International Otology Outcome Group:
The future of cholesteatoma research and care
• Staging the disease
  • Adrian James DM FRCS

• Describing the surgery
  • Arun Iyer FRCS

• Using the systems
  • Yu Matsumoto MD PhD

• Outcomes
  • Adrian James DM FRCS

• Putting it into practice
  • Walter Kutz MD
Which operation for which cholesteatoma?

Evidenced based answers?
Does surgical approach effect outcome?

CWU versus CWD

• Less “recurrence”?

• 3/2000 studies

Stanokovic 2007
ORL J Otorhinolaryngol Relat Spec
Does surgical approach effect outcome?

**Biases in cholesteatoma research**

- Non-randomized
- Retrospective
- Selective reporting
- Publication bias

- Uncontrolled variables
  - Disease severity
  - Definition of approach
  - Outcome measures
  - Surgical skill
Does surgical approach effect outcome?

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? Compare different centres

- Prospective collection
- Consecutive collection & reporting
- Report negative findings
Does surgical approach effect outcome?

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![Graph showing ability vs proportion with a peak at around 50%]

0 100

Ability

Proportion
Cholesteatoma: Not all created equally
Cholesteatoma staging

Adrian James
Lukas Anschuetz
## Cholesteatoma Staging

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<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
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<tr>
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<td>Tos (Cholesteatoma meeting)</td>
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<td>2002</td>
<td>Potsic and Wetmore</td>
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<td>Belal et al.</td>
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<td>Presutti, Marchioni</td>
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<td>Olszewska et al. (EAONO)</td>
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<td>EAONO/JOS</td>
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<td>2018</td>
<td>Linder et al.</td>
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Development

Original EAONO consensus on the Definitions and Classification of Cholesteatoma (Based on Delphi method involving broad EAONO membership)

Original JOS Classification and Staging of Cholesteatoma (Based on Committee opinion)

EAONO/JOS joint consensus on Definitions, Classification and Staging of Middle Ear Cholesteatoma (Based on Committee opinion) – DRAFT 1

Feedback from representatives of National Otological Societies (5 Societies) – DRAFT 2

Feedback following debates at Consensus Session at Chole2016 – DRAFT 3

Feedback from international otologists (44 responders from 21 countries) – FINAL DOCUMENT
CHOLESTEATOMA

CONGENITAL

ACQUIRED

RETRACTION POCKET CHOLESTEATOMA
- Pars tensa cholesteatoma
- Pars flaccida cholesteatoma

NON-RETRACTION POCKET CHOLESTEATOMA
- Secondary to TM Perforation
- Following trauma or iatrogenic causes

Combination of pars flaccida and pars tensa cholesteatoma

Post surgery
- Not mutually exclusive
  - Recurrent cholesteatoma
  - Residual cholesteatoma

UNCLASSIFIABLE
STAM System
- S: Difficult access sites
- T: Tympanic cavity
- A: Attic
- M: Mastoid
EAONO/JOS Staging System

- Stage I: Cholesteatoma in the primary site
- Stage II: Cholesteatoma involving two or more sites

- Stage III: Cholesteatoma with extracranial complications
  - Facial palsy
  - Labyrinthine fistula
  - Postauricular abscess
  - Canal wall destruction
  - Destruction of tegmen
  - Adhesive otitis

- Stage IV: Cholesteatoma with intracranial complications
Staging of Middle Ear Cholesteatoma

STAMCO System
- S: Difficult access sites
- T: Tympanic cavity
- A: Attic
- M: Mastoid
- C: Complication
  - Cn: No
  - C1: extracranial
  - C2: Intracranial
- Ossicular status
  - On: Intact chain
  - O1: One ossicle missing
  - O2: Two ossicles missing
  - O3: Three ossicles missing or fixed footplate
  - Ox: Unknown status
EAONO-JOS Stage: Should we use it?

Advantages

• Years of development
• International consensus
• Relevant data-fields

• Allows international collaboration
• Better than independent datasets

• Can be improved with evidence based data
Is my “Canal wall down” the same as yours? How can we compare our results?
Why do we need international common data fields?

Arun Iyer
Consultant ENT surgeon/ Otologist
University Hospital Monklands
Scotland
(Acknowledge Matthew Yung, Ipswich)
Conflict of interest

• Organizer Glasgow EES dissection course
• Sponsored by Storz & Medtronic
• Organizer Glasgow temporal bone dissection course
• Sponsored by Stryker & Oticon
What’s in a name

Hae a wee dram, yer birthday!
A review of the literature on nomenclature of tympanomastoid surgery

• Most terminologies are historical and do not reflect recent advances in surgical procedures

• Some historical terms are open to interpretations

• Terminologies need updating to incorporate new surgical procedures

• Surgical coding of tympanomastoid procedures vary amongst countries
The main purpose of the IOOG is the creation of a common data set for the otological community that can be used as a standardised system to facilitate international collaboration in research towards improving patient outcomes.
Consensus methodology of SAMEO-ATO scheme
Consensus of SAMEO-ATO scheme

21 National Otology Societies
95% full approval
Acronym of SAMEO-ATO

- **Mastoid Surgery**
  - *Stage of Operation*
  - *Approach*
  - *Mastoidectomy procedure*
  - *External auditory canal reconstruction*
  - *Obliteration of mastoid cavity*

- **Middle Ear Surgery**
  - *Access*
  - *Tympanic Membrane repair*
  - *Ossicular chain repair*
SAMEO scheme for mastoid procedures

S  Stage of surgery
  $S_1$  Primary (first surgery)
  $S_{2p}$  Planned ($2^{nd}$ look or staged procedure)*
  $S_{2r}$  Revision (unplanned)*

*2 represents non-primary surgery and not the number of previous surgery

A  Approach
  $A_1$  Transcanal (Total Endoscopic Ear Surgery)
  $A_2$  Transcanal (with microscope)**
  $A_3$  Endaural
  $A_4$  Retroauricular

** Once incision is used for the surgical approach, endoscopic surgery is considered as an adjunct procedure
E  External ear canal reconstruction

\[ E_x \] No external ear canal reconstruction

\[ E_1 \] Reconstruction with soft materials (air pocket behind materials)

\[ E_2 \] Reconstruction with rigid materials (air pocket behind materials)

O  Obliteration of mastoid cavity

\[ O_x \] No obliteration

\[ O_1 \] Partial obliteration (eliminate air pocket in mastoid cavity)†

\[ O_2 \] Total obliteration (eliminate air pocket in mastoid cavity)†

†Total obliteration is obliteration of the whole mastoid AND attic cavities. Partial obliteration spares the attic cavity + part of mastoid cavity (ie just a reduction of the size of cavity)
ATO scheme for middle ear procedures

A  Access to middle ear

A_x  No bone removal from the external ear canal wall (flattening of suture line alone is still considered as A_x)

A_1  Widening of the posterior portion of tympanic sulcus (including canal curettage or drilling to visualise the ossicular chain or hypotympanum)

A_2  Partial or circumferential widening of the bony canal (canalplasty)

A_3  Total canalplasty with soft tissue grafting of exposed bone††

††The IOOG Categorization does not apply to congenital meatal atresia
### ATO scheme for middle ear procedures

**T**  Tympanic membrane

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>$T_x$</td>
<td>No tympanic membrane grafting performed</td>
</tr>
<tr>
<td>$T_n$</td>
<td>Original tympanic membrane preserved</td>
</tr>
<tr>
<td>$T_1$</td>
<td>Supplement to intact tympanic membrane (reinforcement)</td>
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<tr>
<td>$T_2$</td>
<td>Partial tympanic membrane grafting†††</td>
</tr>
<tr>
<td>$T_3$</td>
<td>Subtotal / total tympanic membrane grafting†††</td>
</tr>
</tbody>
</table>

†††Total perforation is defined as complete absence of the tympanic membrane and annulus. Subtotal perforation is the absence of tympanic membrane but the annulus is still preserved.
Conclusions

• Standardize definitions of surgery
• Data can be pooled for comparison
• Outcomes; power
• PROMs
Thanks
Collecting data is easy

Yu Matsumoto MD PhD
Assoc. Professor
University of Tokyo Hospital, Japan
Summary of IOOG SAMEO-ATO framework

EAONO/JOS system 2017
Classification and Staging of Middle Ear Cholesteatoma

Classification of Middle Ear Cholesteatoma

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
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<tr>
<td>Congenital</td>
<td>Acquired</td>
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Non-Intracanal Cholesteatoma
- Pars tensa
- Pars flaccida
- Secondary to perforation
- Following trauma or otosclerosis

Intracanal Cholesteatoma
- Pars tensa
- Pars flaccida
- Contrast of pars flaccida and pars tensa

Staging of Middle Ear Cholesteatoma

1. Divisions of the middle ear space (STAM system)
   - In order to simplify the extent of cholesteatoma, the middle ear and mastoid space is divided into four sites: the diffused access site (S), the tympanic cavity (T), the attic (A) and the mastoid (M). The difficult access site (S) includes S1, the supratubal recess (also called the anterior epitympanum or promontory) and S2, the sinus tympani. The posterior border of the attic is the posterior end of the incus short process or the fossa incucis. The mastoid includes the antrum and the mastoid cells.

2. The EAONO/JOS staging system applies to 4 types of middle ear cholesteatoma
   - (Pars tensa cholesteatoma, cholesteatoma of the attic, cholesteatoma of the canal, and cholesteatoma of the sinus tympani)

Stage I
- Cholesteatoma localized in primary site
  - The site of cholesteatoma origin, i.e., the attic (A) or a pars flaccida (F) of the sinus tympani (T)
  - Pars tensa cholesteatoma, congenital cholesteatoma and cholesteatoma secondary to a tympanic perforation

Stage II
- Cholesteatoma with extracanal complications or pathologic conditions including
  - Facial hearing (F), labyrinthitis (L), labyrinthitis (L), canal wall destruction (CWD)
  - More than half of the tympanic mucosa loss
  - Destruction of the tympanic membrane

Stage III
- Cholesteatoma involving two or more sites
  - Tympanic cavity (T), attic (A), mastoid (M), subnasal (SN)

Stage IV
- Cholesteatoma with intracanal complications
  - Cholesteatoma involving two or more sites
  - Cholesteatoma with intracanal complications

3. Staging systems for respective cholesteatoma types
   - Pars tensa cholesteatoma, cholesteatoma of the attic, cholesteatoma of the sinus tympani, and cholesteatoma of the canal

S, A, M, E, O, T, O, ?
Cholesteatoma outcomes

Adrian James MD FRCS
Jennifer Siu MD MPh
Outcomes

**Endoscopic ear surgery**
- Less morbidity
- Less residual disease
- Similar closure tympanoplasty closure
- Similar hearing ossiculoplasty
- Recurrent cholesteatoma?

**Recurrence variables**
- a. Reporting method
- b. Patient
- c. Cholesteatoma
- d. Surgery
Recurrence $\neq$ Residual
Recurrence increases with time

Kaplan Meier Survival Curve
Time to recurrent cholesteatoma

0 5 10
Time (years)

15% at 5 years
20% at 10 years
Recurrence increases with time

Kaplan Meier Survival Curve
Time to recurrent cholesteatoma
International Otology Outcome Group

The first collaboration

• 1500 new cholesteatoma
• Prospective
• Consecutive
• 9 centres

Arun Iyer
Keiji Matsuda
Lynn Cooke
Masafumi Sakagami
Michael Cohen
Tetsuya Tono
Yuka Morita
Yutaka Yamamoto
EAONO-JOS validation

Retrospective EAONO-JOS staging

• Challenges
  • Different interpretations ~ 10%
  • Errors in data entry ~ 3%

Retrospective:
• Different data
• Missing data

Good inter- & intra-user variability
Kappa 0.8 (95% confidence interval 0.7-0.9)
EAONO-JOS validation

Retro-fitting to EAONO-JOS

- Problems
  - Different interpretations
  - Errors in data entry

Retrospective:
- Different data
- Missing data

<table>
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<tr>
<th>Study centre</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
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### Centre

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</table>

### Missing data

- Different interpretations
- Errors in data entry
- Different data
- Missing data
EAONO-JOS, Surgical approach & Outcome

- Mx: no mastoidectomy
- M1a: canal wall preserved
- O1, O2: obliterate mastoid
- M2c: whole canal wall removed

No mastoid Surgery (TEES)  Canal wall up  Obliterate mastoid  Canal wall down
Recurrence: Patient factors

**Gender**
- Kaplan-Meier survival estimates for gender: F (female) and M (male).

**Age**
- Kaplan-Meier survival estimates for age groups: Adult < 18yrs and Adult > 18yrs.
Recurrence: Extent of cholesteatoma

- Number of subsites
Recurrence: Extent of cholesteatoma

- Number of subsites

**Kaplan-Meier survival estimates**
Recurrence: Surgical approach

Kaplan-Meier survival estimates

Obliteration < combined approach
Recurrence: Surgical approach

Kaplan-Meier survival estimates

Obliteration < combined approach
Recurrence: EAONO-JOS Stage

Stage 4 excluded (n = 4)

? No correlation with stage
Recurrence: EAONO-JOS Stage

Stage 4 excluded (n = 4)

? No correlation with stage
Recurrence: EAONO-JOS Stage

Stage 4 excluded (n = 4)

? No correlation with stage

But:
Age & Stage influence surgical approach
EAONO-JOS stage, demographics, surgical approach

Cox regression

Compared with EJS Stage 1:

**Stage 2**
2.77 times higher hazard of recurrence

**Stage 3**
3.61 times higher hazard of recurrence

Assumptions:
- no residual confounding
- no selection bias
- no information bias
EAONO-JOS stage, demographics, surgical approach

Cox regression

Compared with TEES-type surgery:

**Combined approach CWU**
3.00 times higher hazard of recurrence

**Mastoid obliteration**
0.25 times hazard of recurrence
p < 0.05

Assumptions:
- no residual confounding
- no selection bias
- no information bias

| _t    | Haz. Ratio | Std. Err. | z     | P>|z| | [95% Conf. Interval] |
|-------|------------|-----------|-------|------|----------------------|
| pedo3 | 1.807963   | 0.495769  | 2.16  | 0.031| 1.056245 3.094669    |
| gender| 0.832018   | 0.2056795 | -0.74 | 0.457| 0.5125201 1.350687   |
| eaono3| 2          | 2.770922  | 1.141666 | 2.47 | 0.013| 1.235706 6.213459    |
|       | 3          | 3.608162  | 1.789086 | 2.59 | 0.010| 1.365284 9.535626    |
| approach | cat    | 3.009653 | 0.8886409 | 3.73 | 0.000| 1.687281 5.368404    |
|         | cwteam | 1.19709  | 0.5166027 | 0.42 | 0.677| 0.5137976 2.789085   |
|         | obliterate | .2465843 | 0.1446838 | -2.39 | 0.017| .0780767 0.778708    |
Provisional Summary

• Recurrence increases with
  • Age <18 years
  • EAONO-JOS stage
  • CWU surgery

• Recurrence reduced with
  • Adulthood
  • Obliteration

Limitations

• Missing data
• Retrospective staging
• Long term follow up
Implementing IOOG

Walter Kutz MD
University of Texas SouthWestern, USA
Challenges implementing a classification and staging system for cholesteatoma in the US

Walter Kutz, MD, FACS
Associate Professor
University of Texas Southwestern Medical Center
Dallas, TX
Current state

No agreed upon classification and staging system in the US

Few individual institutions use staging systems (Dornhoffer – OOPS for ossiculoplasty)

Makes comparing data difficult
Obstacles

- HIPAA
- IRB
- Complexity of data
- Time
- Consensus
Proposed solutions

Consider using EAONO-JOS Classification/staging system AND IOOG classification of type of tympanoplasty/mastoidectomy surgery

Consider using REDCap Smart use of Epic or other EMR
IRB obstacles

Consider creating database for quality improvement and not research
If used later for research, can them identify this data set as source
If sharing database, IRB should be involved

*Check the policy at your institution*
HIPAA, 21 CFR part 11, FISMA compliant

Unable to sync with EMR (maybe soon)

Widely available and easy to use

Not available at all institutions

Sharable among institutions

Can export data into excel, STATA, etc
Complexity

There are endless possible datapoints in chronic ear disease and surgery

Consider starting with database using EAONO-JOS and IOOG classification systems
EMR solutions

Epic is used at UTSW

Ability to define “discrete” data

This can be identifies and extracted

Example: We use smartphrase with discrete data .hbscale to record facial nerve function

You could have an op note template with discrete data that could be extracted and mirror the REDCap database
Stage of surgery
- S1: Primary (first surgery)

Approach
- A1: Endoscopic transcanal

Mastoid surgery

- **Mx**: no mastoidectomy
- **M1a**: canal wall preserved + posterior tympanotomy
- **M2a**: only scutum removed
- **M2b**: scutum + postero-superior wall removed whole canal wall removed
- **M1a+2a**: combination of M1a and M2a
- **M1b+2a**: combination of M1b and M2a
- **M3a**: subtotal petrosectomy; otic capsule preserved
- **M3b**: subtotal petrosectomy; otic capsule removed

Mastoidectomy
- [SAMEO-ATO Mastoid-9157]

External ear canal reconstruction
- [SAMEO-ATO EAM 9158]

Obliteration of mastoid
- [SAMEO-ATO Obliteration mastoid.9159]
Discussion
Unknows: Your help needed!

Surgical approach & outcomes

• How much better is TEES?
• Other outcomes & techniques?
• Long term follow up?
• Different surgeons?
• Is EAONO-JOS optimized?

Prospective data collection
• Matching datasets
• Multi-centre collaboration

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