Grommets for Otitis Media With Effusion in Children With Cleft Palate: A Systematic Review

Abstract

Background and Objective: No consensus has yet been reached with regard to the link between otitis media with effusion (OME), hearing loss, and language development in children with cleft palate. The objective of this study was to address the effectiveness of ventilation tube insertion (VTI) for OME in children with cleft palate.

Methods: A dual review process was used to assess eligible studies drawn from PubMed, Medline via Ovid, Cumulative Index to Nursing and Allied Health Literature, Cochrane Library, and reference lists between 1948 and November 2013. Potentially relevant papers were selected according to the full text of the articles. Relevant data were extracted onto a data extraction sheet.

Results: Nine high- or moderate-quality cohort studies were included in this study. VTI was administered in 38% to 53% of the OME cases, and more severe cases appeared more likely to undergo VTI. Compared with conservative forms of management (eg, watchful waiting), VTI has been shown to be beneficial to the recovery of hearing in children with cleft palate and OME. Growing body of evidence demonstrates the benefits of VTI in the development of speech and language in children with cleft palate and OME. These children face a higher risk of complications than those undergoing conservative treatments, the most common of which are eardrum retraction and tympanosclerosis, with an incidence of ~11% to 37%.

Conclusions: This review provides evidence-based information related to the selection of treatment for OME in children with cleft palate. Additional randomized controlled trials are required to obtain bias-resistant evidence capable of reliably guiding treatment decisions. The conclusions in this review are based on underpowered cohort studies and very-low-strength evidence. Pediatrics 2014;134:983–994

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Key Words: cleft lip and palate, conductive hearing loss, grommet tube, middle ear effusion, otitis media, systematic review

Abbreviations

GRADE—Grading of Recommendations Assessment, Development and Evaluation
OME—otitis media with effusion
VTI—ventilation tube insertion

Dr Kuo contributed to the conception and design of this research and the acquisition, analysis, and interpretation of data, drafted the first version of the manuscript, and participated in a critical revision of the manuscript; Dr Tsao contributed to the conception and design of the research and the acquisition, analysis, and interpretation of data and participated in revising the manuscript; Dr Cheng participated in the conception and design of the research and the analysis and interpretation of data and approved revisions to the manuscript; Drs Lien, Hsu, and Huang participated in the conception and design of the research and the analysis and interpretation of data, and revision of the manuscript; Drs Lien, Hsu, and Huang participated in the conception and design of the research, analysis and interpretation of data, and revision of the manuscript; Dr Shiao contributed to the conception and design of the research, acquisition, analysis, and interpretation of data and participated in critical revisions of the manuscript; and all authors approved the final manuscript as submitted.

doi:10.1542/peds.2014-0323

Accepted for publication Aug 5, 2014

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Otitis media with effusion (OME) is a collection of nonpurulent fluid in the middle ear space. Before the age of 1 year, OME occurs at least once in ≤90% of children with cleft palate, increasing to 97% by the age of 2 years. OME may lead to conductive hearing loss of ≤30 dB. Long-term hearing loss has been shown to negatively influence the language development of children.

Alt first identified the association between cleft palate and hearing impairment in 1878. Since that time, OME has been the subject of extensive investigation, particularly with regard to children with cleft palate. The long-term benefits of ventilation tube insertion (VTI) remain an issue of debate among specialists, given the difficulties and complications inherent in aggressive treatment regimens. The risks children with cleft palate face in later life should not be used to justify early aggressive treatment of OME until the question of optimal management has been resolved. Although a large number of reviews on the use of surgical treatment for OME in children with cleft palate have been published, many of these were narrative, and others were systematic investigations that pertained mainly to otherwise healthy children with typical developmental characteristics. A lack of research on the subgroup of children with cleft palate means that there is currently no evidence-based information available to clinicians and parents about the effectiveness of grommet insertion to treat OME in children with cleft palate. Only 1 systematic review addressed the early routine insertion of grommets for OME in children with cleft palate. In that study, data synthesis was not performed according to patient-centered outcomes, and data were limited to studies conducted before 2006, since which time a number of important studies have been conducted. We therefore conclude that the information currently available is insufficient to provide a reliable base with which to evaluate the clinical practice of early routine grommet placement for OME in children with cleft palate.

This systematic review investigates the benefits and harm attributable to the placement of grommets to treat OME in children with cleft palate. We also contrast this invasive form of intervention with more conservative treatments, including watchful waiting and the use of hearing aids.

METHODS

Eligibility Criteria

This study followed the methods used in Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Eligibility criteria were specified unambiguously to ensure that studies were selected in a systematic and unbiased manner: We included case series studies, prospective and retrospective cohort studies, and randomized controlled trials. The patient population was defined as children (≤18 years old) diagnosed with any type of cleft palate, including unilateral or bilateral cleft palate with or without cleft lip, cleft palate only, and submucous cleft palate. A search was conducted to identify studies that evaluated the outcomes of grommet insertion in children with cleft palate. We also sought to determine whether a control group was included in the studies. Studies had to include at least 1 outcome of routine or early grommet insertion related to hearing, speech and language development, frequency of treatment, and complications or sequelae.

Information Sources

We identified studies by searching electronic databases and then consulting with experts in the field. The search was performed in multiple databases including PubMed (1950 to November 2013), Medline via Ovid (1948 to November 2013), the Cochrane Library (1953 to November 2013), and the Cumulative Index to Nursing and Allied Health Literature (1982 to November 2013). Initial searches performed in November and December 2012 were updated in May and November 2013.

Search Terms

An experienced research librarian provided the following predefined list of search terms and medical subject headings: children, pediatric, cleft palate, cranio-facial anomalies, maxillo-facial anomalies, jaw abnormalities, stomatognathic diseases, congenital anomalies, otitis media with effusion, middle ear effusion, conductive hearing loss, grommet tube, ventilation tube, tympanostomy tube, myringotomy tube, T-tube, ear tube, pressure equalization tube, vent, middle ear ventilation, hearing aids, sensory aids, watchful waiting, observation, management, and treatment. No language restrictions were imposed in these searches.

Study Selection

A dual review process was applied to review the abstracts of all citations identified in the searches. After duplicate results were removed, potentially relevant articles were included on the basis of the full text in the articles. Additional studies were obtained from the references of the selected articles. Disagreements were resolved by consensus among the senior authors. Only studies matching the eligibility criteria were included in this systematic review.

Data Collection Process

This study used a standardized data extraction sheet for the articles deemed eligible. Data were extracted from the included studies by 1 author and then checked by a second author. A third author was consulted when an agreement could not be reached. The authors of studies were also contacted to obtain additional information when necessary.
Randomized controlled cohort or follow-up study. Level 4 was defined as case series, case–control studies, or historically controlled studies. Level 5 was defined as mechanism-based reasoning. These levels could be downgraded on the basis of study quality, a lack of precision, indirectness, or inconsistency between studies, or in cases where the absolute effect size was small. Conversely, the level could be upgraded in cases where a large effect size was noted. The evidence provided in each selected article was independently categorized by 2 team members according to level.

**Summary Measures**

The intended summary measure of effect may have differed from that used in some of the studies; therefore, we prespecified the summary measure of effect for each outcome. For hearing outcomes, the natural effect measure was the difference in hearing ability. For studies with outcome measurements performed on different scales, measures were summarized as the percentage of ears presenting hearing loss or improvement. For the frequency of grommet insertion, measures were summarized as the percentage of ears with ≥1 grommet insertion and the frequency of tube insertion. For complications or sequelae, the measures were summarized as the frequency with which complications manifested.

**Synthesis of Results**

Heterogeneity in the methods used in the eligible studies rendered them unsuitable for pooled analysis, and additional quantitative analysis was deemed inappropriate or unnecessary. Therefore, the evidence was summarized qualitatively, and no attempt was made to perform meta-analysis.

**Grading the Strength of Evidence (Quality of Evidence)**

To provide a transparent, structured process for presenting evidence, we graded the quantity, quality, and consistency using the evidence grading scheme developed by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group. Randomized controlled trials were initially treated as high-quality evidence, and observational studies were considered low-quality evidence.

The quality of evidence could be downrated according to 5 factors: risk of bias, inconsistency, indirectness, imprecision, and publication bias. The quality of evidence could be upgraded according to 3 factors: large effect, dose–response gradient, and inclusion of all plausible confounders. Ultimately, evidence was classified into 4 categories according to strength: high strength (additional research is unlikely to change our confidence in the estimate of effect), moderate (additional research is likely to have a notable impact on our confidence regarding the estimation of effect), low (additional research is very likely to have a notable impact on our confidence regarding the estimation of effect), and very low (any estimate of effect is highly uncertain). A summary table was created to provide key information about the quality of evidence and the magnitude of effect of VTI on all important outcomes.

**RESULTS**

**Study Selection**

A total of 484 records were identified (Fig 1). Four additional records were identified by manual reference searches. After removing duplicates (115 records), we screened 373 records on the basis of title and abstract. From these, 326 records with subjects that were obviously different or irrelevant were eliminated. We assessed 47 full-text articles according to the inclusion and exclusion criteria. Seventeen articles were excluded for the following reasons: cases with cleft lip only ($n = 1$), comparison
between children with and without cleft palate \((n = 4)\), statistical error \((n = 1)\), more than half of the data missing \((n = 1)\), unavailable \((n = 2)\), information obtained from questionnaires \((n = 5)\), and in a language other than English or Chinese \((n = 3)\). Four studies evaluating the post-VTI outcomes of children with and without cleft palate were excluded from this review; however, they are included in Supplemental Table 8. The only randomized controlled trial in the review had to be excluded because the authors did not clearly state whether the 2 groups were statistically comparable.
regarding patient characteristics, and in particular because the follow-up period was only 6 months for the VTI group and 20 months for the control group.28 Furthermore, the method used for randomization was not mentioned. To increase the strength of the evidence in this systematic review, low-quality cohort studies (n = 6) and case series studies (n = 14) were also excluded. These are listed in Supplemental Table 9. This left a total of 9 cohort studies of high or moderate quality for inclusion in the qualitative integration of data.

**Study Characteristics**

Most of the eligible studies (78%) were published in the last 2 decades, and 33% were conducted in the United Kingdom (Table 1). The designs of the studies we included were prospective (n = 1) and retrospective (n = 8) cohort studies. Quality assessment revealed that 2 of the studies were of high quality and 7 studies were of moderate quality. The evidence presented in these studies was categorized as follows: level 3 (n = 1) and level 4 (n = 8). A total of 702 patients with cleft palate were evaluated in this review, with a mean age ranging from 3 months to 12 years. In most of the cases, follow-up was conducted for ≥3 years.

**Comparative Effectiveness of VTI for Hearing Outcome**

Five cohort studies (1 prospective29 and 4 retrospective30–33) in this review included comparisons of the hearing outcomes between children receiving VTI and those undergoing non-VTI treatments (eg, myringotomy alone for temporary effusion drainage without insertion of ventilation tube, hearing aids, and watchful waiting) (Table 2). Two studies reported that VTI significantly improved hearing in children with cleft palate over the short term (≤18 months after VTI).31,32 In the study by Li et al31 postoperative hearing was significantly improved in both the VTI and the non-VTI groups (P < .01). However, the improvements in the VTI group (26.93 dB above normal adult hearing level) were significantly greater than those observed in the non-VTI group (14.13 dB above normal adult hearing level; P < .05). In the study by Liu et al32 a significant improvement in hearing was observed in the VTI group (15.4 dB, P = .01), but not in the non-VTI group (2 dB, P > .05). Three studies observed no significant differences in hearing outcome between VTI and non-VTI groups in a 3- to 9-year follow-up period, despite the fact that hearing showed improvements postoperatively in children with VTI.29,30,33

**Comparative Effectiveness of VTI for Speech and Language Outcomes**

Comparisons of speech and language outcomes between children with and without VTI for OME were performed in 3 cohort studies, including 1 prospective29 and 2 retrospective studies (Table 3).34,35 In the high-quality prospective cohort study by Hubbard et al,29 children who had undergone early VTI demonstrated significantly better consonant articulation and were less likely to need speech therapy than those who had not received this treatment. The 2 retrospective studies also showed that VTI is beneficial for speech and language outcomes in children with cleft palate and OME; however, outcome differences between the VTI and non-VTI groups failed to reach significance.34,35

**Complications and Sequelae of VTI for OME**

Seven of the studies included in this review reported post-VTI complications and sequelae,29,30,32–34,36,37 5 of which provided comparisons of these problems in cases where VTI was or was not implemented to deal with OME (Table 4).29,30,33,36,37 Four of the 5 cohort studies reported a significantly higher rate of complications among children who received VTI, compared with those who did not receive this treatment, over the short term (<5 years)36,37 and the long term (≥9 years).33 Only Hubbard et al29 reported that the rate of complications differed only slightly between the 2 groups.

**Eardrum Perforation**

Eardrum perforation occurred in 1.3% to 19% of VTI-treated ears during 1 to 9 years of follow-up.29,30,33,34,36,37 Two...
studies specifically compared the incidence of eardrum perforation in VTI and non-VTI groups. One study reported a higher rate of eardrum perforation in the VTI group (15.4%) compared to the non-VTI group (0%) over the short term (18 months of follow-up), whereas the other study reported a lower rate of perforation in the VTI group (2.3%) compared to the non-VTI group (2.3%) over the long term (9 years of follow-up).

Eardrum Retraction

The rate of eardrum retraction was between 11.5% and 36.8% over the short term (6–18 months of follow-up) [26,35]. Only 1 study specifically evaluated the incidence of post-VTI eardrum retraction in children with and without VTI, the results of which showed a higher rate of retracted eardrum in the VTI group (11.5%) compared to the non-VTI group (2.3%).

Tympanosclerosis

Tympanosclerosis was the third most commonly reported VTI-related complication, with rates ranging from 11% to 37% during 1 to 9 years of follow-up. Only 1 study specifically compared the incidence of tympanosclerosis between children with and without VTI, reporting that children with VTI (37%) had a higher incidence than those without VTI (17%).

Secondary Acquired Cholesteatoma

Only 2 retrospective cohort studies of moderate quality reported the incidence of post-VTI cholesteatoma. Gordon et al. [33] reported that the incidence of post-VTI cholesteatoma was between 11.5% and 36.8% over the long term (9 years of follow-up) [26,35]. One study reported a higher rate of cholesteatoma in the VTI group (15.4%) compared to the non-VTI group (0%).

TABLE 2 Effectiveness of Grommets for OME in Children With Cleft Palate: Effects on Hearing Development

<table>
<thead>
<tr>
<th>Author (Year, Country)</th>
<th>Design, Quality, LOE</th>
<th>Intervention</th>
<th>Participants</th>
<th>Hearing Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hubbard et al [29] (1985, USA)</td>
<td>PC, high, 3</td>
<td>Gp I: routine VTI with more assiduous antibiotic treatment in children with cleft palate. Gp II: Conservative treatment ± myringotomy in children with cleft palate.</td>
<td>n = 48 children (Gp I 24, Gp II 24 matched for cleft type, age, gender, socioeconomic status, and birth order; age at the time of first treatment: Gp I 3 mo, Gp II 3.8 mo; age at testing: Gp I 18.8 y, Gp II 9.0 y)</td>
<td>Hearing better with early VTI (P = 0.05–0.10).</td>
</tr>
<tr>
<td>Liu et al [32] (2004, China)</td>
<td>RC, high, 4</td>
<td>Gp I: unilateral VTI in ears with OME and worse hearing. Gp II: untreated opposite OME ears with less hearing impairment (but &gt; 25 dB)</td>
<td>n = 19 children (68 ears; Gp I 19, Gp II 18; age 5.8 y (4–7.9), F/U 8.4 mo (2 wk–18 mo)</td>
<td>Significant hearing improvement in Gp I (42.7–27.3 dB, P = 0.01) but not in Gp II (29–27 dB, P &gt; 0.05).</td>
</tr>
<tr>
<td>Li et al [31] (2007, China)</td>
<td>RC, moderate, 4</td>
<td>Gp I: bil VTIs. Gp II: bil tympanocentesis.</td>
<td>n = 34 children (68 ears; Gp I 38, Gp II 30; age at intervention: Gp I 16.9 mo (2–12), Gp II 6.6 mo (2–12); F/U 1 wk to 12 mo)</td>
<td>The hearing was improved in both Gp I and II postoperatively (P &lt; 0.01). Gp I had more improvement in hearing than Gp II (26.93 dB above normal adult hearing level vs 14.13 dB above normal adult hearing level, P &lt; 0.05). Hearing results ≤20 dB: Gp I 71% (34/48) vs Gp II 88% (44/50, P &gt; 0.05).</td>
</tr>
<tr>
<td>Gordon et al [23] (1988, New Zealand)</td>
<td>RC, moderate, 4</td>
<td>Gp I: VTI at the time of palatoplasty or later. Gp II: non-VTI. Palatoplasty at 5 and 9 mo of age.</td>
<td>n = 50 children (100 ears; Gp I 50, Gp II 50; mean age at latest F/U 12 y (9–17); F/U = 9 y after palatoplasty.</td>
<td>Hearing results ≤20 dB: Gp I 71% (34/48) vs Gp II 88% (44/50, P &gt; 0.05).</td>
</tr>
</tbody>
</table>

bil, bilateral; F/U, follow-up; Gp, group; HA, hearing aid; LOE, level of evidence; PC, prospective cohort study; RC, retrospective cohort study; VTI, ventilation tube insertion.
### TABLE 3
Effectiveness of Grommets for OME in Children With Cleft Palate: Effects on Speech and Language Development

<table>
<thead>
<tr>
<th>Author (Year, Country)</th>
<th>Design, Quality, LOE</th>
<th>Intervention</th>
<th>Participants</th>
<th>Speech and Language Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hubbard et al29 (1985, USA)</td>
<td>RC, moderate, 3</td>
<td>Gp I: VTI group; Gp II: non-VTI group</td>
<td>n = 48 children (Gp I 24, Gp II 24 matched for cleft type, age, gender, socioeconomic status, and birth order); age at the time of first treatment: Gp I 3 mo, Gp II 6 mo.</td>
<td>Consonant articulation better with early VTI ($P = .03$). Ear with VTI had better speech outcomes than those without ($P &lt; .05$).</td>
</tr>
<tr>
<td>Kobayashi et al34 (2012, Japan)</td>
<td>RC, moderate, 4</td>
<td>Gp I: VTI in children with OME; Gp II: myringotomy in children with cleft palate and OME at age 30 mo.</td>
<td>n = 108 children (216 ears; Gp I 82, Gp II 134); F/U 9.42 y (6–15 years).</td>
<td>The difference in the language development between Gp I and II was not significant.</td>
</tr>
<tr>
<td>Shaw et al35 (2003, UK)</td>
<td>RC, moderate, 4</td>
<td>Gp I: VTI for symptomatic OME; Gp II: non-VTI for subclinical OME.</td>
<td>n = 72 children (168 ears; Gp I 20, Gp II 52); speech assessments were carried out at the age of 3–4 y; F/U 10 y.</td>
<td>Frequency of grommet insertion was low among children with cleft palate over the short term (3.8%, 18 months) and the long term (0%, &gt;9 years). Both studies also reported that the incidence of cholesteatoma was comparable in VTI and non-VTI groups.</td>
</tr>
</tbody>
</table>

#### Otorrhea

Only 1 retrospective cohort study of moderate quality reported cases of post-VTI otorrhea. That study identified post-VTI otorrhea in 11.5% of children with cleft palate, whereas no cases of otorrhea were identified among children with hearing aids or those undergoing watchful waiting. The follow-up period of that study was 18 months.

#### Frequency of Grommet Insertion

The frequency of grommet insertion was estimated from 5 studies (Table 5). During a follow-up period of 4 to 9 years, 38% to 53% of children with cleft palate underwent ≥1 VTIs for OME. Maheshwar et al reported that the average number of VTIs needed for OME in children with cleft palate was 1.7 during a follow-up period of 18 months. In addition, the number of VTIs was found to be significantly associated with cleft type, with severe or complete clefts more likely to undergo grommet insertion.

#### Strength of Evidence

After the quantity, quality, and consistency of evidence were summarized, the strength of evidence regarding the effectiveness of grommet insertion for OME in children with cleft palate was considered very low for all outcomes: hearing, speech and language, complications, and frequency of VTI (Table 6).

### DISCUSSION

Compared with conservative management, VTI can be beneficial for the recovery of hearing in children with cleft palate and OME over the short term and the long term (Table 2). Three studies address the effectiveness of grommets on speech and language development in children with cleft palate. According to these results, children with cleft palate could benefit from VTI. In a high-quality prospective cohort study by Hubbard et al, equal numbers of children were matched for cleft type, age, gender, socioeconomic status, and birth order. After a follow-up of 9 years, children with early VTI were shown to have significantly better consonant articulation and were less likely to need speech therapy than those who had not undergone the procedure.

In the VTI group, myringotomy was followed by tube insertion for the continuous drainage of middle ear effusion, and in the control group a single myringotomy without tube insertion was performed for the temporary drainage of effusion when deemed necessary. Thus, it could be reasonable assumed that watchful waiting (ie, without temporary drainage of middle ear effusion by a single myringotomy) may have a more deleterious effect on the development of consonant articulation, with subsequent effects on speech and language outcomes. However, clinical practitioners should be aware that speech and language skills depend not only on the approach to the management of OME but also on the timing in the application of palatoplasty.

Children with cleft palate generally have a higher risk of post-VTI complications than those who did not receive this treatment over the short term (<5 years) and the long term (≥9 years) (Table 4). In the study by Hubbard et al, only a slight difference was observed in the rate of complications between the VTI and non-VTI groups; however, some of those children...
<table>
<thead>
<tr>
<th>Author (Year, Country)</th>
<th>Design, Quality, LOE</th>
<th>Intervention</th>
<th>Participants</th>
<th>Complications and Sequelae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hubbard et al29 (1985, USA)</td>
<td>PC, high, 3</td>
<td>Gp I: routine VTI with more assiduous antibiotic treatment in children with cleft palate; Gp II: conservative treatment + myringotomy in children with cleft palate</td>
<td>$n = 48$ children (Gp I 24, Gp II 24 matched for cleft type, age, gender, socioeconomic status and birth order); age at the time of first treatment: Gp I 3 mo, Gp II 30.8 mo; age at testing: Gp I 8.8 y, Gp II 9.0 y</td>
<td>Little difference in the complications between groups: Normal TM: Gp I 21% vs Gp II 21%</td>
</tr>
<tr>
<td>Liu et al32 (2004, China)</td>
<td>RC, high, 4</td>
<td>Gp I: unilateral VTI in ears with OME and worse hearing; Gp II: untreated opposite OME ears with less hearing impairment (but $&gt;25$ dB)</td>
<td>$n = 19$ children (38 ears; Gp I 19, Gp II 19); age at testing: Gp I 8.8 y, Gp II 9.0 y</td>
<td>Complication in Gp I</td>
</tr>
<tr>
<td>Gani et al30 (2012, UK)</td>
<td>RC, moderate, 4</td>
<td>Gp I: VTI; Gp II: HA; Gp III: watchful waiting</td>
<td>$n = 217$ children (Gp I 41, Gp II 22, Gp III 154); F/U 3 y</td>
<td>VTI-related complications: 25.5%</td>
</tr>
<tr>
<td>Kobayashi et al34 (2012, Japan)</td>
<td>RC, moderate, 4</td>
<td>VTI in children with cleft palate and OME at age 1–5 y</td>
<td>$n = 108$ children (216 ears; Gp I 82, Gp II 134); F/U 9.42 y (6–13)</td>
<td>Rate of favorable outcome (no OME even at age $\geq 5$ or OME healed in response to conservative treatment) after age 6: VTI 68.3% (56/82) vs non-VTI 95% (95/100)</td>
</tr>
<tr>
<td>Kwan et al36 (2011, Hong Kong)</td>
<td>RC, moderate, 4</td>
<td>VTI in cleft patients with OME (80.5% of VTIs concurrent with palatoplasty)</td>
<td>$n = 84$ children (125 patient-ears with OME; 80 with VTI, 45 without); age 7.5 y (2.7–12.4); F/U 4.3 y</td>
<td>Rates of complications in ears without VTI (0%) and with VTI (15.7%, $P = .013$)</td>
</tr>
<tr>
<td>Maheshwar et al37 (2002, UK)</td>
<td>RC, moderate, 4</td>
<td>Gp I: HA; Gp II: VTI; Gp III: HA + VTI; Gp IV: observation</td>
<td>$n = 70$ children (Gp I 17, Gp II 12, Gp III 14, Gp IV 27); age at first use of HA: 3 y and 2 mo (12 mo–8 y); F/U 18 mo</td>
<td>Complication rate: children with VTI (Gp II + III) 38.4% vs without VTI (Gp I + IV) 45.6% ($P &lt; .005$)</td>
</tr>
<tr>
<td>Gordon et al35 (1988, New Zealand)</td>
<td>RC, moderate, 4</td>
<td>Gp I: VTI at the time of palatoplasty; Gp II: non-VTI</td>
<td>$n = 50$ children (100 ears; Gp I 50, Gp II 50); mean age at latest F/U 12 y (9–17); F/U $\geq 9$ y after palatoplasty</td>
<td>Higher rate of abnormal TM in ears with VTI (Gp I 72%, Gp II 14%, $P &lt; .001$; excluding 7 ears with VT in place)</td>
</tr>
</tbody>
</table>

bil, bilateral; F/U, follow-up; Gp, group; HA, hearing aid; LOE, level of evidence; PC, prospective cohort study; RC, retrospective cohort study; TM, tympanic membrane; VTI, ventilation tube insertion.
We believe that this may have increased the rate of complications in areas such as eardrum perforation and scarring and could partly explain the similar complication rates observed in the VTI and non-VTI groups.

Among the various types of complication, eardrum perforations (incidence 1.3%–19%) are the most commonly reported sequelae after VTI, followed by eardrum retraction (incidence 11.5%–36.8%) and tympanosclerosis (incidence 11%–37%).

For other complications and sequelae, such as the occlusion of grommets and the presence of granulation tissue, the evidence was too limited and blurred to determine the direction of the effect between VTI and adverse events in the children with cleft palate and OME.

A large percentage (38%–53%) of the children with cleft palate underwent bilateral grommet insertion.

### Table 5: Effectiveness of Grommets for OME in Children With Cleft Palate: Frequency of Treatment

<table>
<thead>
<tr>
<th>Author (Year, Country)</th>
<th>Design, Quality, LOE</th>
<th>Intervention</th>
<th>Participants</th>
<th>Frequency of Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kobayashi et al³⁴ (2012, Japan)</td>
<td>RC, moderate, 4</td>
<td>VTI in children with cleft palate and OME at age 1–5 y</td>
<td>n = 108 children (216 ears; Gp I 82, Gp II 134); F/U 9.42 y (6–13)</td>
<td>38% of all ears had ≥1 VTIs (all children with cleft palate).</td>
</tr>
<tr>
<td>Kwan et al²⁹ (2011, Hong Kong)</td>
<td>RC, moderate, 4</td>
<td>VTI in patients with cleft palate with OME (80.5% of VTIs concurrent with palatoplasty)</td>
<td>n = 84 children (125 patient-ears with OME; 80 with VTI; 43 without); age 7.5 y (2.7–12.4); F/U 4.3 y</td>
<td>53.2% of all patients had VTI.</td>
</tr>
<tr>
<td>Shaw et al²⁵ (2003, UK)</td>
<td>RC, moderate, 4</td>
<td>VTI for symptomatic OME</td>
<td>n = 72 children (Gp I 20, Gp II 52); speech assessments were carried out at the age of 3–4 y; F/U 9 y</td>
<td>Severe clefts are more likely to have grommets inserted (P &lt; .01).</td>
</tr>
<tr>
<td>Malhotra et al²⁷ (2002, UK)</td>
<td>RC, moderate, 4</td>
<td>HA + VTI</td>
<td>n = 100 children (Gp I 17, Gp II 12, Gp III 14, Gp IV 27); age at first usage of HA: 3 y and 2 mo (12 mo–8 y); F/U 18 mo</td>
<td>Average number of VTIs: 1.7</td>
</tr>
<tr>
<td>Gordon et al³³ (1988, New Zealand)</td>
<td>RC, moderate, 4</td>
<td>VTI at the time of palatoplasty or later</td>
<td>n = 50 children (100 ears, Gp I 150, Gp II 50); mean age at latest F/U 12 y (9–17); F/U ≥9 y after palatoplasty</td>
<td>More patients with complete clefts had repeated VTIs than those with incomplete clefts.</td>
</tr>
</tbody>
</table>

VTI, ventilation tube insertion; Gp, group; RC, retrospective cohort study; VTI, ventilation tube insertion; LOE, level of evidence; F/U, follow-up.
≥1 VTIs for OME. Cleft defects play an important role in OME formation; therefore, it is reasonable to assume that grommets are more likely to be needed for children with more overt palatal malformations. This assumption is supported by the cohort studies included in this review, in which the relationship between the severity of the cleft and frequency of VTI was established, with severe or complete clefts presenting a greater likelihood of necessitating grommet insertion.

One question that must be addressed with regard to VTI for OME in children with cleft palate is the timing of grommet insertion. The studies in this review indicate that grommets are generally inserted on 2 occasions: therapeutic insertion for children with symptoms or signs of OME and prophylactic VTIs at the time of palatoplasty. Despite a belief that early VTI at the time of palatoplasty is beneficial, the existing evidence remains insufficient to support any assertions about the optimal timing of grommet insertion.

**Strength of Evidence**

All studies included in this review were observational cohort studies, which were initially graded as low-quality evidence according to the GRADE approach. For each outcome, the studies were unable to adequately control for known confounding factors. In addition, differences in the measurement of outcomes may also have increased the risk of bias in the outcome results. For example, some of the studies obtained absolute thresholds using standard pure tone audiometry for the measurement of hearing outcomes, whereas 1 study used the percentage of ears with hearing thresholds ≤20 dB (normal limit). Furthermore, there was a high probability of publication bias with each outcome because of the small number of participants in the observational studies. Taking these factors into consideration, we must lower the strength of evidence for each outcome. Based on the GRADE approach, we conclude that the strength of evidence regarding the effectiveness of VTI for OME in children with cleft palate was very low for each outcome, including hearing, speech and language, complications, and frequency of VTI (Table 6).

**Limitations**

This review had the following limitations. First, there is a notable lack of high-quality randomized controlled trials evaluating the effectiveness of VTI for OME in children with cleft palate. As a result, nonrandomized cohort studies of high or moderate quality provided the only available evidence for this review. Second, we did not examine non-English or non-Chinese studies in our review. We identified only 3 non-English or non-Chinese language articles (1 in Spanish and 2 in German), which were excluded from the review because we were unable to obtain complete articles. However, it is probable that no qualitative or quantitative differences exist between studies written in English or any other language with regard to how the authors deal with health equity or report their results. Egger et al claimed that a search for English literature in PubMed is sufficient for most systematic reviews. Furthermore, Cochrane reviews do not impose language restrictions; however, all their studies are published in English. Given the large literature base we used, we believe that we captured most of the relevant studies, and it is unlikely that the conclusions of this review were affected by the exclusion of non-English studies. The nature of retrospective, uncontrolled studies makes them particularly susceptible to selection bias with regard to which patients received tubes and which patients did not. This makes it difficult to draw conclusions about the actual contribution of the tubes to the assessed outcomes. Specifically, during the assessment of children as candidates for tube insertion, those with more pronounced delays in speech and language development would be more likely to receive tubes and therefore end up in the VTI group. Similarly, children with more pronounced

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<tr>
<td>Hearing</td>
<td>Cohort studies</td>
<td>5</td>
<td>368</td>
<td>Compared with a conservative approach, VTI may improve hearing outcomes in the children with cleft palate and OME. VTI may bring benefits to children with cleft palate and OME in speech and language.</td>
<td>Very low</td>
</tr>
<tr>
<td>Speech and language</td>
<td>Cohort studies</td>
<td>3</td>
<td>228</td>
<td>Children with VTI may have a higher risk of complications than those who undergo conservative treatments. The most common post-VTI complications would be eardrum retraction and tympanosclerosis, with incidence of ~11%–37%.</td>
<td>Very low</td>
</tr>
<tr>
<td>Complications</td>
<td>Cohort studies</td>
<td>5</td>
<td>469</td>
<td>A large percentage (38%–53%) of children with cleft palate may need ≥1 VTIs for OME, with patients with severe or complete clefts more likely to have grommet insertion.</td>
<td>Very low</td>
</tr>
<tr>
<td>Frequency of VTI</td>
<td>Cohort studies</td>
<td>5</td>
<td>384</td>
<td></td>
<td>Very low</td>
</tr>
</tbody>
</table>

OME, otitis media with effusion; VTI, ventilation tube insertion.
baseline retraction, effusion, or hearing loss would also be more likely to end up in the VTI group. A comparison of baseline factors in the study can be used to control for this bias but only to a limited degree. The direction of this bias would be against the positive effects of VTI.

Future Research Needs

All studies included in this review were cohort studies with a heterogeneous study design, which was a barrier to evidence synthesis. Future investigations may require the development of rigorous methods to examine functional outcomes in children with cleft palate after VTI. Great attention must be paid to the study methods to improve the literature base and facilitate cross-study integration.

CONCLUSIONS

To the best of our knowledge, this is the first systematic review to address the effects of VTI on children with cleft palate and OME according to patient-centered outcomes. We followed the protocol outlined in Preferred Reporting Items for Systematic reviews and Meta-Analyses to fully and transparently assess the existing literature, to provide evidence-based information about the management of OME in children with cleft palate. First, 38% to 53% of the children with cleft palate underwent VTI for OME, and more severe cases appeared more likely to undergo grommet insertion. Second, compared with a conservative approach, VTI may improve hearing outcomes in the children with cleft palate. The improvements have been shown to remain for 1–9 years after surgery. Third, VTI may benefit children with cleft palate and OME in the development of speech and language. In addition, children who have undergone VTI face a higher risk of complications than those who have not received this form of treatment. The most common post-VTI complications are eardrum retraction and tympanosclerosis, with incidence rates of 11% to 37%. Of particular importance is the need to perform grommet insertion within a highly specified time frame. At present, the existing evidence is insufficient to support any assertions about the use of grommets either therapeutically or prophylactically, at the time of palatoplasty or later. Although the results of this study are evidence based, the studies included in the analysis are underpowered cohort studies, and the evidence for each outcome is of very low strength. Therefore, well-designed randomized controlled trials will be needed to verify the conclusions of this study. Additional prospective studies comparable between institutes will also be needed to develop a comprehensive evidence base with which to validate the conclusions in this systematic review.

ACKNOWLEDGMENTS

We thank the Biostatistics Task Force and Digital Medical Library, Taipei Veterans General Hospital, Taipei, Taiwan, Republic of China, for their support in assembling this review, including consultations with experienced biostatisticians and librarians.

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Grommets for Otitis Media With Effusion in Children With Cleft Palate: A Systematic Review

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*Pediatrics* 2014;134;983; originally published online October 6, 2014; DOI: 10.1542/peds.2014-0323

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Grommets for Otitis Media With Effusion in Children With Cleft Palate: A Systematic Review
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