessary rather than depending on the company’s criteria.
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