Conclusions: The robotic system allows the accurate and safe drilling of a minimally invasive tunnel to the inner ear for cochlear implantation procedures. The evaluation of the system in a first in man clinical trial will take place in the near future.

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Emerging Technologies (2) (R661)

ID: 661.3

The Case for Cochlear implantation Robotics and an autonomous drilling robot

Presenting Author: **Chris Coulson**

Chris Coulson

Queen Elizabeth Hospital, Birmingham. endoscope-i

Learning Objectives: Cochlear implantation leads to cochlear trauma, reducing this may help optimize implantation performance. An autonomous cochlea drilling robot may be one of the components in reducing this trauma.

Introduction: To detail the intra cochlear trauma caused during cochlear implantation and its effect on CI performance. To demonstrate a human trial of an autonomous robot capable of performing a bony cochleostomy whilst preserving the underlying endosteal membrane.

Methods: A review of the implantation literature assessing cochlear trauma and its impact on implant performance. An autonomous cochleostomy robot was used to create a cochleostomy in 3 live patients during a cochlear implantation procedure.

Results: Twenty one papers were identified which were relevant to our search. In total, 686 implants were inserted and 121 (17.6%) showed evidence of trauma.

The robotic cochleostomy drilling robot was able to perform a complete cochleostomy whilst preserving the underlying endosteal membrane.

Conclusions: Cochlea trauma is a common result of cochlear implantation. An autonomous robotic drill can perform a cochleostomy whilst preserving the underlying endosteal membrane. This is one of the necessary steps in being able to perform a completely robotic cochlear implantation - with an intention to reduce the typical cochlear trauma.

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Free Papers (F662)

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Middle fossa approach for cochlear implantation

Presenting Author: **Wojciech Gawęcki**

Wojciech Gawęcki[1], Łukasz Borucki[1], Michał Karlik[1], Vittorio Colletti[2], Witold Szyfter[1]

[1]*Poznań University of Medical Sciences,* [2]*University of Verona*

Learning Objectives: To present indications, surgery and results of cochlear implantation via middle fossa approach.

Introduction: Classic approach to the cochlea through the mastoid and facial recess may not be suitable for patients after middle ear surgery for cholesteatoma. In 1998 Colletti presented a technique to bypass the middle ear, and insert the electrode through the middle cranial fossa approach.

Material and methods: In our department cochlear implant program started in 1994 and till now 1266 cochlear implantations were performed. In 4 patients middle fossa approach was used. Indications, surgical technique and results in this group were analyzed. Results: Initially 6 deaf patients after middle ear operation for cholesteatoma were qualified to cochlear implantation via middle fossa approach. A middle cranial fossa craniectomy was performed. Then a careful dissection of the dura was carried out to expose the arcuate eminence and the greater petrosal nerve. In two cases surgery was stopped because of strong adhesions and bleeding from the dura during preparation. In the rest 4 cases the basal turn of the cochlea was discovered, the cochleostomy was done and successful implantation was performed. The time of surgery was nearly two times longer than during standard implantation. In 3 cases there were no complications and in one case hematoma occurred 2 days after surgery and the patient was reoperated. Postoperative CT showed correct intracochlear position of the electrode in all cases. All 4 patients use their implants and have good hearing thresholds in sound free field, but they can't fully communicate using hearing only and require lip reading.

Conclusions: Middle fossa approach enables cochlear implantation in deaf patients after middle ear surgery where implantation through standard approach (antromastoidectomy and posterior tympanotomy) is not possible.

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Free Papers (F662)

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Systematic Review of VSB in C/M Hearing Loss

Presenting Author: **Arne Ernst**

Arne Ernst[1], Jan Wagner[2]

[1]*Charité Medical School,* [2]*dept otolaryngology at ukb, hospital of the univ. of berlin (Charité)*

Pubmed, OvidSP (MEDLINE), EMBASE (DIMDI), the NHR Centre for Reviews and Dissemination (including NHS EED, DARE, and HTA), and the Cochrane Library were searched to identify papers published between January 2006 and December 2015 using the MeSH terms

VSB, mixed hearing loss, conductive hearing loss, middle ear implant, vibroplasty and combinations of them. Data were only extracted if reported in the text or tables, or if they could be accurately calculated from graphs, figures, or raw data sets. Information was extracted from each article on 1) sample characteristics (age, gender, aetiology, diagnosis, treatment received/receiving), 2) type of intervention (use of HA, surgical approach, audio processor type), and 3) type of outcome measures (testing intervals, surgical complications, AC and BC pure tone thresholds, sound-field thresholds, functional gain, hearing preservation, speech perception/recognition at various presentation levels in quiet and noise, results of questionnaires). The evidence presented in the selected studies was assessed and classified using the levels of evidence defined by the Oxford Centre for Evidence-based Medicine.

As demonstrated by the variety of studies reported, the VSB and the specific surgical techniques developed ("vibroplasty") have enabled to adapt this active, electronic middle ear implant to nearly every pathophysiological situation within the middle ear and to restore hearing by amplification of residual hearing. This new strategy in hearing rehabilitation has lead to an improved quality of hearing and life of the patients, respectively.

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Free Papers (F662)

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Prognostic Factors in Paediatric Cochlear Implantation: Definition Location Evaluation

Presenting Author: **Jane Black**

Jane Black[1], Bruce Black[2]

[1]*University of Queensland,* [2]*Lady Cilento Children's Hospital*

Learning Objectives:

Objectives: Accurate prognostication in paediatric cochlear implantation (PCI) is essential for informed counselling of a child's outlook during the pre-operative period. This work sought to devise a methodology by which researchers could more clearly define, locate and evaluate adverse factors in PCI to formulate an accurate prognosis to counsel the family prior to implantation, the key to success in PCI.

Method: Three steps in the prognostic process are addressed 1) the exact site, action, probability and severity of the individual adverse factors are assessed using refined descriptors to more clearly denote the pathology and action of these influences 2) illustration of the anatomical location of the factors along the route of PCI stimulation, location of the pattern of influences and their potential impact on the functional aspects of the auditory pathway 3) an evaluation method is presented that allows location of individual factors, their impact on ability, then an estimation of their cumulative effect, the prognosis. Six domains of ability are assessed: cortical maturation, neurological function, otological, general medical, psychological and family.

Result: Considerable difficulties and deficiencies of prior prognostic works are demonstrated. The work provides a "road map" by which clinicians may assemble an orderly estimation of the threats present in a particular case. The evaluation technique, yet to be validated by clinical research, offers a sensibility method of prognostic assessment in PCI.

Conclusions: PCI prognostication requires precise evaluation of the site, pathology and action of adverse factors with focus on the specific pathology, systematic examination of the auditory pathway and a method of evaluation of the combined effect of several impaired domains. However, the overall impact remains an individual study, case-by-case due to the complexity of each situa, particularly in the complicated management of the child with multiple difficulties.

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Free Papers (F662)

ID: 662.4

Keyhole cochlear implantation surgery: adaptation to Soundbridge and Bonebridge devices

Presenting Author: **Bruce Black**

Bruce Black

University of Queensland/Lady Cilento Children's Hospital

Introduction: Cochlear implantation (CI) techniques have evolved towards progressively minimalist surgery. Three guiding principles have emerged. Firstly, brief, limited surgery, to minimise the overall impact, particularly in small infants. Secondly, safety issues: good outcomes with minimal complications. Thirdly, acceptable psychological/cosmetic results, especially with repect to the families of children.

Hitherto, similar surgical principles for the implantation of other devices has attracted only limited comment.

Materials and Methods: Keyhole CI sugery, as outlined in previous work, has achieved the above outcomes effectively. A later modification stabilises the device in situ using a soluble percutaneious suture passed around the neck of the device, when in the pericranial pocket, replacing previous stabilisation methods. Bony retention wells are avoided.

The Keyhole method has been adapted to the Med EL Soundbridge and Bonebridge devices. The former requires a larger posterior tympanotomy to permit fixation to the incus, and this may be supplemented by a transcanal approach.

The Bonebridge surgery employes a slightly larger auricular incision and a loose pericranial pocket, as fixation is not problematic. The larger pocket facilitates implant positioning over the fixation points.

Results: In over 600 CI cases, plus 36 Soundbridge and 25 Bonebridge cases the keyhole approach has achieved optimal outcomes in terms of the three principles above, being brief, with minimal trauma and scarring.