The Yung Percutaneous Mastoid Vent

A Medium-Term Follow-up Study

Matthew Man-Wah Yung, PhD, FRCS, DLO

Background: I designed a percutaneous mastoid vent to provide permanent ventilation to the middle ear. The vent consists of an outer titanium tube that osseointegrates with the mastoid bone and an inner Teflon tube that protrudes into the mastoid antrum.

Objective: To follow up all patients who had the mastoid vent inserted since 1995.

Study Design and Setting: Retrospective study of 14 patients with mastoid vents inserted at the ear, nose, and throat clinic of a district general hospital.

Patients: All patients had ventilation problems of the ear that failed to respond to conventional treatment. Three patients had persistent otitis media with effusion; 10 had completely collapsed eardrums; and 1 had failed tympanoplasty with recollapsed eardrum.

Intervention and Outcome Measure: The mastoid vent extrusion rate, surrounding skin reaction, patency of the vent, and functional results were assessed with a follow-up period of 9 to 36 months.

Results: Only 1 vent was extruded in a patient who had a previous cortical mastoidectomy. There was no dermatitis around any of the vents. All vents remained patent, and 9 of the 14 ears underwent successful ventilation. Four ears had adhesions within the mastoid antrum, mainly due to a previous cortical mastoidectomy. Six of 8 ears with intact ossicles also had improved hearing.

Conclusion: The percutaneous mastoid vent can provide medium-term ventilation to the middle ear.


Negative pressure in the middle ear can lead to various pathologic conditions, such as otitis media with effusion (OME), atelectasis, or cholesteatoma. To date, the main treatment is still insertion of a ventilating tube through the tympanic membrane. However, these tubes often extrude from the ear and need to be replaced repeatedly if there is a long-term ventilation problem of the middle ear. Numerous long-staying ventilating tubes can provide long-term ventilation to the middle ear. However, these tubes also have a high rate of extrusion from the ear. Moreover, conventional ventilating tubes are situated in the ear canal and have the same risk of the tube being blocked by crust and the inconvenience of having to keep water away from the ear.

In 1994, I designed the Yung percutaneous mastoid vent with Nobel Biocare to provide permanent ventilation to the middle ear cleft without having to put a tube through the tympanic membrane. The vent is a percutaneous device that can be inserted into the mastoid antrum, allowing air to get into the middle ear through the aditus and epitympanum. The vent consists of an outer titanium tube and an inner Teflon tube. The outer titanium tube is inserted through the skin into the mastoid antrum using the established technique of osseointegration and hence becomes truly permanent. The inner Teflon tube protrudes beyond the bottom end of the titanium tube into the mastoid antrum and keeps the system patent by preventing the lining of the mastoid antrum from growing over the bottom of the mastoid vent (Figure 1). The inner tube can be removed for cleaning purposes and replaced easily. It has an outer flange to prevent it from sliding too deep into the lumen of the outer titanium tube. The outer titanium tube has an internal thread that allows it to be connected to external devices so that extra air or pressure can be delivered into the middle ear cleft if required. Patients can still enjoy water sports by simply “capping” the vent at the outer end. This article is a report of more than 9 months of follow-up of patients I treated since 1995.
RESULTS

The indication of operation, history of mastoidectomy, ossicular status, length of follow-up, middle ear ventilation, and complications for each patient are illustrated in Table 1. Results of the Yung mastoid vent operation can be summarized as follows.

MOBILITY OR EXTRUSION OF THE IMPLANTED VENT

Of the 14 vents inserted, 1 extruded after 6 months in a patient who had a previous cortical mastoidectomy and hence had inadequate bone surrounding the vent. All other vents were stable and immobile.
SKIN REACTION

There was no dermatitis or excoriation of skin around any Yung mastoid vent. However, 3 patients (2 children and 1 adult) had skin prolapsed over the outer end of the vent due to inadequate soft-tissue removal during the initial operation, requiring further reduction of the subcutaneous tissue around the vent. There was no perichondritis in any patient.

OTITIS MEDIA

There was 1 episode of discharge through the vent in a patient following an upper respiratory tract infection. This resolved quickly with oral antibiotics, and the vent remained patent after the inner tube was changed.

ACCEPTANCE BY PATIENTS AND PARENTS

The vents were well accepted by all patients and their parents regarding their aesthetic appearance and discomfort (Figure 3).

PATENCY OF THE YUNG MASTOID VENT

The patency of only 13 of 14 vents was assessed since 1 vent extruded after 6 months. All vents were patent. However, only 9 vents were functioning, which was confirmed by the entry of air from the vent into the middle ear. The other 4 ears had fibrous adhesions within the mastoid antrum, which was confirmed on surgical exploration of the ears. Of these 4 ears, 2 had a previous cortical mastoidectomy, which could explain the fibrous adhesions within the mastoid antrum.

FUNCTIONAL RESULTS

Eight of the 9 functioning vents were on ears with a previously collapsed eardrum, and were reinflated following the operation and remained so throughout follow-up (Figure 4 and Figure 5). The other functioning vent was on an ear with persistent OME, which did not recur after the Yung mastoid vent was inserted. Six of the 14 ears in this study also had an ossicular defect that required ossiculoplasty at the time of vent insertion. Therefore, it was inappropriate to present these hearing results since they also depend on the outcome of ossiculoplasty. Hence, only the hearing results of 8 ears that had intact ossicular chains are presented (Table 2). Six of these 8 ears had an improvement of hearing, mainly from the resolution of the OME or reinflation of the collapsed eardrum. The patient whose vent extruded has since had a recurrence of OME. One patient had a further deterioration of hearing due to adhesive otitis media after the operation.

COMMENT

The Yung mastoid vent is not designed to replace conventional ventilation tubes. These simple-to-use tubes should always be used first. However, there are some patients who cannot benefit from a conventional tube, such as those with atrophic and collapsed eardrums that cannot keep a conventional tube in place. The vent might

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age, y</th>
<th>Follow-up Period, mo</th>
<th>Indication for Operation</th>
<th>History of Cortical Mastoidectomy</th>
<th>Ossicular Status</th>
<th>Ventilation of Middle Ear</th>
<th>Complication</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>42</td>
<td>36</td>
<td>Otitis media</td>
<td>No</td>
<td>Intact</td>
<td>Yes</td>
<td>None</td>
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<td>13</td>
<td>15</td>
<td>Atelectasis</td>
<td>No</td>
<td>Intact</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>20</td>
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<td>Intact</td>
<td>Yes</td>
<td>Subcutaneous tissue overgrowth</td>
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<td>8</td>
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<td>No</td>
<td>Intact</td>
<td>Yes</td>
<td>None</td>
</tr>
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<td>5</td>
<td>17</td>
<td>10</td>
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<td>Intact</td>
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<td>None</td>
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<td>6</td>
<td>9</td>
<td>15</td>
<td>Atelectasis</td>
<td>Yes</td>
<td>Intact</td>
<td>No</td>
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<tr>
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<td>15</td>
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<td>Yes</td>
<td>Intact</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
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<td>20</td>
<td>6</td>
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<td>Intact</td>
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<td>Extruded at 6 mo</td>
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<tr>
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<td>13</td>
<td>36</td>
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<td>Yes</td>
<td>Incus eroded</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>45</td>
<td>24</td>
<td>Failed tympanoplasty; atelectasis</td>
<td>Yes</td>
<td>Incus and stapes eroded</td>
<td>Yes</td>
<td>1 Episode of discharge (transient)</td>
</tr>
<tr>
<td>11</td>
<td>24</td>
<td>22</td>
<td>Atelectasis</td>
<td>No</td>
<td>Incus eroded</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>12</td>
<td>11</td>
<td>12</td>
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<td>23</td>
<td>Atelectasis</td>
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<td>Incus and stapes eroded</td>
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</table>
be a useful treatment in these cases. It has the advantage
over a conventional long-staying tube in that it osseo-
integrates with bone and can be connected to external
devices. Not only would it work as a permanent vent, but
it also opens up many diagnostic and therapeutic poten-
tials. The vent could act as a channel through which
middle-ear gas content and pressure can be sampled
and measured. It can even allow a microendoscope to pass
through to examine the mastoid antrum. Furthermore,
extra air or pressure can be delivered to the middle ear
to reinflate a collapsed eardrum.

Figure 3. Ear with the Yung vent inserted 16 months previously.

The Yung mastoid vent detailed in this study is a
second prototype. The first prototype consisted of just
the outer titanium tube without an inner Teflon tube. It
was used on 4 patients, but the tubes were all blocked at
the bottom end since titanium is so biocompatible that
it allows fibroblasts to grow over its surface. The inner
Teflon tube was subsequently incorporated into this sec-
ond prototype, which keeps the system patent and eas-
ily replaceable to overcome any blockage from crust or
old blood trapped inside. However, for the vent to pro-
vide adequate ventilation to the mesotympanum, the chan-
nel between the mesotympanum and the mastoid an-
trum, including the aditus, epitympanum, and tympanic
isthmus, must be patent. Therefore, any adhesions or
blockage in these areas, which occurred in 4 patients in
this study, could affect the efficacy of the vent.

Three patients in this study required further reduc-
tion of the subcutaneous tissue around the Yung mas-
toid vent because of inadequate removal during the ini-
tial operation. These patients were enrolled in the early
part of the study, and such a problem was not encoun-
tered with subsequent patients. Similar to users of bone
anchor hearing aids, it is essential that the skin around
the vent be kept clean by the patient to avoid crusting
dermatitis. It was also observed that mucus often ac-
cumulates inside the inner tube, and hence regular as-
piration was necessary to maintain its patency.

Table 2. Hearing Results Following the Yung Mastoid Vent
Operation on 8 Ears That Had Intact Ossicular Chains

<table>
<thead>
<tr>
<th>Patient</th>
<th>Follow-up</th>
<th>Preoperative Hearing Level, dB*</th>
<th>Postoperative Hearing Level, dB*</th>
</tr>
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<tbody>
<tr>
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<td>Period, mo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>36</td>
<td>39.00</td>
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</tr>
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<td>28.85</td>
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<td>28.75</td>
<td>43.00</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>30.00</td>
<td>26.00</td>
</tr>
<tr>
<td>8</td>
<td>6†</td>
<td>45.00</td>
<td>45.00</td>
</tr>
</tbody>
</table>

*Four tone average at 0.5, 1, 2, and 3 kHz.
†This vent was extruded after 6 months.
Any permanent device needs to stand the test of time. This article represents a medium-term follow-up of patients in whom all conventional treatments had failed. The conventional treatment of a completely collapsed eardrum has been particularly disappointing. It has been reported that more than 50% of completely atelectatic eardrums will eventually recollapse.\(^7\) Hence, the most encouraging result of this study is that all atelectatic eardrums were reinflated.

I regard the Yung mastoid vent as effective only if it can remain patent and provide long-term ventilation to the middle ear. The air insufflation test is considered a reliable assessment. The impedance test was not as useful since most ears in this study had a reinforcement tympanoplasty using cartilage, which can result in a thick eardrum and a flat impedance curve. So far, the results of using the Yung mastoid vent seem encouraging. However, a longer follow-up period involving a multicenter trial is warranted.

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REFERENCES