Volume 11
Supplement 1
December 2021

Prelude to ORLIAC 2022
High Tech in ENT

# ENT Updates

ISSN 2149-6498
entupdatesjournal.org

ENT Updates



AVES

Publisher
İbrahim KARA

Director of Operations
Ali ŞAHİN

Editorial Development
Gizem KAYAN TEKAÜT

Publications Director
İrem SOYSAL

Finance and Administration
Emre KARA

Publication Coordinators
Arzu YILDIRIM
Deniz KAYA
Bahar ALBAYRAK
Gamze BİLGEN
Irmak BERBEROĞLU
Alara ERGİN
Ebru BOZ

Web Coordinator
Sinem Fehime KOZ

Contact
Address: Büyükdere Cad. 105/9
34394
Şişli, İstanbul, Turkey
Phone: +90 212 217 17 00
E-mail: info@avesyayincilik.com

ENT Updates

**Aims and Scope**

ENT Updates is an international, scientific, open access, online-only periodical published in accordance with independent, unbiased, and double-blinded peer-review principles. The journal is published triannually in April, August, and December. The publication language of the journal is English.

ENT Updates aims to contribute to the literature by publishing manuscripts at the highest scientific level on otorhinolaryngology and related subjects. The journal also covers related specialties of ENT such as allergy, pediatrics, neurology, psychiatry neurosurgery, radiology, anesthesiology, pulmonology and etc. The journal welcomes basic and clinical research articles, experimental studies, reviews, case reports, expert opinion on guidelines, systematic reviews, bibliometric analysis, historic communications, and letters to the editors.

The target audience of the journal includes specialists, researchers and professionals who working and interested in the field of otorhinolaryngology or related specialties.

ENT Updates is currently indexed in Web of Science – Emerging Sources Citation Index, DOAJ, Proquest, EBSCO, and TUBITAK ULAKBIM TR Index.

The editorial and publication processes of the journal are shaped in accordance with the guidelines of the International Committee of Medical Journal Editors (ICMJE), World Association of Medical Editors (WAME), Council of Science Editors (CSE), Committee on Publication Ethics (COPE), European Association of Science Editors (EASE), and National Information Standards Organization (NISO). The journal is in conformity with the Principles of Transparency and Best Practice in Scholarly Publishing (doaj.org/bestpractice).
Processing and publication are free of charge with the journal. No fees are requested from the authors at any point throughout the evaluation and publication process. All manuscripts must be submitted via the online submission system which is available at entu.manuscriptmanager.net. The journal guidelines, technical information, and the required forms are available on the journal's webpage.

**Advertisement Policy**
ENT Updates can publish advertisement images in the journal's website upon the approval of the Editor in Chief. Potential advertisers should contact the Editorial Office. Advertisers have no effect on the editorial decisions or advertising policies.

**Disclaimer**
Statements or opinions expressed in the manuscripts published in the journal reflect the views of the author(s) and not the opinions of the editors, editorial board, and/or publisher; the editors, editorial board, and publisher disclaim any responsibility or liability for such materials.

**Open Access Statement**


**Editor in Chief:** Vedat Topsakal
**Address:** Department of Otorhinolaryngology,Vrije Universiteit Brussel, Belgium

**Publisher:** AVES
**Address:** Büyükderece Cad., 105/9 34394 Şişli, İstanbul, Turkey
**Phone:** +90 212 217 17 00
**E-mail:** info@avesyayincilik.com
**Webpage:** www.avesyayincilik.com

**Instructions to Authors**

ENT Updates is an international, scientific, open access, online-only periodical published in accordance with independent, unbiased, and double-blinded peer-review principles. The journal is published triannually in April, August, and December. The publication language of the journal is English.

ENT Updates aims to contribute to the literature by publishing manuscripts at the highest scientific level on otorhinolaryngology and related subjects. The journal also covers related specialties of ENT such as allergy, pediatrics, neurology, psychiatry neurosurgery, radiology, anesthesiology, pulmonology and etc. The journal welcomes basic and clinical research articles, experimental studies, reviews, case reports, expert opinion on guidelines, systematic reviews, bibliometric analysis, historic communications, and letters to the editors.

The target audience of the journal includes specialists, researchers and professionals who working and interested in the field of otorhinolaryngology or related specialties.

**EDITORIAL AND PUBLICATION PROCESS**

The editorial and publication processes of the journal are shaped in accordance with the guidelines of the International Council of Medical Journal Editors (ICMJE), the World Association of Medical Editors (WAME), the Council of Science Editors (CSE), the Committee on Publication Ethics (COPE), the European Association of Science Editors (EASE), and National Information Standards Organization (NISO). The journal conforms to the Principles of Transparency and Best Practice in Scholarly Publishing (doaj.org/bestpractice).

Originality, high scientific quality, and citation potential are the most important criteria for a manuscript to be accepted for publication. Manuscripts submitted for evaluation should not have been previously presented or already published in an electronic or printed medium. The journal should be informed of manuscripts that have been submitted to another journal for evaluation and rejected for publication. The submission of previous reviewer reports will expedite the evaluation process. Manuscripts that have been presented in a meeting should be submitted with detailed information on the organization, including the name, date, and location of the organization.

**PEER REVIEW PROCESS**

Manuscripts submitted to ENT Updates will go through a double-blind peer-review process. Each submission will be reviewed by at least two external, independent peer reviewers who are experts in their fields in order to ensure an unbiased evaluation process. The editorial board will invite an external and independent editor to manage the evaluation processes of manuscripts submitted by editors or by the editorial board members of the journal. The Editor in Chief is the final authority in the decision-making process for all submissions.

**ETHICAL GUIDELINES**

An approval of research protocols by the Ethics Committee in accordance with international agreements (World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects," amended in October 2013, www.wma.net) is required for experimental, clinical, and drug studies and for some case reports. If required, ethics committee reports, or an equivalent official document will be requested from the authors. Submissions which do not have ethical approval will be reviewed according to COPE's Research, Audit and Service Evaluations guideline.

Such manuscripts can be rejected after editorial review due to the lack of ethics committee approval.

For manuscripts concerning experimental research on humans, a statement should be included that written informed consent of patients and volunteers was obtained following a detailed explanation of the procedures that they may undergo.

It is the authors' responsibility to protect the patients' anonymity carefully. For photographs that may reveal the identity of the patients, signed releases of the patient or their legal representative should be enclosed, and the publication approval must be provided in the Methods section.

For studies carried out on animals, an approval research protocols by the Ethics Committee in accordance with international agreements (Guide for the care and use of laboratory animals, 8th edition, 2011" and/or "International Guiding Principles for Biomedical Research Involving Animals, 2012") is required. Also, the measures taken to prevent pain and suffering of the animals should be stated clearly in such studies.

Information on patient consent, the name of the ethics committee, and the ethics committee approval number and date should also be stated in the Methods section of the manuscript.

**PLAGIARISM AND ETHICAL MISCONDUCT**

ENT Updates is extremely sensitive about plagiarism. All submissions are screened by a similarity detection software (iThenticate by CrossCheck) at any point during the peer-review and/or production process.

When you are discussing others' (or your own) previous work, please make sure that you cite the material correctly in every instance.

Authors are strongly recommended to avoid any form plagiarism and ethical misconduct that are exemplified below.

**Self- plagiarism (text-recycling):** Overlapping sections or sentences with the author's previous publications without citing them. Even if you are the author of the phrases or sentences, the text should not have unacceptable similarity with the previously published data.

**Salami slicing:** Using the same data of a research into several different articles. Reporting the same hypotheses, population, and methods of a study is into different papers is not acceptable.

**Data Fabrication:** It is the addition of data that never occurred during the gathering of data or the experiments. Results and their interpretation must be based on the complete data sets and reported accordingly.

**Data Manipulation/Falsification:** It means manipulating research data with the intention of giving a false impression. This includes manipulating images (e.g. micrographs, gels, radiological images), removing outliers or 'inconvenient' results, changing data points, etc.

In the event of alleged or suspected research misconduct, e.g., plagiarism, citation manipulation, and data falsification/fabrication, the Editorial Board will follow and act according to COPE flowcharts.

**PREPRINT**

ENT Updates does not consider preprint publications as prior publication. In other words, authors are allowed to present and discuss their findings on a non-commercial preprint server before submission to a journal.

Authors must provide the journal with the pre-print server deposition of their article accompanying its DOI during initial submission.

If the article is published in the ENT Updates, it is the responsibility of the authors to update the archived preprint and link it to the published version of the article.

**AUTHORSHIP**

Each person listed as an author should fulfill the authorship criteria recommended by the International Committee of Medical Journal Editors (ICMJE - www.icmje.org). The ICMJE recommends that authorship is based on the following four criteria:

1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
2. Drafting the work or revising it critically for important intellectual content; AND
3. Final approval of the version to be published; AND
4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

In addition to being accountable for the parts of the work he/she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. Also, authors should have confidence in the integrity of the contributions of their co-authors.

All those designated as authors should meet all four criteria for authorship, and all who meet the four criteria should be identified as authors. Those who do not meet all four criteria should be acknowledged in the title page of the manuscript.

ENT Updates requires corresponding authors to submit a signed and scanned version of the Copyright Agreement and Acknowledgement of Authorship form (available for download www.entupdates.com.) during the initial submission process to act appropriately on authorship rights and to prevent ghost or honorary authorship. If the editorial board suspects a case of "gift authorship," the submission will be rejected without further review. As part of the submission of the manuscript, the corresponding author should also send a short statement declaring that he/she accepts to undertake all the responsibility for authorship during the submission and review stages of the manuscript.

**CHANGE OF AUTHORSHIP**

ENT Updates reviews the authorship according to the author's declaration in the Title Page, thus it is the authors responsibility to send the final order of the complete author names. Requests in the change of authorship (e.g. removal/addition of the authors, change in the order etc) after submission are subject to editorial approval. Editorial Board will investigate this kind of cases and act following COPE flowcharts.

Change of authorship requests should be submitted to the Editorial Office with an official letter stating the reasons of the change. The letter must be signed by all authors and include their approval on the change in authorship. If the request is approved by the Editorial Board, authors need to submit a new Copyright Agreement Form according to the final order list.

**DECLARATION OF INTEREST**

ENT Updates requires and encourages the authors and the individuals involved in the evaluation process of submitted manuscripts to disclose any existing or potential conflicts of interests, including financial, consultant, and institutional, that might lead to potential bias or a conflict of interest. Any financial grants or other support received for a submitted study from individuals or institutions should be disclosed to the Editorial Board. To disclose a potential conflict of interest, the ICMJE Potential Conflict of Interest Disclosure Form should be filled in and submitted by all contributing authors. The journal's

Editorial Board resolves cases of a potential conflict of interest of the editors, authors, or reviewers within the scope of COPE and ICMJE guidelines.

**APPEALS AND COMPLAINT**
The Editorial Board of the journal handles all appeal and complaint cases within the scope of COPE guidelines. In such cases, authors should get in direct contact with the editorial office regarding their appeals and complaints. When needed, an ombudsperson may be assigned to resolve claims that cannot be resolved internally. The Editor in Chief is the final authority in the decision-making process for all appeals and complaints.

**COPYRIGHT AND LICENSE**
ENT Updates requires each submission to be accompanied by a Copyright Agreement and Acknowledgement of Authorship form (available for www.entupdates.com.). By signing this form, authors retain the copyright of their work and agree that the article, if accepted for publication by the ENT Updates will be licensed under a Creative Commons Attribution-NonCommercial (CC BY-NC) 4.0 International License which permits third parties to share and adapt the content for non-commercial purposes by giving the appropriate credit to the original work.

When using previously published content, including figures, tables, or any other material in both print and electronic formats, authors must obtain permission from the copyright holder. Legal, financial and criminal liabilities in this regard belong to the author(s).

**DISCLAIMER**
Statements or opinions expressed in the manuscripts published in ENT Updates reflect the views of the author(s) and not the opinions of the editors, the editorial board, or the publisher; the editors, the editorial board, and the publisher disclaim any responsibility or liability for such materials. The final responsibility regarding the published content rests with the authors.

**MANUSCRIPT PREPARATION**
The manuscripts should be prepared in accordance with ICMJE-Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals (updated in December 2018 - http://www.icmje.org/icmje-recommendations.pdf). Authors are required to prepare manuscripts in accordance with the CONSORT guidelines for randomized research studies, STROBE guidelines for observational original research studies, STARD guidelines for studies on diagnostic accuracy, PRISMA guidelines for systematic reviews and meta-analysis, ARRIVE guidelines for experimental animal studies, and TREND guidelines for non-randomized public behavior. To find the right guideline for your research, please complete the questionnaire by Equator Network here.

The style of the manuscripts should be prepared according to AMA Manual of Style 11th Edition.

Manuscripts can only be submitted through the journal's online manuscript submission and evaluation system, available at entu.manuscriptmanager.net. Manuscripts submitted via any other medium and submissions by anyone other than one of the authors will not be evaluated.

Manuscripts submitted to the journal will first go through a technical evaluation process where the editorial office staff will ensure that the manuscript has been prepared and submitted in accordance with the journal's guidelines. Submissions that do not conform to the journal's guidelines will be returned to the submitting author with technical correction requests.

Authors are required to submit the following:
- Copyright Agreement and Acknowledgement of Authorship Form, and
- ICMJE Potential Conflict of Interest Disclosure Form (should be filled in by all contributing authors) during the initial submission. These forms are available for download at www.entupdates.com.

**Preparation of the Manuscript**
**Title page:** A separate title page should be submitted with all submissions and this page should include:
- The full title of the manuscript as well as a short title (running head) of no more than 50 characters,
- Name(s), affiliations, highest academic degree(s), and ORCID IDs of the author(s),
- Grant information and detailed information on the other sources of support,
- Name, address, telephone (including the mobile phone number), and email address of the corresponding author,
- Acknowledgment of the individuals who contributed to the preparation of the manuscript but who do not fulfill the authorship criteria.

**Abstract:** An abstract should be submitted with all submissions except for Letters to the Editor. The abstract of Research Articles should be structured with subheadings (Background, Methods, Results, and Conclusion). Please check Table 1 below for word count specifications.

**Keywords:** Each submission must be accompanied by a minimum of three to a maximum of five keywords for subject indexing at the end of the abstract. The keywords should be listed in full without abbreviations. The keywords should be selected from the National Library of Medicine, Medical Subject Headings database (https://www.nlm.nih.gov/mesh/MBrowser.html).

**Main Points:** All submissions except letters to the editor should be accompanied by 3 to 5 "main points" which should emphasize the most noteworthy results of the study and underline the principal message that is addressed to the reader. This section should be structured as itemized to give a general overview of the

article. Since "Main Points" targeting the experts and specialists of the field, each item should be written as plain and straightforward as possible.

**Manuscript Types**

**Research Articles:** This is the most important type of article since it provides new information based on original research. Acceptance of original papers will be based upon the originality and importance of the investigation. The main text of original articles should be structured with Introduction, Material and Methods, Results, and Discussion subheadings. Please check Table 1 for the limitations for Original Articles.

**Clinical Trials**

ENT Updates adopts the ICMJE's clinical trial registration policy, which requires that clinical trials must be registered in a publicly accessible registry that is a primary register of the WHO International Trials Registry Platform (ICTRP) or in ClinicalTrials.gov.

Instructions for the clinical trials are listed below.

- Clinical trial registry is only required for the prospective research projects that study the relationship between a health-related intervention and an outcome by assigning people.
- To have their manuscript evaluated in the journal, author should register their research to a public registry at or before the time of first patient enrollment.
- Based on most up to date ICMJE recommendations, ENT Updates accepts public registries that include minimum acceptable 24-item trial registration dataset.
- Authors are required to state a data sharing plan for the clinical trial registration. Please see details under "Data Sharing" section.
- For further details, please check ICMJE Clinical Trial Policy at http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/clinical-trial-registration.html

**Data Sharing**

As of 1 January 2019, a data sharing statement is required for the registration of clinical trials. Authors are required to provide a data sharing statement for the articles that reports the results of a clinical trial. The data sharing statement should indicate the items below according to the ICMJE data sharing policy:

- Whether individual deidentified participant data will be shared
- What data in particular will be shared
- Whether additional, related documents will be available
- When the data will be available and for how long
- By what access criteria will be shared

Authors are recommended to check the ICMJE data sharing examples at http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/clinical-trial-registration.html

While submitting a clinical trial to ENT Updates,

- Authors are required to make registration to a publicly accessible registry according to ICMJE recommendations and the instructions above.
- The name of the registry and the registration number should be provided in the Title Page during the initial submission.
- Data sharing statement should also be stated in the Title Page even the authors do not plan to share it.

Clinical trial and data sharing policy of the journal will be valid for the articles submitted from 1 March 2021.

**Reporting Statistical Analysis**

Statistical analysis to support conclusions is usually necessary. Statistical analyses must be conducted in accordance with international statistical reporting standards (Altman DG, Gore SM, Gardner MJ, Pocock SJ. Statistical guidelines for contributors to medical journals. Br Med J 1983: 7; 1489-93). Information on statistical analyses should be provided with a separate subheading under the Materials and Methods section and the statistical software that was used during the process must be specified.

Values for reporting statistical data, such as P values and CIs should be presented and rounded appropriately. P values should be expressed to 2 digits to the right of the decimal point unless the first 2 digits are zeros, in which case 3 digits to the right of the decimal place should be provided (eg, instead of P .01, report as P = .002). However, values close to .05 may be reported to 3 decimal places because the .05 is an arbitrary cut point for statistical significance (eg, P = .053). P values less than .001 should be designated as P .001 rather than exact values (eg, P = .000006).

Units should be prepared in accordance with the International System of Units (SI).

**Expert Opinion on Guidelines:** This type of article aims to provide a critical commentary and further discussion of guidelines on otorhinolaryngology. Manuscripts should be a maximum of 3000 words long with an unstructured abstract. Expert opinion on guidelines should be prepared by the senior researchers and clinicians. These authors may be invited by the journal.

**Bibliometric Analysis:** Bibliometric analysis aims to objectively analyze the bibliographic data of published literature to provide an overview of knowledge in a given field of inquiry. Bibliometric studies on otorhinolaryngology and related subjects will be considered for evaluation in ENT Updates.

**Historic Communications:** Historic communications are prepared by senior authors who have extensive knowledge on a particular field, and these authors are invited by the journal. This type of article aims to provide historical background, current perspective, and the progress in the clinical topics of otorhinolaryngology that will affect patient care. A historical communication should be a

maximum of 3000 words long, accompanied by a 150-word unstructured abstract. Original illustrations are highly appreciated.

**Editorial Comments:** Invited brief editorial comments on selected articles are published in the ENT Updates. Editorials should not be longer than 1000 words excluding references. Editorial comments aim to provide a brief critical commentary by reviewers with expertise or with high reputation in the topic of the research article published in the journal. Authors are selected and invited by the journal to provide such comments. Abstract, Keywords, and Tables, Figures, Images, and other media are not included.

**Systematic Reviews:** Systematic reviews focus on a research question that incorporates all high-quality research findings relevant to that question. The manuscript should be structured as Introduction, Methods, Results, and Discussion, and this type of manuscript should reach an evidence-based conclusion. The methods section should clearly state the literature search strategy, data extraction procedure, evidence grading, and type of analysis used. Authors are encouraged to comply with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

**Review Articles:** Reviews prepared by authors who have extensive knowledge on a particular field and whose scientific background has been translated into a high volume of publications with a high citation potential are welcomed. These authors may even be invited by the journal. Reviews should describe, discuss, and evaluate the current level of knowledge of a topic in clinical practice and should guide future studies. The subheadings of the review articles should be planned by the authors. However, each review article should include an "Introduction" and a "Conclusion" section. Please check Table 1 for the limitations for Review Articles.

**Case Reports:** There is limited space for case reports in the journal and reports on rare cases or conditions that constitute challenges in diagnosis and treatment, those offering new therapies or revealing knowledge not included in the literature, and interesting and educative case reports are accepted for publication. The text should include Introduction, Case Presentation, and Discussion with an unstructured abstract. Please check Table 1 for the limitations for Case Reports.

**Letters to the Editor:** This type of manuscript discusses important parts, overlooked aspects, or lacking parts of a previously published article. Articles on subjects within the scope of the journal that might attract the readers' attention, particularly educative cases, may also be submitted in the form of a "Letter to the Editor." Readers can also present their comments on the published manuscripts in the form of a "Letter to the Editor." Abstract, Keywords, and Tables, Figures, Images, and other media should not be included. The text should be unstructured. The manuscript that is being commented on must be properly cited within this manuscript.

**Tables**

Tables should be included in the main document, presented after the reference list, and they should be numbered consecutively in the order they are referred to within the main text. A descriptive title must be placed above the tables. Abbreviations used in the tables should be defined below the tables by footnotes (even if they are defined within the main text). Tables should be created using the "insert table" command of the word processing software and they should be arranged clearly to provide easy reading. Data presented in the tables should not be a repetition of the data presented within the main text but should be supporting the main text.

**Figures and Figure Legends**

Figures, graphics, and photographs should be submitted as separate files (in TIFF or JPEG format) through the submission system. The files should not be embedded in a Word document or the main document. When there are figure subunits, the subunits should not be merged to form a single image. Each subunit should be submitted separately through the submission system. Images should not be labeled (a, b, c, etc.) to indicate figure subunits. Thick and thin arrows, arrowheads, stars, asterisks, and similar marks can be used on the images to support figure legends. Like the rest of the submission, the figures too should be blind. Any information within the images that may indicate an individual or institution should be blinded. The minimum resolution of each submitted figure should be 300 DPI. To prevent delays in

**Table 1. Limitations for each manuscript type**

| Type of manuscript | Word limit* | Abstract word limit | Reference limit | Table limit | Figure limit |
|---|---|---|---|---|---|
| Research Article | 4000 | 250 (Structured) | 35 | 6 | 5 or total of 10 images |
| Expert Opinion on Guidelines | 3000 | 250 | 40 | 5 | 4 or total of 8 images |
| Bibliometric Analysis | 4000 | 250 | 35 | 5 | 4 or total of 8 images |
| Historic Communications | 3000 | 150 | 35 | 5 | 4 or total of 8 images |
| Editorial Comments | 1000 | No Abstract | 5 | No tables | No media |
| Systematic Reviews | 5000 | 250 | 50 | 6 | 10 or total of 15 images |
| Review Article | 5000 | 250 | 50 | 6 | 10 or total of 15 images |
| Case Report | 1200 | 200 | 15 | No tables | 4 or total of 8 images |
| Letter to the Editor | 400 | No Abstract | 5 | No tables | No media |

*Word limit should not include the abstract, references, tables, and figure legends.

the evaluation process, all submitted figures should be clear in resolution and large in size (minimum dimensions: 100 × 100 mm). Figure legends should be listed at the end of the main document.

All acronyms and abbreviations used in the manuscript should be defined at first use, both in the abstract and in the main text. The abbreviation should be provided in parentheses following the definition.

When a drug, product, hardware, or software program is mentioned within the main text, product information, including the name of the product, the producer of the product, and city and the country of the company (including the state if in USA), should be provided in parentheses in the following format: "Discovery St PET/CT scanner (General Electric, Milwaukee, WI, USA)"

All references, tables, and figures should be referred to within the main text, and they should be numbered consecutively in the order they are referred to within the main text.

Limitations, drawbacks, and the shortcomings of original articles should be mentioned in the Discussion section before the conclusion paragraph.

**References**
Both in-text citations and the references must be prepared according to the AMA Manual of Style 11th Edition.

While citing publications, preference should be given to the latest, most up-to-date publications. Authors are responsible for the accuracy of references If an ahead-of-print publication is cited, the DOI number should be provided. Journal titles should be abbreviated in accordance with the journal abbreviations in Index Medicus/MEDLINE/PubMed. When there are six or fewer authors, all authors should be listed. If there are seven or more authors, the first three authors should be listed followed by "et al." In the main text of the manuscript, references should be cited in superscript after punctuation. The reference styles for different types of publications are presented in the following examples.

**Journal Article:** Ağdaş F, Eryılmaz A, Gökmen Yılmaz E, Ergin K. The effect of Sulindac on cell viability, cell cycle and angiogenesis in pharyngeal cancer cells. ENT Updates. 2020;10(3):373-380.

**Book Section:** Fikremariam D, Serafini M. Multidisciplinary approach to pain management. In: Vadivelu N, Urman RD, Hines RL, eds. Essentials of Pain Management. New York, NY: Springer New York; 2011:17-28.

**Books with a Single Author:** Patterson JW. Weedon's Skin Pahology. 4th ed. Churchill Livingstone; 2016.

**Editor(s) as Author:** Etzel RA, Balk SJ, eds. Pediatric Environmental Health. American Academy of Pediatrics; 2011.

**Conference Proceedings:** Morales M, Zhou X. Health practices of immigrant women: indigenous knowledge in an urban environment. Paper presented at: 78th Association for Information Science and Technology Annual Meeting; November 6-10; 2015; St Louis, MO. Accessed March 15, 2016. https://www.asist.org/files/meetings/am15/proceedings/openpage15.html

**Thesis:** Maiti N. Association Between Behaviours, Health Characteristics and Injuries Among Adolescents in the United States. Dissertation. Palo Alto University; 2010.

**Online Journal Articles:** Tamburini S, Shen N, Chih Wu H, Clemente KC. The microbiome in early life: implications for health outcometes. Nat Med. Published online July 7, 2016. doi:10.1038/nm4142

**Websites:** International Society for Infectious Diseases. ProMedmail. Accessed February 10, 2016. http://www.promedmail.org
Epub Ahead of Print Articles: Cai L, Yeh BM, Westphalen AC, Roberts JP, Wang ZJ. Adult living donor liver imaging. Diagn Interv Radiol. 2016 Feb 24. doi: 10.5152/dir.2016.15323. [Epub ahead of print].

**REVISIONS**
When submitting a revised version of a paper, the author must submit a detailed "Response to the reviewers" that states point by point how each issue raised by the reviewers has been covered and where it can be found (each reviewer's comment, followed by the author's reply and line numbers where the changes have been made) as well as an annotated copy of the main document. Revised manuscripts must be submitted within 30 days from the date of the decision letter. If the revised version of the manuscript is not submitted within the allocated time, the revision option may be canceled. If the submitting author(s) believe that additional time is required, they should request this extension before the initial 30-day period is over.

Accepted manuscripts are copy-edited for grammar, punctuation, and format. Once the publication process of a manuscript is completed, it is published online on the journal's webpage as an ahead-of-print publication before it is included in its scheduled issue. A PDF proof of the accepted manuscript is sent to the corresponding author and their publication approval is requested within 2 days of their receipt of the proof.

**Editor in Chief:** Vedat Topsakal
**Address:** Department of Otorhinolaryngology, Vrije Universiteit Brussel, Belgium

**Publisher:** AVES
**Address:** Büyükderece Cad., 105/9 34394 Şişli, İstanbul, Turkey
**Phone:** +90 212 217 17 00
**E-mail:** info@avesyayincilik.com
**Webpage:** www.avesyayincilik.com

**Contents**

ENT Updates

Prelude to ORLIAC 2022
DOI: 10.5152/entupdates.2021.001

# Robot-Assisted Middle Ear Endoscopic Surgery: Preliminary Results on 32 Patients

Yann Nguyen, M. Veleur, G. Lahlou, R. Torres, H. Daoudi, I. Mosnier, E. Ferrary, O. Sterkers

*Sorbonne Université, AP-HP, GHU Pitié-Salpêtrière, Service ORL, GRC Robotique et Innovation Chirurgicale, Paris, France*
*Inserm UMR 1120 "Innovative Technologies and Translational therapeutics for deafness", Hearing Institute Paris, Paris, France*

**Background:** Endoscopy during middle ear surgery is advantageous for a better exploration of the middle However, using an endoscope shows some weakness as a surgical gesture is performed by one hand. This may disturb surgeons accustomed to two-handed surgery which affects accuracy and guidance. A robot-based holder may combine the benefits of endoscopic exposure and a two-handed technique. The purpose of this study was to assess the safety and value of an endoscope held by a teleoperated system such as the RobOtol® (Collin Medical, Bagneux, France).

**Methods:** A case series of 32 consecutive patients operated with an endoscopic exposure with robot-based assistance were analyzed retrospectively. The RobOtol® system was teleoperated as an endoscope holder alone or in combination with the microscope. Available endoscopes were 0° or 30° and 3.3 mm diameter (Karl Storz, Tuttlingen, Germany).
Patient demographics, indications for surgery, procedure type, complications, ossicular chain defect, incision type, ossicular chain reconstruction surgery material, mean air and bone conduction threshold, air-bone gap, air-bone gap gain, word recognition score, at 3 months-postoperative mean operation duration were collected.
Patient had a type I (myringoplasty), II (partial ossiculoplasty), or III (total ossiculoplasty) in 14, 13, and 3 cases, respectively. In 2 cases, patients had a partial petrosectomy for extended cholesteatoma to the petrous apex with posterior labyrinth drilling. Ambulatory procedure was carried out in 22 out of 32 patients (69%).

**Results:** Mean postoperative surgical duration was 157±9.8 min [53-313 min]. Complete healing with no perforation of tympanic membrane was noted in postoperative in all patients. No complications related to the robot manipulation occurred during surgery nor in postoperative. Mean bone conduction variation was 1±3.5 dB (mean± SEM). Mean air conduction gain was 11±4.5 dB for type I (n = 14), 11±4.8 dB for type II (n = 13), or 35±29 dB for type III (n = 3) tympanoplasty, respectively. Postoperative air-bone conduction gap was 12±4 (n = 14) dB for type I, 19±4.3 dB for type II, or 14±7.9 dB for type III tympanoplasty.

**Conclusion:** This study shows that robot-assisted endoscopy is a safe and trustworthy tool for several categories of middle ear procedures. It combines the benefits from endoscopic exposure and a two-handed technique in the surgery of the middle ear. It can be used as a standalone tool for pathology limited to the middle cleft or in combination with the microscope in an extended lesion to the mastoid or petrous apex.

# Robot-Assisted Cochlear Implantation: The Robotol® System Experience

Daniele De Seta[3], Yann Nguyen[2], Hannah Daoudi[1], Renato Torres[1], Isabelle Mosnier[2], Olivier Sterkers[1]

[1]*Inserm / Institut Pasteur, Institut de l'Audition, Technologie et thérapie génique de la surdité, Paris, France,* [2]*Sorbonne Université / AP-HP, GHU Pitié-Salpêtrière, DMU ChIR, Service ORL, GRC Robotique et Innovation Chirurgicale, Paris, France,* [3]*Università di Cagliari, Dipartimento di Scienze Chirurgiche, unità di Otorinolaringoiatria, Cagliari, Italy*

**Background:** Robotic surgery in the last years has gained popularity in otology as an effective tool to improve the accuracy of surgical gestures by reducing involuntary movements of the surgeon such as tremor, drift, undershoot and overshoot, and jerk-a sudden muscular reflex. Moreover, it could improve the force-control feedback. Recent studies report that cochlear implantation may take advantage of the robotic assistance in all the steps of the surgery: the approach to the middle ear by automated mastoidectomy and posterior tympanotomy through a tunnel also known as direct cochlea access; a minimally invasive cochleostomy by means of robot-assisted drilling tool; the alignment of the correct insertion axis on the cochlear basal turn; the insertion of the electrodes array via motorized insertion tools.

**Methods:** We report the experience of the cochlear implantation with the RobOtol® system, a robot-based teleoperated arm with 6 *df* developed to be able to operate in the middle ear and mastoid.
Cochlear insertions are possible using specific tools available for the different electrode arrays (straight or precurved) that can be connected to the instrument holder arm. After the opening of the round window membrane, the array is aligned to the chosen insertion axis and pushed in the scala tympani by the controlled movement of the robotic arm; for this purpose, all the axes of freedom of the robot are blocked (X-, Y-, and rotation axes) with the exception of the Z-axis, allowing the robot arm to move linearly along the trajectory at constant low insertion speed.

In the present series, both straight (8 Cochlear CI522/622 and 8 AB Slim J) and precurved (4 AB Mid-Scala) electrode arrays were robotically implanted and matched to 40 manual implantations. Three-dimensional reconstruction images of the basilar membrane and the electrode arrays were obtained from pre- and postimplantation CT scans, and intracochlear EA position was analyzed.

**Results:** At present, more than 100 CIs have been implanted with the aid of RobOtol® in several cochlear implant centers around Europe and China, and the number of procedures and published data from these groups is rapidly increasing. For straight electrode arrays, scalar translocations occurred in 19% of the robot-assisted group and 31% of the manually inserted group. Considering the number of translocated electrodes, this was lower in the robot-assisted group (7%) than in the manually inserted group (16%) ($P < .0001$). For precurved electrode arrays, scalar translocations occurred in 50% of the robot-assisted group and 38% of the manually inserted group. The average total time of surgery was 138±7.1 minutes versus 109±4.0 minutes for the manual insertions.

**Conclusion:** The results from the first robotized electrode arrays insertions were very encouraging, showing a trend to less traumatic insertion compared with manual insertion. The use of robot-assisted insertion allows a slow and constant insertion speed and the possibility to modify the insertion axis during the insertion, for example, in the case of changes during intraoperative electrocochleography recording. Furthermore, preoperative calculation of the optimal insertion axis enables a robotic semiautomated insertion and would further reduce the incidence of electrode array misplacement.

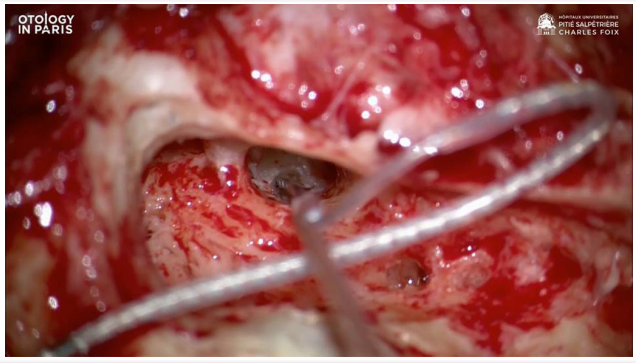


Figure 1. Eight Cochlear CI522/622, eight AB Slim J

## Autonomous Inner Ear Access in Robot-Assisted Cochlear Implant Surgery (RACIS)

Vedat Topsakal[1], Griet Mertens[2], Vincent Van Rompaey[2], Paul Van De Heyning[2]

[1]*UZ Brussel- Vrije Universiteit Brussel, Brusssels, Belgium,* [2]*UZA Antwerpen-University of Antwerp, Antwerp, Belgium*

The HEARO® robotic system is an assistive otological next-generation surgical robot to assist the surgeon with cochlear implantation surgery. It provides software-defined spatial boundaries for orientation and reference information to anatomical structures in order to execute drilling directly toward the inner ear to facilitate keyhole access. Here, we report not only the feasibility but also the safety and efficiency of this procedure for Robot-assisted cochlear implant surgery in the first 25 patients. All patients indicated for cochlear implantation in a routine conventional work-up fulfilling the audiological criteria were radiologically screened. Patients with suitable anatomy were approached for participation with written informed consent. This clinical trial was approved by the medical ethics comity. Seven cases had not passed the radiological screening and only one patient opted to have conventional cochlear implantation surgery. The robot-assisted cochlear implant surgery was performed in 25 patients including 6 women (24%) and 19 men (76%). The age values of 25 patients ranged from 20 to 89 (Figure 5). Three procedures were converted to conventional surgery because of our safety protocols, mainly for the facial nerve during drilling of middle ear access. In total, 22 procedures were successfully drilled up to the level of the inner ear without any facial nerve injuries or any other adverse events. From these 22 cases, all patients had a full insertion of the cochlear implant. In 1 case, the post-op image showed that the last electrode was at the level of the round window. Although the patient had auditory sensations with this electrode, it was the only electrode that was switched off by the audiologist. Specific cases with aberrant anatomy, surgical challenges, and anatomical accuracy will be discussed in the presentation. We conclude that the HEARO® procedure is safe and effective assistive tool for a cochlear implant surgeon.

Figure 1. The HEARO procedure is ce marked for cochlear implantation and won the Swiss medisch prize in 2019

## Pediatric Endoscopic Airway Surgery

Wei-Chung Hsu

*Division of Pediatric Otolaryngology, Department of Otolaryngology Head and Neck Surgery, College of Medicine, National Taiwan University, National Taiwan University Hospital & Children's Hospital*

Pediatric endoscopic airway surgery has been evolutionized and resurgent in the management of pediatric airway diseases due to modern high-tech instruments, availability of new biomaterials, and integration with endoscopic procedures, which are also complimentary for traditional open airway surgery. As we all know, pediatric airway problem is always a life-threatening challenge for pediatric otolaryngologists. In the past decades, tracheostomy and open reconstructive surgeries were the main choices for parents to keep the babies surviving by bypassing the obstructive upper airway. However, long-term tracheotomy-dependent impacted both children and family on the respiration, swallowing, phonation, and quality of life. Nowadays, by modern high-tech medical advancement, minimally invasive surgical intervention as precision medicine requested was the mainstream. Therefore, endoscopic techniques for the management of the airway in pediatric patients have matured greatly with the introduction of laser, microdebrider, coblator, balloon dilator, bioresorbable stents, and applicable topical agents such as tissue fibrin glue, etc. For example, to treat severe laryngomalacia, subglottic hemangioma, laryngeal papillomatosis, laryngeal web, laryngeal cleft, subglottic or tracheal stenosis, bilateral vocal fold paralysis, tracheobronchial tumor, congenital fistula, etc., all could be effectively treated in selective cases. These developments have proved that pediatric endoscopic techniques combined with high-tech products and devices can be performed in the airway safely and effectively when a team approach is well-collaborated. The appropriate choice of accessory instruments or devices, professional pediatric anesthesia access, post-operation intensive cares, cooperation and understanding of families were all essential factors for a successful endoscopic airway surgery in children. With recent advancements in optic instrumentation, high-resolution digital video systems, and endoscopic techniques, therapeutic interventional endoscopic surgeries have replaced some traditional open surgical techniques and become the primary option for pediatric airway initial management during the modern practices of pediatric otolaryngology. Successfully coupling accessory high-tech instruments to an endoscope represented a logical extension of the clinical application of modern medical techniques. Using this modality, a pediatric otolaryngologist takes advantage of endoscopic access, precise tissue vaporization, better hemostasis, minimal local inflammation with relatively painless and less subsequent edema of the narrow airway in the pediatric population. Therefore, in conclusion, pediatric endoscopic airway surgery is not only confined to clinical diagnosis but also may treat successfully certain airway diseases which could avoid performing tracheostomy in children with aerodigestive disorders.

## Transoral Robotic Surgery for Oropharyngeal Cancer

Armando de Virgilio

*Department of Otorhinolaryngology, Humanitas University, Italy*

The introduction of transoral robotic surgery in 2009 dramatically changed the history of oropharyngeal carcinoma treatment, pushing again surgery as a valid treatment alternative in selected cases. The possibility to reduce surgical invasiveness allows to achieve a radical treatment with excellent functional results. Although no randomized comparisons are now available, oncological and functional results appear overlapping from the analysis of gross data obtained from the literature on transoral robotic surgery and IMRT.

As a consequence, from 2009, we can observe a significant increase in the proportion of all surgical procedures performed as primary treatment for oropharyngeal SCC and especially in T1-2 tumors. In parallel, in the first 2000, it became clear that HPV positivity

represents a positive prognostic impact for OPSCC. In general, the prognosis for HPV-positive oropharyngeal cancer patients is better than that for patients with HPV-negative tumors, regardless of nodal status, age, stage, tumor differentiation, or gender. Several studies have shown OS rates of 80-95% at 2-3 years for the HPV-positive patients compared to 57-62% for the HPV-negative subgroup of oropharyngeal tumors. Nowadays, HPV+ OPSCC is considered by NCCN as a distinct pathological entity with dedicated guidelines and TNM staging.

The evidence of the excellent OS of HPV+ OPSCC pushed the dispute between transoral robotic surgery and IMRT into a new battlefield. Radiation oncologists and surgeons hypothesized that a less aggressive cancer could be efficiently treated with a less aggressive treatment: de-escalation was born.

The aim of the present lecture is to illustrate the current status of research in de-intensification surgery through transoral robotic surgery in the treatment of the OPSCC.

## Transoral Robotic Surgery for Laryngeal Cancer

Chen-Chi Wang

*Department of Otolaryngology Head and Neck Surgery, Taichung Veterans General Hospital, Taiwan*

**Background:** Transoral robotic surgery has been widely used for treating oropharyngeal cancers. However, transoral robotic surgery for conservative or radical treatment for laryngeal cancers is seldom reported.

**Methods:** The first part of the study was on transoral robotic surgery for fresh or salvage conservative surgery on glottis cancer involving the anterior commissure. From July 2010 to December 2019, 22 patients with early T1 and 2 stage primary (n = 11) or recurrent (n = 11) glottic cancer with anterior commissure involvement received transoral robotic surgery without adjuvant therapy in a tertiary referral medical center. Only 2 patients received neck dissection due to suspected cervical metastasis but the pathologic results were negative.The second part of the study was on transoral robotic surgery for total laryngectomy. From November 2013 to August 2017, another 7 patients with recurrent laryngeal cancers without evidence of neck metastasis were selected to receive transoral robotic surgery-assisted TL without neck dissection, while conservative surgery was not possible anymore.Results
In the first part, after a mean follow-up of 49±35.9 months, the Kaplan-Meier method estimated 5-year overall/disease-specific/recurrence-free survival, and organ preservation of 22 patients was 93.75%, 93.75%, 74.56%, and 86.3%, respectively. The 11 patients receiving salvage treatment had a higher (45.45%) recurrence rate after transoral robotic surgery. However, the patients could be rescued by further total laryngectomy without compromising their survival. In the follow-up, only one patient expired. The other 21 patients could have satisfactory swallowing function with functional outcome swallowing scale of 0.33±0.66. Five patients depended on tracheostomy, but the remaining 17 patients had a serviceable voice with a voice handicap index-10 of 18.41±11.29.
In the second part, transoral robotic surgery-assisted TL was successfully performed on all 7 patients with a mean surgical console time of 111±66 minutes. Strap muscles and hyoid bone were resected like open surgery in 6 and 5 patients, respectively. For all the 7 patients, there was no severe pharyngo-cutaneous fistula formation requiring repair in a second surgery but tracheostoma stenosis was not uncommon (57%). Three patients received adjuvant chemotherapy/radiotherapy. After a follow-up of 36.1±15.8 months, 2 patients had neck recurrence, 1 patient died 19 months after surgery, but the other 5 patients were alive without disease recurrence. The overall survival rate was 85.7% (6/7), and all patients had good swallowing function without tube feeding.

**Conclusion:** Our results suggested that transoral robotic surgery is feasible for both primary and salvage conservative treatment of glottis cancer with anterior commissure involvement. In addition, transoral robotic surgery-assisted TL is a feasible approach for selected patients with recurrent laryngeal cancers. The oncologic and functional outcomes were satisfactory. A further larger cohort study is worthwhile to further elucidate the value of transoral robotic surgery for laryngeal cancers.

## Transoral Robotic Surgery for Hypopharyngeal Cancer

Wen-Jiun Lin

*Department of Otorhinolaryngology Head and Neck Surgery, Taichung Veterans General Hospital, Taiwan*

**Background:** Transoral robotic surgery has been used for treating hypopharyngeal cancer for several years. However, the long-term oncologic results and functional outcomes of transoral robotic surgery, the sparing rate of adjuvant irradiation after transoral robotic surgery, and the feasibility of neoadjuvant chemotherapy before transoral robotic surgery were seldom reported in the literature.

**Methods:** From September 2014 to May 2018, 20 patients with clinical T1-T3 cancers of hypopharynx were prospectively recruited for transoral robotic surgery in a tertiary referral medical center. All 20 patients were suggested to receive transoral robotic surgery with neck dissection and Cisplatin-based neoadjuvant chemotherapy was given in 11 patients before the surgery. After transoral robotic surgery, the pathologic reports were used to assess the risk of disease and the need for adjuvant irradiation. After long-term

follow-up, the survival was presented by the Kaplan-Meier method. Swallowing and voice function were reported by the Functional Outcome Swallowing Scale and Voice Handicap Index-10.Results
The primary tumor sizes were all reduced in 11 patients who received neoadjuvant chemotherapy. Transoral robotic surgery was finished successfully without major complications in 20 recruited patients. After surgery, only 40% of patients needed adjuvant irradiation with a mean dosage of 5933 cGY. With a mean follow-up of 38.9±14.7 months, the estimated 5-year disease-specific survival was 89.4%. In the last follow-up, 17 patients were alive without tracheostomy and tube feeding. The mean ± standard deviation of Functional Outcome Swallowing Scale (0.1±0.3) and Voice Handicap Index-10 (1.5±4.0) showed they had good functional outcomes.

**Conclusion:** Transoral robotic surgery is an effective, minimal-invasive organ-preserving surgery. Irradiation could be avoided or the dosage should be reduced in about half of our patients. The 5-year long-term survival and functional outcomes were satisfactory. Preliminary results showed that neoadjuvant chemotherapy is a potential method for downsizing the tumor and facilitating tumor resection in transoral robotic surgery and it merits further investigation.

## Three-Dimensional Computer-Assisted Surgical Planning in Mandibular Reconstruction

Thanitta Bovornprus, Phakdee Sannikorn

*Department of Otolaryngology, Head and Neck Surgery, Rajavithi Hospital, Thailand*

The reconstruction of the mandible after resection is one of the most challenging procedures. The free-hand technique consumes more operative time, needs experienced surgeons in plate bending and bony reconstruction.

We have used virtual planning (3D planning) in the treatments of mandibular tumors resection and reconstruction with free tissue transfer. Tumor mapping in 3-dimensional images helps surgeons to analyze better. The resection and reconstruction plans are made before operation. The mandible cutting guide gives a better result for the tumor margin. The fibular cutting guide facilitates bone reconstruction at the correct angle. Prebent plates are an advantage to decrease the operative time.

There are also some limitations of virtual planning, those are perfect for bone, not soft tissue planning. Virtual planning could not replace surgical skills. Sometimes, we could not achieve the plan. The surgeon's decision and flexibility in the operation are still the most important. The planning, manufacturing of patient-specific cutting guides, and 3D model may lengthen the waiting time to operation.

## High Tech Transoral Tongue Base Surgery: A Comparative Evaluation

Claudio Vicini, Giannicola Iannella, Giuseppe Meccariello, Angelo Eplite

*ENT Unit, Forlì and Faenza Hospital, H&N Department-AUSL Romagna, University of Bologna and Ferrara, Italy*

Tongue base area surgery is even now a challenge in our clinical practice. In the last decade, transoral robotic surgery was applied in an extensive way for removing TB cancers and for clearing retrolingual airways in OSA and proved to be a very reliable tool. More recently, a 3D endoscope was introduced offering one more option for a tridimensional visualization of upper airways. At the same time, a wide range of new technologies was developed for a more targeted, soft, and minimally aggressive tissue manipulation (e.g., Coblator). The aim of our contribution is to compare 2 different high-tech settings for approaching tongue base in benign disease according to our experience. The data of about 700 cases are analyzed in order to discuss the pros and cons of 2 different settings:

1. transoral robotic approach by Da Vinci (3D scope+ monopolar), and
2. transoral Storz Vitom endoscope + coblator.

Both systems were applied to an identical case mix of situations, in order to describe the best application of each of them for technological optimization.

## Transcanal Endoscopic Ear Surgery for Attic Retraction Pockets

Chung Thuy, KM Thai, LK Huy

*Department of ENT, Vietnam National University HCMC Faculty of Medicine, Vietnam*

**Aim:** Assessment of the results of transcanal endoscopic ear surgery in patients with attic retraction pockets.

**Methods:** A descriptive study of 25 patients with attic retraction pockets for whom transcanal endoscopic ear surgery was performed to take out the retraction pockets at Ear Nose and Throat Hospital of Ho Chi Minh City.

**Result:** In 25 cases, the mastoid bone was preserved with transcanal endoscopic approach, and the clinical symptoms improved a lot after surgery. After a mean follow-up time of 20.28±8.57 months, our success rate is 96% with 1 recurrent case needed second operation. Eleven out of 25 cases with ossicular chain discontinuity have undergone ossicular chain reconstruction with an improved mean PTA of 10.4 dB.

**Conclusion:** Transcanal endoscopic ear surgery is an effective method for the treatment of attic retraction pockets, improving patient's clinical symptoms. Endoscopic surgery helps preserve the mastoid bone and provides a good view and control of the attic space. However, during surgery, checking the facial recess was important to prevent recurrence at this place after surgery.

## Neurovascular Conflict and Endoscopic-Assisted Decompression

Arnaud Deveze

*Ear & Skull Base Institute, Clairval Hospital Ramsay Santé, Marseille France*
*Laboratory of Applied Biomechanisms, UMR T 24 – Gustave Eiffel University & Aix Marseille University, Marseille, France*

Neurovascular compression syndromes are nowadays quite fully understood. Imaging findings, symptoms, and surgical treatment are becoming routine. From these, hemifacial spasm and trigeminal neuralgia are the 2 most common conditions related to neurovascular compression syndrome. The initial surgical procedure done in 1965 by Janetta became more routinely acceptable in the 90s, with the concept of mini-invasive surgery using retrosigmoid approach thanks to the association of endoscope and microscope during surgery that led to more efficient decompressive surgery.

Back to the huge experience of the department headed by Professor Jacques MAGNAN (that started the minimal invasive procedure in 1974), we demonstrated that the systematic use of the endoscopy improved the quality of the visualization of the conflict, reducing mobilization of cerebellum and brainstem structure and drastically improving the final results.

Endoscopy has, here, a valuable role, since it allows checking the REZ of the facial nerve without extensive dissection of the acoustico-facial nerve bundle. Hence, the dissection of the flocculus, which hides the REZ of the facial nerve, is one of the riskiest factors for additional injury of the cochlear nerve, leading to various degrees of sensorineural hearing loss.

In addition, checking the REZ of the facial nerve before manipulating the arteries and arachnoid layers prevent accidental mobilization of the offending vessel, which may be a cause of misdiagnosis.

Eventually, the quality of the decompression realized is controlled under the final endoscopy of the CPA.

We will be presenting a summary of the experience of more than 600 patients operated from hemifacial spasm, demonstrating the benefit of endoscopic using video-case presentation and discussing the feasibility of carrying fully endoscopic decompression of neurovascular compression syndrome.

## A Novel Technique for Patulous Eustachian Tube Augmentation

Holger Sudhoff

*Department of Otorhinolaryngology Head and Neck Surgery, Bielefeld University Medical Faculty OWL, Campus Klinikum Bielefeld, Bielefeld, Germany*

Patients suffering from patulous Eustachian tube dysfunction (PETD) underwent one of the following procedures: Group (A) transpalatinatal soft-tissue bulking agent with infiltration/augmentation under local anesthesia in a sitting position, group (B) transpalatinatal soft-tissue bulking agent infiltration/augmentation under general anesthesia in the flat position or group (C) infiltration/transoral augmentation of the ET with velotraction under general anesthesia in a flat position. The requirement to repeat the procedure due to the recurrence of any PETD-related symptoms was recorded and retrospectively analyzed. A total of 50 procedures were executed in 50

patients with unilateral PETD. The necessity to perform a second procedure has analyzed a mean of 6 months postoperatively (range: 6-17 months). Compared to the transpalatinatal augmentation in local anesthesia (group A) (100% success rate), the 6-month failure rate was significantly higher for transpalatinatal augmentation under general anesthesia (group B) (80% success rate) and velotraction augmentation under general anesthesia (group C) (67% success rate). Patient cohort with transpalatinatal augmentation under general anesthesia required 20% and augmentation with velotraction under general anesthesia required 33% revision augmentation procedures reviewed at 6 months follow-up (mean follow-up 11.2 months). Although all different approaches resulted in a reduction of PETD-related symptoms, the transpalatinatal ET augmentation in local anesthesia achieved a statistically significant superior clinical improvement. A complete resolution of PETD-related symptoms was obtained and required additional procedures. This improvement may be related to the intraoperative "feedback" by the patients in local anesthesia in the sitting position eliminating the necessity for repeated procedures.

## Videoexoscopic Surgery of Aerodigestive Tract Using 4K3D Exoscopy

Shigeru Hirano, Yoichiro Sugiyama

*Kyoto Prefectural University Of Medicine, Kyoto, Japan*

**Background:** ORBEYE, 4K3D exoscope, is an innovative technology developed by Olympus Co. (Tokyo). ORBEYE provides high-definition images with 4K technology and 3D images which improve the visuality for the surgeon as well as for observers including residents, students, nurses, and other medical staff, which has a great advantage for educational purposes. We report our experience on the use of ORBEYE for the surgery of the aerodigestive tract.

**Methods:** ORBEYE was used for phonomicrosurgery and pediatric tracheostomy.

**Results:** ORBEYE provided clear 3D surgical images in phonomicrosurgery for cases with vocal fold cancer and piriform sinus fistula. As ORBEYE is much more compact than a microscope, the surgeon had a wide working space. ORBEYE also provided very clear and vivid surgical images in pediatric tracheostomy which ordinarily give a limited surgical field. ORBEYE enabled precise procedure by the magnified 3D surgical fields.

**Conclusion:** ORBEYE has proven to have many possibilities to be effectively used in several surgeries for the aerodigestive tract.

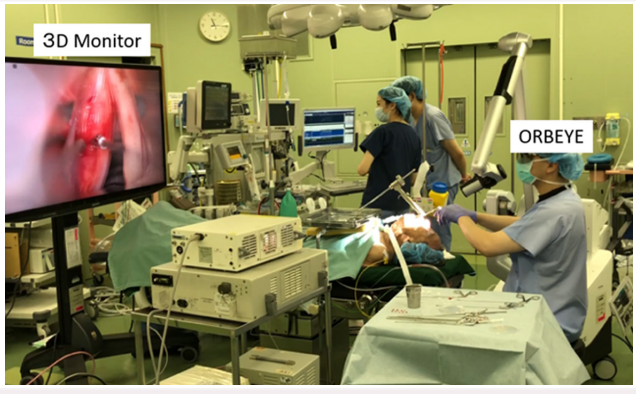


Figure 1. Phonomicrosurgery with ORBEYE

## Exoscopes: A New Feature Coming in Between Microscopes and Endoscopes

O. Nuri Özgirgin

*Department of Otolaryngology-Head and Neck Surgery, Bayındır Hospital, Ankara, Turkey*

Unobstructed surgical field access is a must for otological microsurgical success. This also requires sufficient magnification, illumination, and wide fields of view. The device maintaining these should be ergonomic.

Until recently, there have been 2 major tools to achieve this: microscopes and endoscopes. Indeed, endoscopes have become popular by 2008. And now exoscopes, by gathering the benefits of both microscopes and endoscopes are introduced. They offer 3D visual images in 4K.

They provide magnification, lighting, and high-definition images with a longer optical working distance. The focal depth is considerably high. The exoscopes are easily handled and can be fixed for the surgical field by an arm holder.

One of the important advantages is recording in high definition that enables the surgeons to share videos for didactic sessions. The assistant can better experience the surgical operation and the surgeon's actions with a direct view. With this opportunity, the transition from the role of assistant to that of the first operator can be facilitated.

They provide educational and training opportunities for residents, fellows, students, and operating room staff by offering the same vision as that of surgeons. The 3D technology provides a high perception of depth and surgical dissection technique for assistants.

Three different kinds of otologic surgery will be presented by using Vitom 3D.

## Beyond the Microscope in Ear and Lateral Skull Base Surgery: From Endoscope to Exoscope to Robotic Ear Surgery

Livio Presutti

*Clinic of Otolaryngology, Bologna University, Bologna, Italy*

Ear surgery has been traditionally performed by means of an operative microscope expanding its boundaries up to the lateral skull base with a rich variety of transcanal, transmastoid, and transpetrous approaches. Recently, thanks to the advent of the endoscope and its application to this field, minimally invasive approaches (e.g., transcanal, supragenicular, infracochlear, and transpromontorial) have been developed achieving satisfactory outcomes in terms of disease control and function. Moreover, data regarding its role as a teaching tool for surgeons and students have been reported. During the last few years, exoscopes, combining the advantages and limiting disadvantages of the endoscope and microscope, have been developed and proposed for ear surgery and lateral skull base surgery. In addition, robotic ear surgery has been experimented in several settings showing promising results.

The role of those different technologies in the ear and lateral skull base surgery deserves discussion. The advantages and disadvantages of every tool should be carefully considered before employing it in a specific surgical setting. Moreover, their cost-efficacy and cost-effectiveness should be clarified.

## The Introduction of a Digital Exoscope in Lateral Skull Base Surgery

Thomas Somers, Tony Van Havenbergh

*Antwerp Skullbase Team, Sint-Augustinus Hospital, Antwerp, Belgium*

**Background:** Skull base approaches are often lengthy procedures with a high mental concentration span. Physical fatigue due to non-physiological positions of body, head, and neck could be diminished by using an exoscope providing at the same time perfect 3D vision and enhanced resolution in comparison with classical microscopic vision.

**Methods:** In January 2020, we introduced the synaptive robotized and neuronavigation steered exoscope. We applied it routinely in our skull base procedures, mainly in vestibular schwannoma surgery. We evaluated the ease of use, the viewing under angles, and the image resolution.

**Results:** The use of the robotic exoscope requires training. Steering the exoscope by the neuronavigated device can be done very accurately. Angled views are superior to those achieved with a microscope. Image resolution is improved for middle and high magnification in comparison with the microsurgical vision, the resolution at the highest magnification in a deep surgical field is to be improved. Fatigue is improved due to a more physiological position of head and neck. The surgeon as well as co-surgeon have the same 3D image and so participation in surgery by the co-surgeon can be enhanced.

**Conclusion:** The use of a robotic exoscope in lateral skull base surgery is promising. It requires a learning curve, and image resolution at the highest magnifications should be improved. At lower magnification, the 3D view is perfect for both surgeons and observers, the viewing angles are superior to any microscope, and fatigue is decreased.

## Otolith Electrical Implant Preliminary Results with Chronic Stimulation

Angel Ramos Macias[1], Maurizio Barbara[2], Manuel Jesus Manrique[3], Andrzej Zarowski[4]

*[1]Las Palmas University, Spain, [2]NESMOS Department, Sapienza University, Rome, Italy, [3]Clinica Universidad de Navarra, Spain, [4]Thomas More-hogeschool, Mechelen, Belgium*

**Background:** Bilateral vestibulopathy is an important cause of imbalance that is misdiagnosed. The clinical management of patients with bilateral vestibular loss remains difficult as there is no clear evidence for an effective treatment.

**Methods:** In this paper, we try to analyze the effect of chronic electrical stimulation and adaptation to electrical stimulation of the vestibular system in humans when stimulating the otolith organ with a constant pulse train to mitigate imbalance due to bilateral vestibular dysfunction.We present 9 patients in our study with bilateral vestibular dysfunction according to the Criteria Consensus of the Classification Committee of the Bárány Society. All cases were implanted in 4 different centers: Las Palmas University, Sapienza University, Navarra University, and Antwerp University.

**Results:** Vestibular and clinical tests (Video Head Impulse Test, Videonistagmography Vestibular Evoked Myogenic Potentials, cVEMP, and oVEMP), Subjective vertical visual test, Computerized Dynamic Posturography, Dynamic Gait Index, Time UP and Go test, and Dizziness Handicap Index) were performed. Posture and gait metrics reveal important improvement when compared with the preoperative situation. Oscillopsia, unsteadiness, independence, and quality of life improved to an almost normal situation.

**Conclusion:** Prosthetic implantation of the otolith organ in humans is technically feasible. Electrical stimulation might have potential effects on balance and this is stable after 1-year follow-up.

## The Vestibular Implant: 14 Years of Experience

Raymond van de Berg[1,2], Nils Guinand[3], Elke Devocht, Herman Kingma[1,2], Angelica Perez-Fornos[3]

*[1]Division of Balance Disorders, Department of Otorhinolaryngology and Head and Neck Surgery, Faculty of Health Medicine and Life Sciences, School for Mental Health and Neuroscience, Maastricht University Medical Center, Maastricht, the Netherlands, [2]Faculty of Physics, Tomsk State University, Russian Federation, [3]Service of Otorhinolaryngology and Head and Neck Surgery, Department of Clinical Neurosciences, Geneva University Hospitals, Geneva, Switzerland*

Bilateral vestibulopathy is a heterogeneous disorder that can result in disabling symptoms of imbalance and oscillopsia. Unfortunately until now, no real therapeutic options exist for the treatment of vestibular hypofunction that does not respond to conventional interventions like physiotherapy. Therefore, the Geneva-Maastricht team is working on an artificial balance organ: The Vestibular Implant (VI). This implant is a modified cochlear implant that is able to restore hearing as well as vestibular function. It comprises a cochlear array that is inserted into the cochlea and 3 vestibular arrays with electrodes that are inserted into the semicircular canals (the intralabyrinthine approach) or directly onto the nerves (the extralabyrinthine approach). Motion is first captured by gyroscopes and then sent to a processor. This processor converts the signal into electrical pulses that are transferred to the vestibular arrays. Until now, 15 patients have been implanted by the Geneva-Maastricht team. The main results are as follows: (1) electric vestibular stimulation is feasible and safe in humans with different etiologies; (2) it is possible to elicit an electrically evoked vestibulo-ocular reflex that can be congruent with the stimulated canal, and that shows a natural frequency dependency; (3) responses on the rotatory chair and video head impulse test can be improved by electric stimulation; (4) perceptual symptoms can be elicited by vestibular implant stimulation; (5) canal stimulation most likely also stimulates the otolith organs: electrically evoked VEMPs have been obtained; (6) a functional benefit can be obtained by the vestibular implant by significantly improving the dynamic visual acuity in the middle and high frequencies; (7) the vestibular implant is able to overrule natural residual vestibular function. However, many biomechanical issues still need to be addressed before it can be clinically applied. Nevertheless, these results show that the vestibular implant is feasible as a therapeutic device in the near future to treat vestibular hypofunction.

## Electrocochleographic Findings in Patients with Auditory Neuropathy Spectrum Disorder During and After Cochlear Implant

George A. Tavartkiladze[1,2], Maria R. Lalayants[1,2], Vigen V. Bakhshinyan[1,2]

*[1]National Research Centre for Audiology and Hearing Rehabilitation, Moscow, Russia, [2]Russian Medical Academy of Continuing Professional Education, Moscow, Russia*

**Objective:** Electrocochleography is a useful tool to estimate cochlear health and specify the site of lesion in patients with hearing loss, especially in the case of auditory neuropathy spectrum disorder. Intra- and postoperative electrocochleography registration using intracochlear electrode technique, initially created to estimate preserved hearing during cochlear implantation, appears to be a useful instrument to assess inner ear electrophysiological features in cochlear implant recipients with auditory neuropathy spectrum disorder.

**Methods:** Twelve children with auditory neuropathy spectrum disorder with profound hearing loss according to age-appropriate behavioral tests were enrolled in the investigation. Electrocochleography, acoustic stimulation, and recording were performed using Active Insertion Monitoring systems for Advanced Bionics users (5 children) and Cochlear Research Platform-for Cochlear users (7 children). Electrocochleography was performed at least in 2 modes for each patient: (1) frequency sweep mode-electrocochleography via most apical intracochlear electrode (by default but variable) for different frequencies from 125 Hz to 4000 Hz (depending on the system); (2) electrode sweep mode-electrocochleography via every second intracochlear electrode for stimulation with 500 Hz tone burs (by default but variable). All patients were tested postoperatively, 3 patients implanted in 2020 were also tested intraoperatively. Cochlear microphonic and auditory nerve neurophonic were estimated.

**Results:** Cochlear microphonics with different parameters were recordable in all patients with auditory neuropathy spectrum disorder at most tested frequencies, but electrocochleography thresholds were not comparable with behavioral thresholds and were much lower than hearing thresholds. These differences were more prominent at 2000 and 4000 Hz due to the absence of measurable hearing sensitivity after cochlear implantation without sound processor in all patients in this frequency region, while it was still possible to register the electrocochleography responses. The difference in electrocochleography parameters might be explained by the different etiology of auditory neuropathy spectrum disorder. Due to preserved cochlear structures in patients with auditory neuropathy spectrum disorder, ECoG performed at different frequencies allows specifying the electrode location in the cochlea.

**Conclusion:** Electrocochleography obtained through cochlear implant estimates preserved cochlear structures in patients with auditory neuropathy spectrum disorder of different etiology during and after cochlear implantation. Electrocochleography findings do not correlate with audiometric tests in patients with auditory neuropathy spectrum disorder, therefore intraoperative electrocochleography should not be used for the estimation of the residual hearing levels in patients with an auditory neuropathy spectrum disorder.

## Hearing Preservation in Cochlear Implants Surgery Aided by Intraoperative Intracochlear Electrocochleography

Andrea Laborai, Sara Ghiselli, Erica Pizzol, Domenico Cuda

*Department of ENT, Guglielmo da Saliceto Hospital, Piacenza, Italy*

**Background:** Cochlear implant indications have expanded over the last years, thanks to the advances in electrode array technology and surgical technique (soft surgery). It has been well demonstrated that patients with residual hearing on the low frequencies could benefit from electroacoustic stimulation, i.e. the combination of acoustic stimuli on the low frequencies and electrical stimulation on the higher ones.
In order to use this kind of stimulation, successful postoperative hearing preservation must be obtained.
Intraoperative active monitoring by intracochlear electrocochleography seems to be a promising method to assess cochlear trauma and to guide the surgeon during electrode insertion.

**Methods:** Fifteen patients with useful residual hearing on the low frequencies were implanted with an intracochlear ECoG performed during electrode insertion.
The system guided the surgeon with sound feedback and an intracochlear ECochG graph, by active and real-time testing of the cochlear function.
Tone burst at 250 and 500 Hz were used as acoustic stimuli with an in-ear probe and the most apical contact of the cochlear implant electrode itself was used as the recording electrode.
A pre- and postoperative pure tone audiogram was collected.

**Results:** Comparing the pre- and postoperative pure tone audiogram, we observed the following mean dB decrease in hearing threshold: 15 dB at 125 Hz; 8.3 dB at 250 Hz; 9.1 dB at 500 Hz; 15.8 dB at 1000 Hz; 14.1 dB at 2000 Hz; 12.5 dB at 4000 Hz; 4.1 dB at 8000 Hz.
These results show that hearing preservation can be obtained on low-medium frequencies.

**Conclusion:** Residual hearing preservation is a feasible option in cochlear implant surgery using the soft surgery technique.
With an intraoperative intracochlear ECochg, surgeons can have an electrode insertion real-time feedback in order to avoid damaging the intracochlear structures and by thus obtaining a better hearing preservation rate, allowing the patients to benefit from the electroacoustic stimulation.

## Shaping the Post-pandemic Cochlear Implant Rehabilitation: Introduction to a Large-Scale UK Study on Virtual Rehabilitation

Dan Jiang[1], Deborah Vickers[2], Lorenzo Picinali[3], Pádraig Kitterick[4], Hadassa Merle Mahon[5], Caroline Clarke[5], Sandra Driver[1]

[1]*Hearing Implant Centre, Guy's And St. Thomas NHS Foundation Trust, London, United Kingdom,* [2]*Cambridge University, Cambridge, United Kingdom,* [3]*Imperial College London, London, United Kingdom,* [4]*University of Nottingham, Nottingham, United Kingdom,* [5]*University College London, London, United Kingdom*

**Background:** Older children and teenagers with bilateral cochlear implants do not fulfill their potential due to poor sound localization abilities and degraded speech-in-noise perception. These deficits jeopardize speech and language development, education, and social well-being. The lack of protocols for fitting bilateral cochlear implants, ecologically valid outcome measures, and resources for spatial-hearing training, contribute to these listening difficulties
Spatial hearing abilities develop over time with bilateral experience. A large body of research demonstrates that sound localization can improve with training, underpinned by plasticity-driven changes in the auditory pathways for children and adults.

**Methods:** A group of clinicians, engineers, scientists with help of children and teenagers (public and patients involvement PPI) have developed a package of Virtual-Reality games (BEARS, Both EARS) to train spatial hearing in older children and teenagers with bilateral implants. We have put a program together to evaluate this package. In this program, we will use the "mixed methods research" approach whereby we collect and analyze both quantitative and qualitative data within the study. During the development phase (years 1 and 2), we will optimize BEARS using participatory design methods with a PPI Group as co-creators. Another group will inform the content of a qualitative topic guide for the clinical trial and define the normalization process Theory elements for use in a Process Evaluation and for Scaling Up BEARS for mainstream use in the NHS. A clinician group will manualize the Usual Care Pathway. Additionally, the age-appropriate normal-hearing range will be determined for the new virtual spatial speech-in-noise measures. An existing bilateral hearing-specific quality of life measure and a tool for capturing healthcare resource usage will be adapted for older children and teenagers with bilateral implants for use in the clinical trial. In the trial phase (years 3-5), we will recruit 384 children (8-16 years) with bilateral implants from 9 clinics across the UK. They will be randomly allocated to one of 2 groups: BEARS or Usual Care. Qualitative interviews will occur following the trial. Outcomes include spatial speech-in-noise measures, quality of life, resource use, and perceived benefits. Assessors will be blind to group allocation. A process evaluation will evaluate the trial quality and the intervention engagement. A cost–utility analysis using trial data will be performed.

**Summary:** COVID-19 has had a catastrophic effect on the world; however, out of crisis can come innovation, opportunity, and positive change. Many aspects of our service delivery require "technical change." With the use of new technology in this crisis time, the study may pave a way for a new chapter of cochlear implant assessment, rehabilitation, and outcome measures that depart from the conventional "usual care" model.

## Prognostic Value of Intraoperative Measures in Cochlear Implantation

Nicola Quaranta

*Unit of Otolaryngology, University of Bari, Bari, Italy*

**Background:** The restrictive measures adopted by the Italian Government during the COVID-19 outbreak caused dramatic changes in routine public health care. Surprisingly, emergency activity also registered a reduction in frequency.

**Methods:** This multicentre retrospective study aims to investigate eventual changes in ENT surgical emergencies in a highly populated area of southern Italy during the COVID-19 pandemic. Data concerning the period between February 1 and May 31, 2020, were collected from the main 3 hospitals in the district and compared with the same period of 2019.

**Results:** A substantial reduction was found in the number of ENT emergency interventions in 2020 compared to the same period of 2019, particularly in the main lockdown phase and in the tertiary referral center.

**Conclusion:** The reduction in the absolute number of emergency ENT interventions can be only partially explained by social distancing and home confinement. We have reason to believe that some of these patients may have not sought medical support due to fear of nosocomial SARS-CoV2 infection. This study could represent a trigger for further implementation of health system responses to emergencies in a period of transition that is likely to last for a prolonged period of time.

## TransImpedance Matrix Analysis and Intracochlear Position of Perimodiolar Electrodes Array

Angel Ramos de Miguel

*Las Palmas University, Spain*

TIM is an objective measure that can be configured to measure the intracochlear voltage field resulting from the stimulation of one electrode pair along with the entire electrode array, and the full set of electrical spread curves are normalized by the current. The measures are affected by many different variables, one of them is the electrodeposition regarding the modiolar wall. A maximum value will be obtained on the stimulating electrode and a minimum value on the furthest electrode, although a great variability can be observed. The electric potential decays exponentially with distance, so the relative position of the electrodes can be correlated with the measured potential, in order to deduce the relative position between them. It is important to consider that other parameters like conductivity and cochlear geometry can contribute to this decay. If the other factors are not considered, the decay only indicates the proximity of the other electrodes but not their exact distance between them. We present the clinical implications of this new technique.

## Inner Ear Drug Delivery

Raquel Manrique-Huarte[1], Marta Alvarez de Linera-Alperi[1], Daniella Parilli[1], Jose Antonio Rodríguez[2], Diego Borro[3], Wolfram Federik Dueck[4], Daniel Smyth[4], Alec Salt[5], Manuel Jesus Manrique[1]

*[1]Clinica Universidad de Navarra, Pamplona, Spain, [2]CIMA-Universidad de Navarra, Pamplona, Spain, [3]CEIT and Tecnun, University of Navarra Pamplona, Spain, [4]Cochlear Limited, Sidney, Australia, [5]Washington University School of Medicine, St. Louis, United States of America*

**Background:** The method of drug delivery directly into the cochlea with an implantable pump connected to a CI electrode array ensures long-term delivery and effective dose control and also provides the possibility to use different drugs. The objective is to develop a model of inner ear pharmacokinetics of an implanted cochlea, with the delivery of FITC-Dextran, in the non-human primate model.

**Methods:** A preclinical cochlear electrode array (CI Electrode Array HL14DD, manufactured by Cochlear Ltd.) attached to an implantable peristaltic pump filled with FITC-Dextran was implanted unilaterally in a total of 15 Macaca fascicularis (Mf). Three groups were created (5 Mf in each group), according to 3 different drug delivery times: 2 hours, 24 hours, and 7 days. Perilymph (10 samples, 1 µL each) was sampled from the apex of the cochlea and measured immediately after extraction with a spectrofluorometer. After scarifying the specimens, x-rays and histological analysis were performed.

**Results:** FITC-Dextran quantification showed different patterns, depending on the delivery group. In the 2 hours injection experiment, an increase in FITC-Dextran concentrations over the sample collection time was seen, reaching maximum concentration peaks (420-964 µM) between samples 5 and 7, decreasing in successive samples, without returning to baseline. The 24 hours and 7 days injection experiments showed even behavior throughout the 10 samples obtained, reaching a plateau with mean concentrations ranging from 2144 µM to 2564 µM and from 1409 µM to 2502 µM, respectively.

**Conclusion:** An infusion time ranging from 2 to 24 hours is required to reach a maximum concentration peak at the apex. It establishes then an even concentration profile from base to apex that is maintained throughout the infusion time in Mf. Flow mechanisms during injection and during sampling that may explain such findings may involve cochlear aqueduct flow as well as the possible existence of substance exchange from scala tympani to extracellular spaces, such as the modiolar space or the endolymphatic sinus, acting as a substance reservoir to maintain a relatively flat concentration profile from base to apex during sampling.

## Morphological Classification of Crista Fenestra of Round Window Corridor During Pediatric Cochlear Implantation

Haitham Elfarargy[1], Saad Elzayat[1], Maurizio Barbara[2], Islam Soltan[1], Mona Abd-elkareem[1], Ashraf Lotfy[3], Fathi Baki[4]

*[1]Kafrelsheikh University Faculty of Medicine, Mahalla, Egypt, [2]NESMOS Department, Sapienza University, Rome, Italy, [3]Egyptian Military Medical Academy, Egypt, [4]ENT Clinic, Alexandria Faculty of Medicine, Alexandria, Egypt*

**Aim:** This study aimed to document the observation of Crista Fenestra's morphological types (CF) of the round window and to detect its impact during cochlear implant operation.

**Methods:** A prospective descriptive cohort study. We conducted this study at tertiary referral institutions in Egypt. This study included 140 children who underwent cochlear implantation. We observed the CF's morphological type during the operation according to

(Baki-Elzayat) novel classification of CF anatomy and the need for drilling in each CI operation. CF has 2 main types. Type A, in which CF was present at the same level of round window membrane and attached. Type B, in which CF was medial to the round window membrane. We conducted this study at tertiary referral institutions in Egypt.

**Results:** Type (A) CF was detected in 125 cases (89.28%), while 25 cases (10.71%) showed type (B) CF. Drilling was needed in 10 cases (7.14%), including CF types A.3 and B2. Drilling was not needed in 130 cases (92.85%), including CF types A.1, A.2, and B.1. There was a statistically significant difference in the need for drilling ($P < .001$).

**Conclusion:** According to this prospective study, CF had complicated anatomy. Baki-Elzayat classified CF into 2 main types. In type A, CF was at the same level as round window membrane and attached to it. In type B, CF was medial to round window membrane. We recommended drilling for partial removal of massive CF types (A.3 and B.2) for atraumatic safe insertion of the electrode without deflection. This classification can offer an easy language system for CI surgeons to describe and register CF during their operations and in the surgical files.

## Ear Transduction and Transducers Technology

Rafael Urquiza, Antonio Hernandez-Rubiño, Alberto Daza

*University of Malaga, Otology Laboratory, Malaga, Spain*

In this presentation, the intimate relationship of transduction mechanisms of the ear and the development strategies of new transducers for auditory implants are commented upon. In particular, the application of new technologies to actuator and sensor development is discussed. The potentials and shortcuts of the transduction technologies from the biological, physiological, and implantation aspects are discussed. Some practical examples from our work and the literature are presented or commented to illustrate this matter.

## 25 Years Vibrant Soundbridge: A Story of Success

Wolf-Dieter Baumgartner, Alexandra Jappel

*Department of ENT, University of Vienna, Währinger Gürtel 18-20, Wien, Austria*
*Department of ENT, Karolinska Institutet Hospital, Huddinge, Stockholm, Sweden*
*Danube Hospital Vienna – Sigmund Freud University & Medical University Vienna Teaching Hospital, Austria*

The Vibrant Soundbridge semi-implantable hearing system is indicated in sensorineural hearing loss in regular ossicular chain, as in ossicular chain disruption, or combined hearing loss.

Since its very first implantation in summer 1996 by Hugo Fisch in Zurich, thousands of adult and pediatric patients were implanted successfully.

The concept of the Floating Mass Transducer, designed in the early 1990s by the inventor Geoffrey Ball, was originally intended to be placed in various positions in the middle ear.

Because of the European study trial and the FDA studies in the 1990s and the surgical procedure as established by Prof. Fisch, the long process of the incus was for a decade the target of fixation.

From 1996 to 2005, nearly all surgeries used the recommended fixation onto the long process of the incus.

In May 2005, Vittorio Colletti introduced the round window coupling first time in Verona. Since then, a lot of surgeons in different countries established various fixation locations, as originally intended by Geoffrey Ball.

Now we can compare different locations of fixation of the Floating Mass Transducer in different anatomical regions as for example, the long process of the incus, round window, oval window, or promontorial fenestration.

In November 2014, the recent Vibrant soundbridge 503 has been introduced by Maurizio Barbara in Rome.

The Soundbridge 503 is fully MRI compatible including 1.5 Tesla and has a new coupler system.

These new couplers ease the surgical procedure and make surgical data better comparable and the surgical procedure teachable. Since November 2014, we also can fix the Floating Mass Transducer on the SHORT process of the incus. This makes the surgical procedure even more easier, with the same outcome and audiological performance for the patient.

At the moment about in more than 50% of all VSB surgeries, the Floating Mass Transducer is coupled (fixed) onto the SHORT process of the incus.

As European experience, the new Vibrant Soundbridge surgery is a safe and reliable method of hearing rehabilitation that gives significant benefit to the patient's hearing performance.

Future developments will appear to further improve the direct coupling process and to furthermore ease the surgical procedure.

## Surgical Placement of an Active Middle Ear Prosthesis in Aural Atresia: Technique and Long-Term Stability

Rubens de Brito, Luiz Fernando Lourençone

*Hospital de Reabilitação de Anomalias Craniofaciais, University of Sao Paulo, Sao Paulo, Brazil*

Aural atresia is a condition that imposes severe conductive hearing loss. Improvement of the hearing can easily be done through a bone-anchored hearing system and is well established. But there are many negative aspects. Minor complications as skin problems, local pain, and extrusion are common. Audiological aspects also show negative points. The loss of sound energy through the skull and the stimulation of the contralateral cochlea are aspects that decrease auditive performance.

We propose as an alternative to directly stimulate the cochlea by the placement of an active middle ear prosthesis, the Vibrant Soundbridge implant (MedEl, Austria) in patients with bilateral aural atresia. Surgery was standardized, and the FMT was placed in the malformed stapes or incus using a titanium coupling.

Hearing results and stability were evaluated 1 and 5 years after surgery.

## The Esteem Fully Implantable AMEI for Severe-Profound SNHL

Maurizio Barbara, Simonetta Monini, Chiara Filippi, Edoardo Covelli

*NESMOS Department, Sapienza University, Rome, Italy*

The Esteem (Envoymedical, St. Paul, USA), a totally implantable, active middle ear implant, indicated for the rehabilitation of sensorineural hearing loss of moderate-to-severe degree, has been applied at our Implanting Center based in Rome at the University Hospital Sant'Andrea, in 46 subjects. Apart from the degree of hearing loss, the candidature has also relied upon CT scan data for the evaluation of the space in the mastoid cavity, allowing to accommodate the 2 piezoelectric transducers. The surgical procedure is quite complex and usually requires not less than 4 hours under general anesthesia. The auditory outcome, assessed by the pure tone and speech audiometry with headphones, has been followed up annually with an interval ranging from 4 years to 12 years. From the total of 46 subjects who received the Esteem AMEI, 9 were lost to follow-up (living abroad or followed by other Centers), and 5 have been explanted so that 32 subjects have been under study. In 25 subjects who pre-operatively showed a symmetric hearing loss, the control of the contralateral ear, not operated ear, has allowed considering eventual differences in BC deterioration. The mean preoperative BC threshold level in the implanted ear was 56.1 dB (min 38, max 71), while at the last follow-up was 74.7, with a difference of 18.5 dB. In the contralateral ear, the mean preoperative BC threshold level was 56.6 and 62.55 at the last follow-up, with a difference of 5 dB. In terms of hearing gain, a mean improvement of 16.2 dBHL was found at the last follow-up, including those subjects with BC threshold deterioration, regardless of the follow-up timing. The present study demonstrates that the efficiency of the Esteem AMEI was still beneficial after several years of use even in those subjects whose BC threshold was deteriorated.