Decision Making in Revision Mastoidectomy: What, When & How TO REVISE?

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Abstract

AIMS: The principal aim of any tympanomastoid surgery is to obtain disease eradication to prevent recidivism. Dry, trouble free ears are obtained in greater than 80% cases when performed by experienced surgeons. At times primary mastoidectomies fail and ears continue to drain and develop complications. The aim of our study was to delineate the causes of recurrent disease. We have also tried to focus on the finer details that every surgeon should keep in mind before embarking upon a revision mastoidectomy.

MATERIALS & METHODS: This is a retrospective study of 83 patients who were operated for a revision mastoid surgery at our institute during the period from 1991 to March 2011. We have described the factors which lead to failure of these surgeries by detailed examination by otoscopy, otoendoscopy, otomicroscopy and radiological imaging. The exact cause of occurrence was later evaluated after the revision surgery was done.

RESULTS: Residual disease in the middle ear especially sinus tympani and inadequate exenteration of air cells were the commonest causes leading to failure of mastoid surgeries. A narrow meatoplasty was also found in 28% of cases. Most of the cases had more than one factor leading to failure.

CONCLUSION: In all possible cases, a dry ear with serviceable hearing can be achieved by proper identification of the causative factor and meticulous removal of entire disease. Experience, skills and clinical judgment of the surgeon are extremely important factors in success of revision surgery.
Introduction

The primary goals of all tympanomastoid surgeries for chronic suppurative otitis media is to first eradicate the disease. This includes the prevention of recurrent and persistent cholesteatomas. A secondary goal is the reconstruction of the ear which includes a dry and self-cleaning ear canal and mastoid cavity, restoration of the middle ear aeration and reconstruction of the sound transfer mechanism.

Dry, trouble free ears are obtained in greater than 80% of cases when performed by experienced surgeons. At times, primary mastoidectomies fail and the ears continue to drain and develop complications. Unrecognized and residual squamous epithelium at the time of the primary surgery is the most frequent cause of a recurring cholesteatoma. A revision surgery is frequently needed to correct these problems. Certain troubles are commonly encountered while performing revision mastoid surgery. Early identification of the lateral semicircular canal and the facial nerve are very important to prevent iatrogenic injury to these structures.

REASONS FOR FAILURE OF MASTOIDECTOMY

Nearly all poor results in mastoid surgery are due to a problem with the surgical technique, not the disease. The following are some of the common causes of recidivism:

- Inadequate meatoplasty (small meatus).
- High facial ridge.
- Incomplete posterior bony canal removal.
- Incomplete removal of the anterior and posterior buttresses.
- Deep cavity at mastoid tip. (A deep mastoid tip can act as a reservoir of infection. The lateral portion of the tip can be removed with a drill, reducing its size.) See Figure 1 to the right: Enlarged Pictures at End of Manuscript.
- Incomplete saucerization of the cortical bony edges. This allows the medial collapse of the soft tissue overlying the mastoid and reduces the size of the cavity.
- Inadequate air cell removal.
- Exposed middle ear and eustachian tube with tympanic membrane perforation.
- Reperforation of the tympanic membrane after extrusion of implants and silastic sheet.
- Incomplete clearance of diseased tissue from the critical areas like the sinus tympani, oval window, hypotympanum, eustachian tube and anterior attic (zygomatic aircells).

Recurrent disease after primary surgery commonly appears in the attic, mesotympanum, or develops from a retraction pocket in a manner similar to that seen in patients during primary surgery. Unrecognized and unremoved squamous epithelium during the primary surgery is the most frequent cause of recurring disease. Extension of squamous epithelium over the perforation edges also may lead to recidivism. Recurrent cholesteatoma can also develop from a retraction pocket and from the oval window area.

Figure: 2. Some causes of failure. WHAT?....to REVISE (Figure to Right) Enlarged Pictures at End of Manuscript.
Surgical Steps in Performing a Canal Wall Down Revision Mastoidectomy

(I) The scarring from the previous surgery may make the skin and subcutaneous incision and dissection difficult. If harvesting temporalis fascia is difficult due to fibrosis or its absence, an additional vertical incision is made from the upper end of the postauricular incision and a more superior portion of the temporalis fascia is harvested. Tragal perichondrium as a grafting material can also be considered in difficult cases, although a separate incision would be required and not as much tissue is obtained.

(II) The mastoid cortex is exposed and the air cells are removed creating a mastoid cavity. If the cavity is not well formed either because of inadequate previous saucerization or new bone growth, then a circumferential saucerization is carried out, starting superiorly between the midfossa dura and Tegmen plate.

(III) Mastoid Bone work:

1. Posteriorly, to the level of the lateral sinus plate.
2. Inferiorly, up to the digastric ridge.
3. All the diseased cellular tracts should be cleared from the sinodural angle, the retrolabyrinthine, retrofacial and the tip cells.
4. Supralabyrinthine cells, if involved, should be removed with a diamond burr.
5. Removal of the remaining posterior meatal wall up to the level of the facial nerve is extremely important.
6. Special care has to be taken to remove the bone, lateral to the inferior portion of the vertical facial nerve canal.
7. Lateral attic wall and diseased tissue is removed along with the ossicles.
8. The anterior buttress should be removed completely. This step is important to avoid postoperative pocket formation and the accumulation of squamous debris in the attic area.

(IV) Removal of the cholesteatoma and granulation tissue is imperative. Clearance of the medial and anterior part of the attic is done with care being taken to detect and not damage a dehiscent facial nerve and fistula at the anterior end of the lateral semicircular canal. All matrix is removed from the lateral facial canal and oval window. If a fistula is suspected, this is the very last step before closing and the fistula is immediately covered with fascia. Care must be taken to avoid dislocation of the stapes while removing the cholesteatoma’s matrix. Dissection in a posterior to anterior direction should be done whenever possible so that the stapedial tendon can help stabilize the stapes. The remnant of the tympanic membrane is also cleared from any granulation tissue or marginal growth of squamous epithelium.

(V) Ossicular reconstruction is performed at the same time as revision surgery using a PORP or a newer prosthesis. Silastic sheeting is placed, extending from the eustachian tube orifice to the facial ridge. This forms an air-filled middle ear cleft and prevents graft adhesion to the promontory.

(VI) Placement of the temporalis facia graft is important. The graft not only produces rapid healing but is crucial to protect the middle ear mucosa and eustachian tube orifice. In addition, it rebuilds the eardrum reforming the middle ear space, providing a round window baffle.

(VII) Obliteration of the mastoid cavity can be done to lessen the complications of a draining ear. However, it should only be done if the surgeon is sure that all squamous epithelium and cholesteatoma has been
removed. If there is damage or thinning of the dura, obliteration is desirable. Postoperative drainage can develop in a deep mastoid tip cavity. In this case, obliteration can be performed with a temporalis muscle graft or fascia flaps. If there is a deep cavity between the tegmen and lateral semicircular canal, cavity obliteration can be performed using a temporalis muscle based flap.

**KEY TO SUCCESS IN REVISION MASTOID SURGERIES**

Precise anatomical landmarks in previously operated and failed mastoidectomies are very important to localize early during the surgery. The surgeon should always keep in mind the possibility of an exposed sinus plate, exposed tegmen plate, exposed facial nerve and traumatized semicircular canals from the previous surgery. The previous surgeon may have failed to document all of the earlier details.

Proceed stepwise: First identify the lateral semicircular canal, a more or less landmark. The facial nerve is always deep and anterior to it. The facial nerve has a triangular relationship with the incus and lateral semicircular canal. In addition, identify the cochleariform process.

The facial nerve is always superior and posterior to the cochleariform process.

- Identify Pyramid - The facial nerve is always above and behind the pyramid.
- Eustachian tube orifice and hypotympanum
- Anterior rim of external auditory canal
- Last but not least, the facial nerve (horizontal and vertical part).

The triangular bone between the vertical facial and bony annulus, laterally, should always be drilled completely. Wobbling large burrs, powerful suction and sharp instruments are to be avoided especially in the blind areas like the sinus tympani. New surgical methods are needed to create additional aeration pathways to the epitympanum in order to improve middle ear aeration and to lessen eardrum retraction. Finally, the shape of the cavity should be round and not kidney shaped. The oval window area should be the deepest part of the cavity. Adequate lowering of the posterior meatal wall and facial ridge is a must in all cases. The anterior buttress should be drilled completely so that, the anterior meatal wall and anterior epitympanum forms an arch. An adequate meatoplasty is essential for ventilation, self-cleansing action and postoperative inspection. It is essential to break the spring of the projecting canal cartilage in the inferior meatoplasty flap. This will allow the flap to fall easily over the posteroinferior part of the cavity. The size of the meatoplasty should be at least accommodating to the index finger. Very large cavities should be preferably obliterated as it takes a long time to epithelialize.

**Methods**

This is a retrospective study of 83 patients who were operated on for revision mastoid surgery at our Institute during the period from 1991 to March 2011. As ours is a tertiary care hospital, the largest one in central Gujarat; we received a lot of referred patients from the adjoining 7-8 districts of the M.P., Rajasthan and tribal Gujarat. Six months to one year was considered to be the maximum time period required for an operated ear to become dry after an adequately performed mastoidectomy.

All the patients who presented in the Otorhinolaryngology Outpatient Department of our hospital; having undergone previous mastoidectomies (canal wall up and down) and having persistent ear complaints, even after the first postoperative year were considered as surgical failures. During this period, a trial of systemic
antibiotics and antihistamines along with antibiotics-steroid and/or antibiotic-acetic acid eardrops were given. Some patients also required insufflations of Neosporin dressing powder into their large cavities.

The patients who had surgical failures were serially examined by otoscopy, otomicroscopy and otoendoscopy. After defining the likely cause of surgical failure, a high resolution computerized tomography was usually advised. Previous surgical notes which were available in only a few cases were also analyzed.

Patients were explained the necessity of a revision surgery. Otoendoscopic demonstration of the possible causes of a recidivism helped in convincing the patients about the need for a revision surgery. A preoperative audiogram was performed for all the patients. Routine investigations for anesthetic fitness, e.g., hemogram, cardiogram and chest x-ray were also performed. All cases were operated on by the senior most surgeons in the department. A postaural approach was universally used. The incision was usually kept over the previous scar with an upwards extension into the scalp for harvesting the leftover temporalis fascia to be used later as graft.

The lateral semicircular canal was considered to be the most important landmark. Sinus and dural plates were saucerised adequately and any hidden disease at the Citelli’s angle was cleared. The bony posterior canal wall was lowered to the facial nerve. In all the cases which had any localized dehiscence of the bony facial canal, a proximal and distal decompression was performed. A similar decompression was performed on a patient who had presented with an acute onset of facial paresis; developing after two previous ear surgeries. At the end of our surgery, the oval window was the deepest region and the cavity was circular in shape. A wide meatoplasty was always done to allow easy inspection, drainage and proper ventilation of the cavity.

Figure 3: Our method of meatoplasty (diagram to the right). Enlarged Pictures at End of Manuscript.

The postaural wound was sutured in layers with stitch removal done on the tenth postoperative day. Postoperatively, the patient was reviewed weekly for the first month, every fortnight during the next three months and then monthly during the first postoperative year. A repeat audiogram for hearing assessment was performed after the cavity was dry, usually requiring 6-8 weeks.
The common age group of patients requiring a revision mastoid surgery was between 10-30 years. Male-to-female ratio was 1:1. Duration between primary and revision surgery was between 1-6 years. About 40% of the patients had undergone more than one surgery. Most of the patients had the chief complaint of otorrhoea. One patient had a presenting complaint of facial asymmetry of recent onset. Another patient presented with postauricular fistula. Vertigo was not present in any of our patients. Ajalloueyan, et al.\textsuperscript{1} reported a staggering 31% of patients having vertigo in his study. On opening the previously operated cavity a large percentage (53%) of ears had residual disease in the mesotympanum. Inadequate exenteration of air cells especially at the sinodural angle was also a major factor responsible for recurrence of disease in a good number of cases (48%). In a study by M. Sadoghi, et al.\textsuperscript{2} the most common location for persistent disease was around the facial nerve, sigmoid sinus and mastoid tip and nearly 30% of the patients had recurrent or residual cholesteatoma. A high facial ridge was found in 41% of the cases. More often than not, it divided the circular cavity into two parts hampering drainage and ventilation. It was lowered till the facial nerve. Incomplete removal of the buttress was detected in 38% of the cases. An inadequately drilled anterior buttress eventually led to incomplete disease clearance from the anterior epitympanum. A failure/perforation of the tympanic membrane graft led to continuous otorrhoea in 17 patients. Narrow meatoplasty consequently leading to a continuously draining ear is sometimes not given adequate importance. Bercin S\textsuperscript{3} has reported a narrow meatoplasty to be the cause of failure in 80.9% of the cases. In our study, a staggering 28% of the patients suffered a recurrence due to an inadequate meatoplasty. The age old saying that at the time of developing flaps an adequate meatoplasty is the one which allows at least the index finger to pass still holds good. Postoperatively, there is bound to be some contraction/fibrosis of this gateway (meatoplasty) to the cavity. More than 95% of our revised patients resulted in a dry ear within a period of three months. One patient had intermittent discharge due to a perforation in the graft. Rombout J, et al.\textsuperscript{4} reported a success rate of 80% in cases of radical revision mastoidectomy without cholesteatoma.

### Table 1: Causes of recurrence and their incidence

<table>
<thead>
<tr>
<th>CAUSES OF FAILURE</th>
<th>NO. OF CASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual disease in middle ear</td>
<td>44 (53%)</td>
</tr>
<tr>
<td>Inadequate exenteration of air cells</td>
<td>39 (48%)</td>
</tr>
<tr>
<td>Residual disease in cavity</td>
<td>34 (42%)</td>
</tr>
<tr>
<td>High facial ridge</td>
<td>36 (41%)</td>
</tr>
<tr>
<td>Incomplete removal of buttresses</td>
<td>30 (38%)</td>
</tr>
<tr>
<td>Narrow meatoplasty</td>
<td>23 (28%)</td>
</tr>
<tr>
<td>Tympanic membrane graft failure</td>
<td>17 (19%)</td>
</tr>
</tbody>
</table>

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Figure 4: A good meatoplasty should allow cavity visualization (Picture to the right). 

Enlarged Pictures At End of Manuscript

Conclusion

In all possible cases, we can achieve a dry ear with serviceable hearing by first properly identifying the causative factor and making sure the surgeon has the skills to correct the problem. If not, a referral to a more senior surgeon is in order.

During surgery it is important to meticulously remove all disease, create a smooth, self-cleaning cavity which has no significant facial ridge and create an adequate meatus. Use of a temporalis fascia graft which is laid across the middle ear and mastoid bowl aids in obtaining a dry cavity.

References


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