Choesteatoma of the middle ear:
A modified canal-wall-up technique

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Etiology

- Squamous epithelium inside middle ear cavities
- Possible origins:
  - Cholesteatoma by migration after perforation or retraction
  - Papillary cholesteatoma in epitympanum
  - Metaplastic cholesteatoma

Courtesy of Pr. B. Fraysse
Locations (1)

- Epitympanic:
  - Anterior
  - Posterior
  - Lateral

Courtesy of Pr. B. Fraysse

Locations (2)

- Mesotympanic
- Holotympanic

Courtesy of Pr. B. Fraysse
**Strategy**

Approach adapted to:

- The location
- The degree of extension
- The size and pneumatisation of the mastoid

**ONE STAGE SURGERY OF THE MIDDLE EAR CHOLESTEATOMA**

- Canal-wall-up (CWU) mastoidectomy:
  Limited cholesteatoma with developed mastoid

- Canal-wall-down (CWD) mastoidectomy:
  Extensive cholesteatoma in sclerotic mastoid
ONE STAGE SURGERY OF
THE MIDDLE EAR CHOLESTEATOMA

- Canal-wall-up (CWU) mastoidectomy with posterior tympanotomy: Meso- and holo- tympanic cholesteatoma with posterior extension to sinus tympani

ONE STAGE SURGERY OF
THE MIDDLE EAR CHOLESTEATOMA

- Canal wall up (CWU) mastoidectomy with transmeatal atticotomy: Epitympanic cholesteatoma
Material

- 1992-97: 170 cholesteatomas in 150 adults (mean age: 54 years)
- 5 surgeons: Senior (80% of procedures) and 4 fellows
- 150 first procedures (87%)
- 20 revision procedures (13%)
- 85 patients (57%) previously operated on in other centers presenting with a cholesteatoma recurrence.

Methods

Clinical, and radiological data were analyzed at 24 months:

- Audiometric results (*mean thresholds at 0.5 - 1 - 2 - 3 KHz*):
  - Air conduction (AC) hearing gain
  - Air-bone gap (ABG)
  - Bone conduction (BC) variation at 4 KHz

- Anatomical results
Surgical technique

- Retroauricular approach in 97 %
- 100 canal wall-up (CWU) mastoidectomy (59%) with posterior tympanotomy when necessary
- 70 canal wall-down (41 %)
- 91 ossicular reconstructions (61 %) in a one stage procedure
- Second look if abnormality on postop CT-scan and/or failure of ossiculoplasty

Surgical technique

Revision of a canal wall down mastoidectomy cavity, and type 3 tympanoplasty
Cholesteatoma localization and complications

- Atrium 46 %
- Mastoid and attical 54 %
- Ossicular destruction 61 %
- Labyrinthine fistula 14 %
- Erosion facial nerve canal 27 %

PORP (n=40)

- 15 Incus autografts (16 %)
- 14 Goldenberg® composite (15 %)
- 11 Xomed® hydroxylapatite covered with cartilage (12 %)
TORP (n=51)

- 21 Goldenberg® composite (23 %)
- 16 Xomed® hydroxylapatite covered with cartilage (18 %)
- 14 Teflon prostheses (15 %)
Goldenberg® prostheses

Xomed® Hydroxylapatite Prostheses
## Anatomical results

### Patients (n=150)

<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>Results</th>
<th>Residuals</th>
<th>Recurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>First procedure</td>
<td>Op via CWU</td>
<td>Op via CWD</td>
<td></td>
</tr>
<tr>
<td>Patients (n=150)</td>
<td>85 (57%)</td>
<td>60 CWD</td>
<td>3 recurrences (3.5 %)</td>
</tr>
<tr>
<td>Revision</td>
<td>25 CWU</td>
<td>10 residuals (11.7 %)</td>
<td></td>
</tr>
<tr>
<td>First surgery</td>
<td>65 CWU</td>
<td>4 residuals (6 %)</td>
<td>3 recurrences (4.6 %)</td>
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</tbody>
</table>
Mastoidectomy functional results

Residual ABG, AC gain, BC variation

Functional results in first and revision procedures

Previous surgery (n=85, 57 %)

- Residual ABG
- AC gain
- BC variation
Prosthesis anatomical results

- 10 extrusions (6 %) after a 2 years delay:
  - 6 Goldenberg® (17 %)
  - 4 teflon prostheses (28 %)

Functional results

- ABG: $22 \pm 16.5$ dB, ABG < 20 dB: 60 %
- Air conduction gain: $14 \pm 14.5$ dB

<table>
<thead>
<tr>
<th>24 months</th>
<th>ABG</th>
<th>% ABG &lt; 20 dB</th>
<th>AC gain</th>
<th>BC variation 4 KHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type II tympanoplasty (n=40)</td>
<td>20 ± 9.2</td>
<td>65%</td>
<td>15.0 ± 14</td>
<td>2 ± 10</td>
</tr>
<tr>
<td>Type III tympanoplasty (n=51)</td>
<td>26 ± 12.9</td>
<td>48.00%</td>
<td>13.3 ± 13</td>
<td>3 ± 9.2</td>
</tr>
<tr>
<td>p (Anova test)</td>
<td>$p = 0.0001$</td>
<td>$p = 0.0003$</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>
Negative influencing factors on functional results (ABG)

- Canal wall down (n=70) mastoidectomy versus canal wall up (n=100): p<0.05
- Second surgical procedure versus first surgery (85 patients, 57 %): p<0.001
- Absent stapes arch (n=51): p<0.001
- Cholesteatoma (n=170) versus chronic otitis media (n=400): p<0.02

Conclusions

- Middle ear cholesteatoma in adult can be well cured by one stage procedure including ossicular chain reconstruction
- Regular clinical control, and systematic CT scan in case of closed technique are required
- Hydroxylapatite prostheses covered with cartilage achieved a valuable hearing restoration
Technical progression:
The transmeatal atticotomy

Progression of techniques

1985-1994: n = 105
- CWD: 40%
- CWU: 60%

1994-1997: n = 115
- CWD: 37%
- CWU: 51%
- Transmeatal att.+CWU: 5%
- Transmeatal att.: 7%

1998-2001: n = 120
- CWD: 14%
- CWU: 21%
- Transmeatal att.+CWU: 19%
- Transmeatal att.: 29%
Transmeatal atticotomy

Indications

- Cholesteatoma limited to the external attic
- Attical retraction pockets
- Ossicular fixation in the attic

1996-2001: 65 patients
- 38 males, and 27 females
- Mean age: 44 years (13-74)
- Mean follow-up period: 16 months (2-36)
- 39 first surgeries, and 26 revisions

Indications:
- Attical retraction pocket: 43 (66 %)
- Attical cholesteatoma: 22 (34 %)
Preoperative audiometry

- Preoperative PTA: 45 ± 2.1 dB
- Mean preoperative ABG: 28 ± 1.3 dB
- Preoperative ABG < 20 dB in 18 patients (27 %)

Surgical technique

- Retroauricular approach
- Flap protection by a silastic sheet during drilling
- Thin cartilage slice for reconstruction (tragus or concha)
Technique

Associated procedures in 28 cases (42%):
- CWU mastoidectomy: 24 (86%)
- CWU + posterior tympanotomy: 4 (14%)

Tympanic membrane graft in 53 cases (81%):
- Under the malleus handle: 44 (83%)
- Over the malleus handle: 9 (17%)

Ossicular reconstruction in 50 cases (77%):
- Hydroxylapatite: 45 (90%)
- Autograft: 2 (4%)
- Other prostheses: 3 (6%)

Anatomical results

- Normal tympanic membrane: 55 (85%)
- Recurrence of retraction pocket: 8 (12%)
- Perforation: 1 (1.5%)
- Tympanosclerosis: 1 (1.5%)

- One revision surgery for cholesteatoma recurrence: Canal wall down mastoidectomy
Postoperative functional results

- Mean ABG: 21 ± 1.4 (versus 28 ± 1.3 dB preoperatively)
- PTA: 36 ± 2.7 (versus 45 ± 2.1 dB preoperatively)
- Residual ABG < 20 dB: 32 patients (50%) (versus 27% preoperatively)
- Secondary displacements of the prosthesis: 4 (8%)

Conclusions

- Progression of the surgical strategy towards:
  - Transmeatal atticotomy + CWU mastoidectomy +/- posterior tympanotomy
  - Transmeatal atticotomy alone
- This technique allows a direct, and easy access to the attic
Summary

• Transmeatal atticotomy (TA) in:
  – Limited attical cholesteatoma

• TA+CWU mastoidectomy: Extended cholesteatoma with pneumatised mastoid, and posterior tympanotomy in selected cases

• CWD mastoidectomy in:
  – Recurrence
  – Sclerotic mastoid

• Temporal muscle flap except in case of ongoing infection

Complications:

Labyrinthine fistula
Population

• 1986-1996: Among 252 patients operated on for cholesteatoma, 33 (13%) presented with a labyrinthine fistula.

• 29 files were studied (4 were not available).
• 19 males and 10 females with mean age of 47 years (24-87 y).
• 14 patients (48%) had been operated one to four times previously.
CLINICAL ASPECTS

- Otorrhea: 72%
- Vertigo: 45%
- Facial palsy: 13% (associated with total hearing loss in 3 cases out of 4)
- Positive fistula sign: 34%

Palva classification of fistulas

- In 86% the fistula was located in LSSC
- MRI large fistula or tegmen defect

(* Contact between cholesteatoma and labyrinth)
Labyrinthine fistula

- CT scan is performant for fistulas > 0.5 mm of diameter
- High resolution, thin overlapping sections in both axial and coronal planes
- Positive CT scan in this series: 76%

Virtual endoscopy with threshold variation:
Experimental results

mastoidectomy: before after

Posterior SCC (0.3 mm fistula) at 772 HU

Lateral and superior SCC (0.5 mm fistulas) at 866 HU
Surgical technique

• Cholesteatoma matrix over fistula kept in place until the end of surgery and protected with a silastic sheet
• Open or closed technique was chosen with regard to the size of the mastoid and the extent of the lesion
• Antibiotic therapy was continued for 48h postoperatively

Surgical technique

• Cholesteatoma matrix removed at the end of the procedure except in case of an only hearing ear or large fistula in elderly
• Fistula covered with temporal fascia and bone or cartilage and fixed with fibrin glue
SURGERY

Technique
CWD: 72.5%
Middle Cranial Fossa: 3.5%
CWU: 24%

Cholesteatoma removal
Total: 93%
Partial: 7%

Follow-up
• Medium 18 months (1 month to 5 years)
• Up to 1 year in 21 patients (72%)

Hearing function
Better: 46%
Not changed: 39%
Worse: 15%
Postoperative dizziness at 3 months postoperatively

- No dizziness: 83%
- Dizziness: 17%

Revision surgery
N=10 (34%)

- Bone reconstruction: 6 cases
- Residual cholesteatoma: 3 cases
- Tegmen defect: one case
Conclusions

- The Labyrinthine fistula is still a frequent complication of middle ear cholesteatoma.
- CT-scan is performant in detecting fistulas > 0.5 mm of diameter.
- This complication should be detected preoperatively in order to avoid inner ear traumatism during cholesteatoma removal.
- Fistula should be protected during cholesteatoma removal with silastic sheet.