Advantages of Subannular Tube vs Repetitive Transtympanic Tube Technique

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Objectives: To compare the efficiency of the subannular T-tube (SAT) vs that of the repetitive transtympanic Duravent tube (TTT) in children with recurrent or chronic otitis media (OM) with effusion or tympanic membrane retraction and to establish which population would be more likely to benefit from TTTs vs SATs.

Design: Medical record review.

Setting: Tertiary care pediatric center.

Patients: Children receiving an SAT (234 in 160 patients) or at least 2 TTTs (216 in 111 patients) between January 1, 2002, and December 31, 2006, to allow at least 4 years of follow-up from that period until 2010.

Main Outcome Measures: Average tube duration and complication rates.

Results: The tubes remained in place for a median of 35 months with SAT and 7 months with TTT ($P < .001$). Overall complication rates were lower with SAT (otorrhea, 21.4%; perforation, 7.7%; plugged tube, 13.7%; new acute OM, 13.7%; new serous OM, 5.1%; and cholesteatoma, 1.7%) than with TTT (otorrhea, 26.9%; perforation, 5.1%; blocked tube, 20.8%; new acute OM, 23.1%; new serous OM, 37.5%; and cholesteatoma, 0.46%). Differences were statistically significant for otorrhea, blocked tube, and new acute and serous OM ($P < .001$). With similar rates, TTTs and SATs were used more frequently in acute ($P = .26$) and serous ($P = .32$) OM, whereas SATs were placed more often in adhesive OM and retracted tympanic membrane ($P < .001$).

Conclusions: Insertion of an SAT is a safe and effective method for long-term middle ear ventilation in recurrent or refractory OM, adhesive OM, and retracted tympanic membrane. Associated with fewer complications, SATs offer an alternative to repeated use of the short-term TTTs without damaging the tympanic membrane.


Otitis media (OM) is the second most common disease of childhood after upper respiratory tract infection. It was initially treated by myringotomy by Eli in 1760. Eustachian tube dysfunction plays a significant role in OM etiopathologic development. To successfully ventilate the middle ear, many procedures have been used to maintain a passage between the middle ear and the external ear, such as plastic and metal grommets or tubes.

The use of plastic tubing combined with myringotomy dates from 1954, when Armstrong first described this technique to treat chronic suppurative OM. At that time, the transtympanic tube (TTT) was proposed to provide continuous middle-ear ventilation, thus facilitating its return to the normal state. After an average of 12 months, extrusion of the tube usually occurs because the tympanic membrane migrates centripetally and ejects the tube from the ear canal. The TTT can maintain this ventilation long enough until recovery only in cases of transitory eustachian tube dysfunction. Placement of the TTT has become one of the most common surgical procedures.

Fourteen years after development of the TTT, Simonton described a technique first illustrated by Ersner and Alexander, using a subannular tube (SAT) to extend the intubation time of the middle ear without a need for replacement. The SAT is almost as simple to insert as the TTT and leaves the tympanic membrane intact. Subannular tubes have been used in intractable middle ear effusion, severe myringosclerosis, posterior tympanic membrane collapse, tympanic membrane adhesion, and atelectasis.

The TTT and SAT can be used to treat recurrent or chronic OM with effusion and tympanic membrane retraction. To our knowledge, there has been no previous comparison of these techniques.

The aim of this study was to compare the use of TTTs vs SATs by (1) measur-
ing the average duration that the tubes remain in place, (2) assessing the complication rates, and (3) establishing which population would benefit from TTTs vs SATs.

**METHODS**

This retrospective study was conducted in Sainte-Justine University Hospital Center, a pediatric tertiary care center, to compare use of SAT vs TTT in patients with recurrent or chronic ear disease. Patients in the TTT group had to have undergone at least 2 previous TTT placements. Medical records from 2002 to 2006 of all patients who had received an SAT or at least 2 TTTs were reviewed to ensure at least 4 years of follow-up until 2010.

For both types of surgical procedures, data collected included demographics (sex, age), side of the tube insertion, surgical indications, number of previous TTT and SAT insertions, associated intervention, duration that the tubes remained in place, outcomes of the tubes, postoperative complications, and the ear outcomes (otorrhea, tube occlusion, tympanic membrane perforation, cholesteatoma, new acute OM or serous OM, tympanic membrane retraction, or adhesive OM). Data on treatment of ear infections were also collected. Cases with incomplete data were excluded. Only a few cases had documented preoperative and postoperative audiograms; to prevent bias, those data were not considered in the analysis.

In the present study, the term tympanic membrane retraction represented stage I, II, or III, and the term adhesive otitis represented stage IV of the Sadé classification for tympanic membrane retraction.10

**SURGICAL TECHNIQUES**

**SAT Procedure**

With use of general anesthesia and a microscope, a tympanomeatal flap is elevated from the posterior external auditory canal wall 5 mm from the annulus, exposing the middle ear. Any fluid in the cavity is suctioned, adhesions to the ossicular chain or the promontory are removed, and the ossicular chain is examined. A firm silicone SAT (Goode T-tube [length, 12 mm; internal diameter, 1.14 mm]; Medtronic Xomed, Inc) is inserted in the posterosinferior part of the middle ear under the external auditory canal tympanomeatal flap (Figure 1A and C). While the 2 legs of the tube are in the middle ear, the flap is placed over the tube, leaving only its tip exposed in the canal. Ointment is then applied in the external auditory canal once at the end of the procedure.

**TTT Procedure**

With use of general anesthesia and a microscope, a myringotomy is performed in the anteroinferior quadrant of the ear-drum, and a ventilation tube (V-T Grommet [C-Flex; internal diameter, 1.27 mm]; Medtronic Xomed, Inc) is inserted (Figure 1B and D). Antibiotic drops are applied in the external auditory canal for 1 week.

**STATISTICAL ANALYSIS**

The 2 techniques were compared with a paired t test or a Pearson χ² test for the patient characteristics, proportion of indications, proportion of associated intervention, and proportion of antibiotic treatment use for ear infection with the tubes. The duration that the tubes remained in place and the rates of specific complications were compared using Kaplan-Meier survival curves and a log-rank test. The statistical significance level was set at P < .05. All statistical analyses were performed using commercial software (SPSS, version 19; SPSS Inc).

**RESULTS**

Of the 482 TTT procedures completed during the study period, 216 met our inclusion criteria (111 patients). Of the 286 SAT procedures, using the same selection criteria, 234 were included (160 patients).

**PATIENT CHARACTERISTICS**

A total of 271 patients (450 interventions: 216 TTT and 234 SAT) were included. The patients’ mean age at the time of the surgery, sex, and side of tube insertion are reported in Table 1. Patients who received the SAT were significantly older than those who received the TTT.

**INDICATIONS FOR TTT AND SAT**

The main indications for TTT and SAT were recurrent OM and refractory OM (Table 2). Other indications,
such as eustachian tube dysfunction due to craniofacial syndrome, palatine fissure or cystic fibrosis, and mastoiditis, each had a prevalence of less than 3%; they were not included in the analysis.

**PREVIOUS SURGICAL PROCEDURES**

The TTT group had a mean of 2.6 previous TTT insertions (range, 2-8), and the SAT group had a mean of 2.2 previous TTT insertions (range, 1-8). Sixty percent of patients in the SAT group had received at least 2 TTTs. Table 3 compares the number of previous procedures in each group. All other previous surgical interventions, such as tympanoplasty, staphyloraphy, mastoidectomy, and ossicular reconstruction, had a prevalence of less than 3% in each group and were not considered for analysis.

**ASSOCIATED INTERVENTION**

Myringoplasty was performed more often in the SAT group, and adenoidectomy was more frequent in the TTT group. Table 4 summarizes the results of the associated interventions performed during middle ear intubation.

**DURATION OF TUBE PLACEMENT**

The time that the tubes remained in place was calculated from the time of the intervention to the last time the tube was observed within the ear. The tubes remained in place for a median of 7 months for the TTT group (range, 0-94 months) and 35 months for the SAT group (range, 0-36 months) and 35 months for the SAT group (range, 0-94 months) (Table 4). Figure 2 compares the number of months for which 75%, 50%, and 25% of each of the tubes remained in place. For the SAT group, no standard deviation was included because of the large variability of tube placement duration when 25% of them were still in place.

**OUTCOMES OF SAT AND TTT TUBES**

Outcomes of the tubes are listed in Table 6. Extrusion and replacement were far more frequent in the TTT group. The 2 interventions could not be compared directly since the mean duration of follow-up differed.

**COMPLICATION RATES AND EAR OUTCOMES OF SAT and TTT TUBES**

Complication rates of both surgical procedures and ear outcomes during the follow-up and their analysis are reported in Table 7. There were no statistically significant differences between SATs and TTTs regarding a cholesteatoma formation (SATs, 1.7%; TTTs, 0.46%), tympanic membrane perforation (SATs, 7.7%; TTTs, 5.0%), and new atelectasis or tympanic membrane retraction.

**ANTIBIOTIC TREATMENT OF EAR INFECTION WITH TUBE**

Several routes of administration were used for antibiotic treatment of ear infection while the tubes were in place. Otic drops were used most, with a nonsignificant difference between the 2 groups; oral treatment was used significantly more often with TTTs (Table 8).

**GROUP AGE COMPARISON**

Because the mean age of the TTT group at the time of the procedure was significantly different from that of the SAT group, further analysis was performed using 2 age ranges (3-5 years and 5-7 years) (Figure 3). No significant differences were seen in demographic data (the sex and side of the intervention), indication, associated intervention, and duration that the tubes remained in place, as well as for the complications, perforation, cholesteatoma, and new serous OM. However, when we compared previous interventions, the TTT group had undergone placement of significantly more TTTs compared with the SAT group but only in 3- to 5-year-old children (P = .005).

Otorrhea (P < .001), new acute OM (P = .03), lumen blockage by cerumen (P < .004), and a new adhesive OM or tympanic membrane retraction occurred more frequently and earlier in the TTT group than in the SAT group, again, only in 3- to 5-year-old children. Treatment with oral antibiotics was more frequent in the TTT group than in the SAT group in the 3- to 5-year-old group (P = .004).

**COMMENT**

The SAT technique initially illustrated by Ersner and Alexander in 1960 and described by Simonton, has been used by other practitioners as well as in our study. Patients who develop recurrent acute OM and OM with effusion or experience eustachian tube dysfunction with tympanic membrane retraction require short- to long-term ventilation of the middle ear. These patients undergo different procedures to achieve that ventilation, such as placement of a TTT, an SAT, or a transosseous ventilation tube. A ventilation tube is considered to be long-term if the duration in situ is more than 1 year. Our study permitted a direct comparison of TTTs and SATs inserted by the same team of otolaryngologists.

In our study, patients in the SAT group were significantly older than those in the TTT group. The TTTs and

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**Table 2. Indications for TTTs and SATs**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>TTT</th>
<th>SAT</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent acute OM</td>
<td>62</td>
<td>78</td>
<td>.26</td>
</tr>
<tr>
<td>Recurrent or refractory OM</td>
<td>167</td>
<td>166</td>
<td>.32</td>
</tr>
<tr>
<td>Serous OM</td>
<td>4</td>
<td>4</td>
<td>.01</td>
</tr>
<tr>
<td>Adhesive OM</td>
<td>0</td>
<td>47</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>TM retraction</td>
<td>1</td>
<td>165</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: OM, otitis media; SAT, subannular tube; TM, tympanic membrane; TTT, transtympanic tube. *A patient could have both TM retraction and refractory or recurrent OM.*
SATs were indicated especially in recurrent or refractory acute and serous OM, whereas almost all cases of adhesive OM and tympanic membrane retraction were treated with an SAT because of the absence of the required space between the middle ear cavity and the tympanic membrane to insert a TTT. After a tympanomeatal flap is created and the retracted tympanic membrane is dissected, the SAT is inserted, equalizing the pressure between both sides of the tympanic membrane; thus, the membrane returns to its normal anatomic position.

Abnormal function of the eustachian tube has been implicated as one of the most important factors in the pathogenesis of middle ear disease. To eliminate adenoid effect on eustachian tube function, adenoidectomy is the most common nonotologic surgical procedure undertaken to reduce the occurrence of OM in the pediatric population. A systematic review performed in 2010 showed a significant benefit of adenoidectomy.
with resolution of middle ear effusion in children with OM with effusion. However, the absence of a significant benefit of adenoidectomy on acute OM suggests that routine surgical intervention for this indication is not warranted. In our series, the proportion of the associated interventions with SATs and TTTs was not the same. A total of 86.8% of patients who received an SAT had at least 1 TTT inserted previously, and many had also undergone an adenoidectomy before the SAT was placed; recurrence of OM in these patients reflects the need for long-term middle ear ventilation. These findings demonstrate that SAT is indicated in cases of chronic ear disease, even when adenoidectomy has been performed.

All myringoplasty performed during this study was associated with the use of an SAT to increase the graft success rate and avoid placement of a tube through the grafted tympanic membrane.

Our study confirmed that SATs can be functional for a mean of 35 months (range, 0-94 months) vs 7 months (range, 0-36 months) for TTTs. The mean duration of short-term tubes in the literature varies from 5.5 to 15.4 months and, for long-term tubes, from 20.6 to 52.5 months. Cloutier et al monitored use of 316 SATs, comparing 2 types of tubes: Goode T-tubes (firm silicone) and plain straight-shank tubes (fluoroplastic: length, 12 mm; diameter, 1.14 mm). The T-tubes stayed in place for an average of 23.8 months, and the fluoroplastic tubes remained for 17.8 months. Subannular T-tubes are a possible solution to prevent the use of long-term TTTs associated with a higher complication rate. Tube extrusion and replacement were significantly more frequent with TTTs (66% extrusions and 18% replacements) than with SATs (26% extrusions and 2% replacements), show-

### Table 7. Complication Rates

<table>
<thead>
<tr>
<th>Event</th>
<th>Group</th>
<th>75% (SD)</th>
<th>50% (SD)</th>
<th>25% (SD)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otorrhea</td>
<td>TTT (n = 58)</td>
<td>5 (1.2)</td>
<td>19 (1.4)</td>
<td>...</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 50)</td>
<td>32 (5.0)</td>
<td>72 (17.2)</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Lumen blockage by cerumen or secretion</td>
<td>TTT (n = 45)</td>
<td>9 (2.0)</td>
<td>30 (4.1)</td>
<td>37 (4.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 32)</td>
<td>48 (7.5)</td>
<td>60 (4.4)</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Lumen blockage by granulation tissue</td>
<td>TTT (n = 22)</td>
<td>15 (5.0)</td>
<td>31 (1.8)</td>
<td>...</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 16)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Perforation</td>
<td>TTT (n = 11)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 18)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
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<tr>
<td>Cholesteatoma</td>
<td>TTT (n = 1)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>.90</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 4)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>New acute OM</td>
<td>TTT (n = 50)</td>
<td>5 (0.8)</td>
<td>9 (0.8)</td>
<td>12 (2.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 32)</td>
<td>9 (2.2)</td>
<td>17 (3.8)</td>
<td>28 (2.6)</td>
<td></td>
</tr>
<tr>
<td>New serous OM</td>
<td>TTT (n = 81)</td>
<td>9 (0.5)</td>
<td>14 (1.4)</td>
<td>...</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 12)</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>New atelectasis or TM retraction</td>
<td>TTT (n = 14)</td>
<td>28 (3.1)</td>
<td>28 (1.7)</td>
<td>...</td>
<td>.07</td>
</tr>
<tr>
<td></td>
<td>SAT (n = 38)</td>
<td>42 (4.6)</td>
<td>...</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations:** ellipses, not applicable; OM, otitis media; SAT, subannular tube; TM, tympanic membrane; TTT, transtympanic tube.

- **a** Corresponds to the number of months for which 75%, 50%, and 25% of the ears did not have the complication.
- **b** Fewer than 25% of the ears had the complication at the end of the follow-up.
- **c** Determined using log-rank test.

### Table 8. Antibiotic Treatment of Ear Infection With Tubes

<table>
<thead>
<tr>
<th>Route of Administration</th>
<th>SAT (n = 50)</th>
<th>TTT (n = 58)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM or IV</td>
<td>0</td>
<td>2 (0.9)</td>
<td>.14</td>
</tr>
<tr>
<td>Oral</td>
<td>3 (1.3)</td>
<td>39 (18.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Otic drops</td>
<td>115 (49.1)</td>
<td>111 (51.4)</td>
<td>.63</td>
</tr>
</tbody>
</table>

**Abbreviations:** IM, intramuscular; IV, intravenous; SAT, subannular tube; TTT, transtympanic tube.

- **a** Determined using 2 test.
ing the shorter effect of the TTT, which results in an increased number of subsequent surgical procedures. One of the main reasons for extrusion of TTWs is the centrifugal migration of the tympanic membrane epithelium toward the ear canal. Placement of a tube beneath the anulus may reduce the effect of these migratory forces and enable the tube to remain in situ for a longer time.

In our study, only 2% of SATs were replaced; the longer the tube remains in place, the higher the possibility for middle ear ventilation to become normal. The extrusion rate with TTWs is usually found \(10,11\) to be between 80% and 93%, varying with the tube type and follow-up time. Cloutier et al. \(11\) replaced 22% of their SATs; those most often replaced were the fluoroplastic tubes.

As expected, more SATs (11%) than TTWs (3%) had to be removed after resolution of the initial condition; the T-tube shape of the SAT makes spontaneous extrusion more difficult. A few SATs were still present at the end of this study in December 2010, 94 months after insertion. Tubes were maintained until the child reached the age of 12 years or for at least 5 years after their insertion. After that age and length of time, the tube is no longer required.

In our study, restoring aeration of the middle ear with a ventilation tube was used to prevent ear damage and improve hearing. Most complications occurred earlier with the TTT than with the SAT, demonstrating again the lower efficiency of the TTT. In our patients, although ototympanoplasty occurred in 26.9% of the TTT group and in 21.4% of the SAT group, 50% of ototympanoplasties cases occurred in 19 months in the TTT group and at 72 months in the SAT group (log rank, \(P<.001\)). The longer period without ototympanoplasty in the SAT group might indicate better aeration of the middle ear, with the SAT decreasing the risk of new OM until the lumen is blocked.

Lumen tube blockage is more frequent with TTWs (20.8%) than with SATs (13.7%), and it also happens earlier with TTWs. In our study, 75.3% of the TTT lumen blockage occurred at 9 months by dried secretion after ototympanoplasty; the SAT lumen blockage developed at 48 months, mainly by cerumen. Cleaning of cerumen from the lumen of this kind of SAT is simple and often prevents the need for SAT replacement. In another study, fluoroplastic SAT blockage did not show any significant difference with the subannular T-tube. The TTT group in our study was younger (mean [SD] 3.2 [0.1] years) than the SAT group, exposing them to a higher risk of recurrent multiple upper respiratory tract infections often associated with OM and therefore to ototympanoplasty blocking the TTT. However, 86.8% of the children in our SAT group had received at least 1 TTT; the SAT was indicated because of recurrent or refractory OM. In fact, after stratification of the age ranges, ototympanoplasty, lumen blockage by cerumen, and a new acute OM or tympanic membrane retraction were more frequent and occurred earlier in the TTT group than in the SAT group in children aged 3 to 5 years. On the other hand, the SAT group was more stable and had less infection and secretion; consequently, we found a low proportion of SAT blockage by secretion despite the smaller tube diameter.

In addition, fewer than 25% of SATs were blocked by granulation tissue, which develops at the end of the follow-up period, reflecting late development of an inflammatory reaction to TTT; 79% of the inflammatory reactions occur at 15 months. This higher incidence of granulation tissue is probably associated with earlier ototympanoplasty in the TTT group. An episode of OM after resolution of the initial condition occurred was significantly sooner and more frequently with TTWs, possibly linked to rapid blockage of the TTT lumen.

Reports on the complications of SATs have been published.\(8,9,11\) In our study, few perforations (5.1% of the TTT group vs 7.7% of the SAT group) and cholesteatoma were observed, with no significant difference between the groups. We believe that cholesteatoma formation in the SAT is an iatrogenic process and can be avoided. The usual perforation rate with grommets after spontaneous or surgical tube extrusion is 2.2% to 4.8%,\(5,18,20,21\) and varies with the type of tubes.\(3,18\) It has also been reported\(22\) that the incidence of perforation tends to increase the longer a TTT is in place. A T-tube also can be used as a long-term trans tympanic ventilation tube, but it is associated with more frequent complications: ototympanoplasty (35%), perforation after extrusion or removal (19%-24%), and tympanosclerosis (30%).\(17,20,23,24\) Complication rates rise sharply if trans tympanic T-tubes remain in situ for longer than 36 months, leading some authors\(11\) to suggest elective removal before 36 months. However, Mangat et al\(23\) reported that surgical removal of tubes results in a much higher perforation rate than does spontaneous extrusion (65% vs 19%). A meta-analysis performed by Kay et al\(20\) concluded that long-term tubes were associated with a higher incidence of ototympanoplasty, perforation, and cholesteatoma, with no effect on the rate of blockage, tympanosclerosis, or tympanic membrane retraction. However, recurrent short-term tube interventions have shown no significant effect on the sclerotic changes of the tympanic membrane after 3 years of follow-up.\(26\) We found no reports of patients with external auditory canal fullness following placement of SATs.

Subannular tubes were used in an anterior position by O’Hare and Goebel\(27\) and later by Elluru et al\(28\) during tympanoplasty in patients who already had developed a perforation with eustachian tube dysfunction, adhesive OM, or chronic OM. The same type of T-tube was used by Carr and Robinson,\(29\) with a modified SAT procedure\(26\); they created a groove in the bone of the posterior canal wall for placement of the shaft of the T-tube. Of the 60 tubes evaluated, 26.6% extruded during an average of 16 months. Nearly the same extrusion percentage was noted in our series; thus, a groove to maintain an SAT for an extended time could be avoidable.

Antibiotics used to treat new episodes of OM were mostly otic drops in both groups, but oral antibiotics were used more frequently with TTWs because the infections were more severe and refractory to otic drops, especially for children younger than 5 years. Once again, earlier blockage of TTWs by cerumen or granulation increases the risk of recurrent OM.

Even with the multiple advantages of the subannular Goode T-tube, such as its safety without damage of the tympanic membrane, its longer duration of staying in place, and its lower rate of complications, the short-term TTT is still the choice for the first episode of acute or serious OM.

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However, the SAT is generally indicated in recurrent disease. Our recommendations for situations in which SATs should be used can be summarized as follows:

- recurrent early TTT extrusion;
- multiple TTTS weakening the tympanic membrane;
- eustachian tube dysfunction, especially in patients with craniofacial syndrome, Down syndrome, palatine fissure, and cystic fibrosis;
- chronic OM with atelectasis;
- progressive posterior retraction pocket with intact ossicular chain;
- recurrent OM in patients undergoing myringoplasty, with or without cartilage; and
- atelectasis on ossicular chain reconstruction.

### CONCLUSIONS

The placement of tympanostomy tubes provides an alternative means of middle ear ventilation during periods of eustachian tube dysfunction. The use of SATs for long-term middle ear ventilation has been shown to be safe and more efficient than V-T Grommet TTTS for maintaining middle ear ventilation and preventing recurrent interventions in children. With less otorrhea and plugged tubes, subannular Goode T-tubes remained in place up to 94 months and can be seen as a potent alternative to repetitive TTT placement for chronic conditions such as OM with effusion, recurrent acute OM, adhesive OM, or atelectatic tympanic membrane while being almost as easy to insert.

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**Author Contributions:** All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Saliba, Boutin, Arcand, and Froehlich. Acquisition of data: Saliba, Boutin, Arcand, Froehlich, and Abela. Analysis and interpretation of data: Saliba, Boutin, Arcand, Froehlich, and Abela. Drafting of the manuscript: Saliba, Boutin, Arcand, Froehlich. Critical revision of the manuscript for important intellectual content: Saliba, Boutin, Arcand, Froehlich, Abela, Analysis and interpretation of data: Saliba, Boutin, Arcand, Froehlich, and Abela. Drafting of the manuscript: Saliba, Boutin, Arcand, Froehlich. Critical revision of the manuscript for important intellectual content: Saliba, Boutin, Arcand, Froehlich.

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### REFERENCES