EXPERIENCE WITH OVERLAY TYMPANOPLASTY IN 83 CHINESE PATIENTS

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Abstract

Background In many European and American hospitals, represented by the House Ear Clinic (HEC), the overlay tympanoplasty is used with rare exception, with simultaneous canal wall up or down mastoidectomy being taken if needed. In China, underlay tympanoplasty is used across the country, but the overlay technique is used rarely. The aim of the current study was to report the authors’ experience with overlay tympanoplasty in 83 Chinese patients and study its value. Methods Eight-three patients (86 ears) underwent overlay tympanoplasty in accordance to the standard of the HEC. The patients were followed up and conditions of the external auditory canal, tympanic membrane and hearing were reviewed and analyzed. Results All patients gained stage I incision healing. The size of external auditory canal and tympanic membrane morphology were satisfactory. Hearing either remained unchanged or improved. There were no hearing deterioration or serious complications. Conclusions Overlay tympanoplasty carries positive value in treating chronic otitis media and cholesteatoma with the merits of procedure standardization, adequate operative exposure, thorough disease elimination and extensive adaptation.

Keywords: Tympanoplasty; Overlay technique; External auditory canal; Surgery

Introduction

In 1965, the American Academy of Ophthalmology and Otolaryngology publicized the standard classification of surgery for chronic ear infection. Development of basic theories and techniques of modern tympanoplasty and mastoidectomy followed. With respect to the relationship between the graft and remnant tympanic membrane, tympanoplasty can be divided into overlay and underlay techniques. When mastoidectomy is done at the same time, there are canal wall up (CWU) and canal wall down (CWD) techniques based on whether the posterior canal wall is retained. All these operation methods require various tympano-meatus incisions in the canal under the microscope.

In many European and American hospitals, represented by the House Ear Clinic (HEC), the overlay technique is used in tympanoplasty with rare exceptions, with simultaneous CWU or CWD mastoidectomy if necessary. But in China, the underlay technique is widely used in tympanoplasty across the country, with the overlay technique being used on much less occasions. Because the canal width in Chinese is generally narrower than the westerns, canalplasty is a very important part in the procedure of the tympanoplasty. From reviewing the literature in Chinese on otologic surgery from January 1995 to May 2011, only 436 cases of overlay graft placement have been reported, part of them being simple overlay myringoplasty for the repair of tympanic membrane perforation. Some of these reports lack systemic or standardized approach regarding the operative procedure. In this article, 83 patients (86 ears) who received the overlay tympanoplasty comparable to the HEC standards are reviewed, showing good efficacy. The experiences of the authors and clinical value of overlay tympanoplasty are discussed, in which the canalplasty and graft placement are the two important points.

Patients and Methods

Eighty-three patients received overlay tympanoplasty from November 2004 to June 2011 in Beijing Jishuitan Hospital and Beijing Tongren hospital, including 45 males and 38 females, aging from 19 to 70 years (averaged 38.6 years). Procedure was on right in 46 ears and left in 40 ears. The etiology included inflammation (80
ears), burn (2 ears) and trauma (4 ears). Disease duration was from 3 months to 40 years. Past mastoidectomy (6-30 years ago) was reported in 4 cases.

Comprehensive medical history was collected, and physical examination was done to evaluate the patient’s general condition and overall disease situation. Relevant studies, such as pure tone audiometry and the temporal bone CT were performed to obtain additional disease information. The study was performed in accordance to the Helsinki Declaration. In addition, it was approved by the ethics committee of Beijing Jishuitan Hospital. All subjects provided written informed consent.

Procedures

All patients received general anesthesia and ample local anesthetic was injected in the external meatus and post-auricular area. The overlay tympanoplasty involved 8 steps \(^{[2-4]}\). Briefly the procedure included: 1) Transmeatal incision - two longitudinal incisions were made along the tympanomastoid and tympanosquamous suture lines respectively with a sickle knife. A semilunar incision was made on the posterior canal wall near the tympanic membrane to connect the two incisions with a lancet or round knife. In the early stage, a second semilunar incision was also made at the bone-cartilaginous junction on the anterior wall (Fig. 1, revised from reference 2), but later we found that this incision could be made after deciding which operative style was to be taken;

2) Post-auricular exposure and harvest of temporalis fascia. The C incision in the post-auricular fold was designed to allow harvest of a 2 by 2 cm temporalis fascia which was then trimmed and laid on a Teflon plate for later use. Periosteum over the mastoid was lifted anteriorly using an elevator. A retractor was inserted to retract the auricle and vascular strip of the canal forward to expose the bony ear canal; 3) Removal of the canal skin. Depending on the anatomy of the canal and the pathology in the tympanic cavity, the choice of overlay or underlay tympanoplasty was made. If overlay procedure was chosen, a second semilunar incision was made at the bone-cartilaginous junction on the anterior wall. The anterior flap of the canal was freed carefully and kept in normal saline. The dissection remained superficial to the fibrous layer of the remnant tympanic membrane in such a way that the tympanic membrane was de-epithelized in continuity with the canal skin; 4) Enlargement of the ear canal. Part of the anterior and inferior canal walls was drilled off (Fig 2);

5) De-epithelization of the remnant tympanic membrane. Since most epithelium of the remnant membrane was removed in the former step, the surgeon payed particular attention to the anteroinferior area 1 mm lateral to the annulus at this moment, for the epithelium remnant here may result in the formation of cysts. Meanwhile, the epithelium covering the manubrium was also removed. Calcified lesions or local atrophy in the membrane were also removed. Preservation of the annulus was sufficient for fascia placement. Upon completion of de-epithelization, middle ear diseases were assessed based on the history, temporal bone CT and observation during the operation to determine whether mastoidectomy or tympanoplasty prosthesis would be needed; 6) Placement of the fascia. The dried fascia was trimmed to an oval shape measuring approximately 1.3 by 1.5cm. A slit was cut in the fascia to allow placement under the manubrium, with the apex of the slit in the fascia coming into contact with the tensor tendon. When adjusting the fascia anteroinferiorly, care was taken not to over-ex tend it onto the bony wall. A 1 mm overlap would be the limit. The anterior flap was turned back over the exposed manubrium, resulting in a better appearance of the membrane when healed. When the malleus was absent or mostly absent, the fascia was cut twice, creating a flap that could be tucked under the lateral wall of the epitympanum to stabilize the graft. The anterosuperior edge of the fascia was then swung posteriorly to overlap the upper edge of the graft and secure the seal of the middle ear. A piece of silicon sheet was placed in the middle ear to avoid membrane adherence and in favor of recovery of the mucosa (Fig 3);
7) Replacement of the canal skin. The free skin flap was replaced to cover the bone from where it was removed. The skin flap should be positioned more medially, overlapping the fascia by 1 mm, to promote rapid epithelization, preventing blunting and scarring. Cigar shaped gelatin (Curasan AG, Germany) sponge was used to secure the skin flap; 8) Closure and replacement of the vascular strip. The retractor was released, the posterior skin flap replaced, and the final position adjusted. Transmeatally, the gelatin sponge soaked with antibiotic solution was used to pack the canal, and a plug of cotton was placed in the external meatus. The postauricular incision was closed with subcutaneous sutures and a mastoid dressing applied.

Antibiotics were given for 3-7 days postoperatively, and the dressing was removed 2 days later. There was no need to remove the subcutaneous absorbable suture. The first post-operative visit was 7-10 days after the surgery, the second 3-4 weeks after surgery. Ofloxacin ear drops (0.3%) mixed with Dexamethasone solution was applied 1 week after the surgery, twice daily for 4-6 weeks. The gelatin sponge in the meatus could last for 4-6 weeks, and was left to be absorbed, as determined by follow up examinations.

Results

Lesion type

Judged by pre-operative CT scans and assessment during the operation, chronic suppurative otitis media was confirmed in 57 ears (66.3%) and middle ear cholesteatoma in 29 ears (33.7%). Audiometric examinations showed conductive hearing loss in 56 ears (65.1%), mixed hearing loss in 28 ears (32.6%) and complete hearing loss in 2 ears (2.3%).

Surgical Technique

Three surgical techniques were used for the 86 ears: overlay; overlay plus CWU mastoidectomy; and overlay plus CWD mastoidectomy (Table 1). A prosthesis was used in 27 ears.

<table>
<thead>
<tr>
<th>Lesion Type</th>
<th>No. of Ears</th>
<th>Overlay</th>
<th>Overlay + CWU</th>
<th>Overlay + CWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesteatoma</td>
<td>30</td>
<td>4</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Chronic otitis media</td>
<td>56</td>
<td>32</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td>36 (41.9%)</td>
<td>4 (50.0%)</td>
<td>7 (8.1%)</td>
</tr>
</tbody>
</table>

Four patients with cholesteatoma and 1 patient with chronic suppurative otitis media (5.8% of the cohort) received overlay tympanoplasty plus CWU or CWD mastoidectomy with no initial prosthesis placement, and needed a stage II operation to remove the silicon sheet and reconstruct hearing, due to severe ossicular chain erosion (data not show).

Follow up

The 83 patients were followed up punctually, and the longest was 63 months. All the patients gained stage I incision healing. Several patients needed gelatin sponge re-packing in the meatus for quick absorption. Complete healing was seen 6-8 weeks after the operation in more than 90% patients, with clear and open meatus and intact tympanic membrane (although still pale and thick). At 6 months, the membrane was generally thin and transparent with a good pyramidal shape (Fig. 4) and visible blood vessels on the margin and the manubrium in some cases.

Figure 3 Placement of silicate membrane in middle ear cavity.

Figure 4 Tympanic membrane at supply 6 months after the operation, showing a clear, transparent appearance with blood supply.
hind the fibrous membrane. Tympanic membrane infection was seen 4 weeks after operation in 1 case, which resolved after 3 weeks of topical and oral medications. The ear canal and graft remained wet for 5 months in a patient with cholesteotoma and allergic rhinitis until the allergic rhinitis was under control. For the group, followed up of 6-63 months showed no skin flap necrosis, ear canal stenosis, blunting, lateralization, tympanic membrane atelectasis or epithelial cyst formation.

**Figure 5** CT scan of a patient with fibrous membrane in the right canal and cholesteotoma retention.

In this study, we tested hearing in all the patients 6 months after the surgery, which showed hearing threshold improvement of less than 15 dB in 11 ears, 15-20 dB in 43 ears, 21-30 dB in 21 ears, and more than 30 dB in 11 ears. The bone-air gap improved by 19.2 dB on average.

**Discussion**

The goals of treatment for chronic suppurative otitis media include elimination of disease and restoration of middle ear functions. Overlay and underlay tympanoplasty techniquesIEW both merits and demerits. The choice of surgical technique depends upon the patients’ condition, the surgical indication and the capability and skills of the surgeon, as well as the development background of the particular surgical approach. For example, the overlay technique is the routine method at the HEC, while in China, it is rarely used. Based on the literature and our experiences, the merits of the overlay tympanoplasty include: 1) The standardization of the technique mandates careful assessment of the canal, tympanic membrane and the lesion in the middle ear at the beginning of the operation; 2) Because the canal in the Chinese is comparatively narrower than westerners, canaloplasty is especially important for good surgical exposure in this population, particularly for exposure of the anteroinferior tympanic sulcus. Elimination of the acute angle of the anterior canal wall facilitates the placement of graft and minimizes the formation of blunting and injury of the skin, in addition to eliminating blind spots in post-operative follow up. 3) The tympanic membrane remnant and the calcified lesion and local atrophy can be removed completely. 4) The survival rate of the graft is higher (nearly 93-97%) compared to underlay tympanoplasty (only 88-95%), with lower complication rate than underlay tympanoplasty. 5) The graft is placed outside the membrane remnant, which helps to preserve the middle ear space. 6) This technique allows exposure and removal of lesions in the tympanic cavity and mastoid, especially in the superoanterior tympani. Whether the mastoid needs to be opened depends on the exploration of the ossicular chain, vestibular window, round window and the posterior middle ear. With this, there is an increased chance of adopting the CWU technique, favoring preservation of normal structures. And 7) Finally, this is a technique that can be used for all patients, including those with prior operation or external meatus stenosis. Even without membrane remnant, an artificial sulcus can be drilled out with a 1 mm diamond bur. In this study, the sulcus in 5 cases with large tympanic membrane perforation had been destroyed, but the graft was attached well without slit after the artificial sulcus was created. The demerits of the technique include: 1) The healing time of overlay tympanoplasty (4-8 weeks) is longer than the underlay technique (2-6 weeks). 2) The surgeon must have the solid anatomic knowledge and refined surgical skills to avoid the formation of blunting and lateralization. 3) Cysts can occur if the de-epithelization is not complete. And 4) The operative time is prolonged.

A few points are worth noticing about the technique:

1) Ear canal enlargement is a routine manipulation, which requires removal of the anterior wall skin and facilitates appropriate exposure of the sulcus and provides adequate operative field. This also helps freeing the remnant tissue from the anteroinferior wall to avoid formation of epithelial cyst. There’s no need of suture after replacement of the free skin flap, as it can be secured by the gelatin sponge packing with prompt healing, as shown in our patients and other reports in the literature.

2) Common post-operative problems include blunting, lateralization and cysts formation, which may be prevented by adequate de-epithelization and canal enlargement, and appropriate placement of graft and the first sponge packing. In addition, post-operative follow up visits are very important, which allow adjustment of the sponge and ear drops dosing, and timely management of graft infection, skin flap shift or cholesteatoma formation, and pseudo-membrane formation in the ear canal (Figure 5). 3) Great attention is required when assessing and eliminating the disease in the middle ear to protect the facial nerve and ensure thorough diseases eradication, especially those in the tympanic sinus and facial recess areas. 4) When making the transmeatal incision, the
A semilunar incision on the posterior canal wall near the tympanic membrane must follow the two longitudinal incisions. If overlay tympanoplasty is needed, a second semilunar incision is made at the bone-cartilage junction to connect the two longitudinal incisions, while the longitudinal incision in the deep canal can be extended along the tympanic annulus when the underlay tympanoplasty is intended.

The procedure usually should be started on the CWU technique, and can be modified to a CWD procedure when the following situations occur: 1) The posterior wall of the meatus is severely eroded; 2) The CWU technique does not provide an adequate operative field due to constrictive mastoid space caused by extremely low tegmen tympani and/or anteriorly positioned sigmoid sinus; 3) The only hearing ear with cholesteatoma; 4) Complicated with labyrinth fistula and extensive cholesteatoma; 5) Previous CWU operation in the past with recurrence of cholesteatoma and epitympanum deficiency; and 6) The patient is in poor health or with advanced age but with useful hearing.

A number of factors can influence the efficacy of tympanoplasty. Adequate exposure and correct manipulation are critical for reaching the goals of eliminating lesions and reconstructing functions of the middle ear. Overlay tympanoplasty is a credible method aimed at treatment of suppurative otitis media, which can provide the best exposure of the meatus and middle ear cavity for complete lesion removal and to minimize complications with careful operative manipulation. All these merits help ensure surgery safety and satisfactory hearing restoration. Overlay tympanoplasty facilitates complete elimination of disease and avoidance of unsafe manipulation. It can be effectively used in managing chronic suppurative otitis media and cholesteatoma diseases of various degrees.

References


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