Balloon Dilation of the Eustachian Tube


Policy
Blue Cross and Blue Shield of Kansas City (Blue KC) will not provide coverage for Balloon Dilation of the Eustachian Tube. This is considered investigational.

When Policy Topic is covered
n/a

When Policy Topic is not covered
Balloon dilation of the eustachian tube for treatment of patients with chronic eustachian tube dilatory dysfunction is considered investigational.

Description of Procedure or Service

<table>
<thead>
<tr>
<th>Populations</th>
<th>Interventions</th>
<th>Comparators</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals:</td>
<td>Interventions of interest are:</td>
<td>Comparators of interest are:</td>
<td>Relevant outcomes include:</td>
</tr>
<tr>
<td>• With chronic eustachian tube dilatory dysfunction despite medical management</td>
<td>• Balloon dilation of the eustachian tube</td>
<td>• Continued medical management</td>
<td>• Symptoms</td>
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<tr>
<td></td>
<td></td>
<td>• Mechanical pressure equalization device</td>
<td>• Change in disease status</td>
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<td></td>
<td></td>
<td>• Tympanostomy</td>
<td>• Quality of life</td>
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<td></td>
<td></td>
<td>• Eustachian tuboplasty other than balloon dilation</td>
<td>• Treatment-related morbidity</td>
</tr>
</tbody>
</table>

Summary
Eustachian tube dysfunction occurs when the functional valve of the eustachian tube fails to open and/or close properly. This failure is frequently due to inflammation and can cause symptoms such as muffled hearing, ear fullness, tinnitus, and vertigo. Chronic dysfunction can lead to hearing loss, otitis media, tympanic membrane perforation, and cholesteatomas. Balloon dilation of the eustachian tube is a procedure intended to improve the patency by inflating a balloon in the cartilaginous part of the eustachian tube to cause local dilation.

For individuals who have chronic ET dilatory dysfunction despite medical management who receive balloon dilation of the ET, the evidence includes case series, systematic reviews of case series, a retrospective cohort study, and two
randomized controlled trials (RCTs). The relevant outcomes are symptoms, change in disease status, quality of life, and treatment-related morbidity. The criteria for diagnosing ET dilatory dysfunction are not standardized. Several medical and surgical treatments are used for ET dilatory dysfunction, but there is limited evidence for available treatments. Most case series assessed provided follow-up of less than a year and all showed short-term improvement comparing symptoms before and after balloon dilation. The number of revision procedures required due to the failure of the first ET balloon dilation procedure was reported in 3 case series (n=714 patients); 122 revisions were reported. In one published RCT evaluating balloon dilation of the ET, patients were eligible if they reported persistent ET dilatory dysfunction symptoms as measured on the 7-item Eustachian Tube Dysfunction Questionnaire, a tool to assess symptoms, and had abnormal tympanometry. A greater proportion of patients in the balloon dilation group demonstrated tympanogram normalization (52%) compared with the medical management group (14%) at 6 weeks and reported a reduction in symptoms at 6 weeks on the 7-item Eustachian Tube Dysfunction Questionnaire. The durability of effect at 24 weeks was demonstrated in a subset of patients. The rate of adverse events was low, and none of the serious adverse events were thought to be related to the device or procedure. The 52-week follow-up data have not been reported. The second RCT enrolled patients with moderate to severe ET dysfunction based on the 7-item Eustachian Tube Dysfunction Questionnaire but who were not required to have abnormal middle ear functional assessments. Symptom score change was the primary outcome and mean score decrease was greater in the balloon dilation group than the medical management group. In both RCTs, the initiation, concomitant or continued use of medical therapy of multiple drug classes was at the discretion of the investigators. The durability of effect, rates of reoperation or revisions, and safety data over the first year are needed. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Background**

**Eustachian Tube Function**

The eustachian tube (ET) connects the middle ear space to the nasopharynx. It is approximately 36 mm long in adults. The ET ventilates the middle ear space to equalize pressure across the tympanic membrane, clears mucociliary secretions, and protects the middle ear from infection and reflux of nasopharyngeal contents.\(^1\) The tube opens during swallowing or yawning.

Eustachian tube dysfunction (ETD) occurs when the functional valve of the ET fails to open and/or close properly. This failure may be due to inflammation or anatomic abnormalities. ET dilatory dysfunction (ETDD) is most commonly caused by inflammation including rhinosinusitis and allergic rhinitis. ETDD can cause symptoms such as muffled hearing, ear fullness, tinnitus, and vertigo.\(^2\) Chronic ETDD can lead to hearing loss, otitis media, tympanic membrane perforation, and cholesteatomas.
**Epidemiology of ETD**

The epidemiology of ETD, including incidence and prevalence of the disorder and associated symptoms in the community, primary care, and referral populations, is not well-characterized. Data are also lacking to describe the natural history of the disorder and impact on patient functioning.

**Diagnosis and Outcome Measures**

There are no comprehensive guidelines regarding the diagnosis of ETD. In response to a National Institute for Health Research Health Technology Assessment (2014) concluding that an important limitation with available evidence for treatments of ETD is a lack of consensus on the definition and diagnosis, an international group of scientists and physicians with expertise in ET disorders developed consensus statements on ETD. The meeting was funded by Acclarent, a manufacturer of a dilation technology. The following summarizes relevant 2015 consensus statements from the group.

- There is no universally accepted set of patient-reported symptom scores, functional tests, or scoring systems to diagnose ETD.
- Diagnosis of ETDD should consider patient-reported symptoms along with evidence of negative pressure in the middle ear assessed by clinical assessment.
- Transient ETD is ETD with symptoms and signs lasting less than 3 months while chronic ETD is ETD with symptoms and signs lasting for more than 3 months.
- Future clinical trials should include outcomes related to patient-reported symptoms, otoscopy, tympanometry, and pure-tone audiometry, and outcomes should be assessed at baseline, in the short-term (6 weeks to 3 months) and the long-term (6-12 months).
- The 7-item Eustachian Tube Dysfunction Questionnaire is the only patient-reported outcome scale to have undergone initial validation studies.

Tympanometry is a frequently used outcome measure in ETD. Tympanometry measures the mobility of the tympanic membrane and graphically displays results in tympanograms. Tympanograms are classified by the height and location of the tympanometric peak. They are classified into 3 general patterns: type A indicates normal middle ear and ET function; type B indicates poor tympanic membrane mobility (“flat” tympanogram), and type C indicates the presence of negative middle ear pressure.

The 7-item Eustachian Tube Dysfunction Questionnaire is used to assess ETD-related symptoms such as pressure, pain, “clogged” ears, and muffled hearing over the previous month. The 7 items are rated by patients on a 7-level scale from 1 (no problem) to 7 (severe problem). The overall score is reported as a mean item score with a range from 1.0 to 7.0. The Eustachian Tube Dysfunction Questionnaire has been shown to be a valid and reliable symptom score for use in adults with ETD with overall score of 2.1 or higher having high accuracy to detect the presence of ETD.
Other important outcomes for evaluating a treatment for ETD are hearing outcomes, otitis media, clearance of middle ear effusion, tympanic membrane retraction, and quality of life. Another important consideration is the need for additional treatment, eg, additional surgical procedures (including reintervention).

**Treatment of ETDD**

Medical management of ETDD is directed by the underlying etiology: treatment of viral or bacterial rhinosinusitis; systemic decongestants, antihistamines, or nasal steroid sprays for allergic rhinitis; behavioral modifications and/or proton pump inhibitors for laryngopharyngeal reflux; and treatment of mass lesions. Although topical nasal steroids are commonly used for ETDD, triamcinolone acetonide failed to show benefit in patients ages 6 and older presenting with otitis media with effusion and/or negative middle ear pressure in a randomized, placebo-controlled, double-blind trial published (2011).  

Patients who continue to have symptoms following medical management may be treated with surgery. Available surgical management includes myringotomy with the placement of tympanostomy tubes or eustachian tuboplasty. There is limited evidence and no randomized controlled trials supporting use of these surgical techniques. Norman et al (2014) reported that eustachian tuboplasty (other than balloon dilation) has been evaluated in 7 case series and was associated with improvement in symptoms in 36% to 92% of patients with low rates (13%-36%) of conversion to type A tympanogram (which is normal). Myringotomy and tympanostomy have been evaluated in 2 case series and were associated with symptom alleviation in a subgroup of patients.

**Balloon Dilatation of the ET**

Balloon dilation is a tuboplasty procedure intended to improve the patency of the cartilaginous eustachian tube. During the procedure, a saline-filled balloon catheter is introduced into the eustachian tube through the nose using a minimally invasive transnasal endoscopic method. Pressure is maintained for approximately 2 minutes after which the balloon is emptied and removed. The procedure is usually performed under general anesthesia.

**Regulatory Status**

<table>
<thead>
<tr>
<th>Device</th>
<th>Manufacturer</th>
<th>Date Cleared</th>
<th>510(k) No.</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acclarent Aera Eustachian Tube Balloon D</td>
<td>Acclarent, Inc.</td>
<td>01/16/2018</td>
<td>K171761</td>
<td>Eustachian tube dilation</td>
</tr>
<tr>
<td>Xpress ENT Dilation System</td>
<td>Entellus Medical, Inc.</td>
<td>04/05/2017</td>
<td>K163509</td>
<td>Eustachian tube dilation</td>
</tr>
</tbody>
</table>

In September 2016, the AERA® (Acclarent) was granted a de novo 510(k) classification by the U.S. Food and Drug Administration (FDA) (class II, FDA product code: PNZ). The new classification applies to this device and substantially equivalent devices of this generic type. The AERA® is cleared for dilating the eustachian tube in patients ages 22 and older with persistent ETD.
In December 2016, the XprESS™ ENT Dilation System (Entellus Medical, Plymouth, MN) was cleared for marketing by FDA through the 510(k) process (K163509). FDA determined that this device was substantially equivalent to existing devices for use in eustachian tube dysfunction. The predicate devices are XprESS™ Multi-Sinus Dilation System and AERA® Eustachian Tube Balloon Dilation System.

**Rationale**

This evidence review was created in February 2018 with a search of the MEDLINE database through January 11, 2019.

Evidence reviews assess the clinical evidence to determine whether the use of technology improves the net health outcome. Broadly defined, health outcomes are the length of life, quality of life, and ability to function—including benefits and harms. Every clinical condition has specific outcomes that are important to patients and managing the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms.

To assess whether the evidence is sufficient to draw conclusions about the net health outcome of technology, two domains are examined: the relevance, and quality and credibility. To be relevant, studies must represent one or more intended clinical use of the technology in the intended population and compare an effective and appropriate alternative at a comparable intensity. For some conditions, the alternative will be supportive care or surveillance. The quality and credibility of the evidence depend on study design and conduct, minimizing bias and confounding that can generate incorrect findings. The randomized controlled trial (RCT) is preferred to assess efficacy; however, in some circumstances, nonrandomized studies may be adequate. RCTs are rarely large enough or long enough to capture less common adverse events and long-term effects. Other types of studies can be used for these purposes and to assess generalizability to broader clinical populations and settings of clinical practice.

**Balloon Dilation for Eustachian Tube Dysfunction**

**Clinical Context and Test Purpose**

The purpose of balloon dilation of the eustachian tube (ET) is to provide a treatment option that is an alternative to or an improvement on existing therapies, such as continued medical management, mechanical pressure equalization device, tympanostomy, and eustachian tuboplasty other than balloon dilation in patients with chronic ETDD despite medical management.

The question addressed in this evidence review is: does balloon dilation of the eustachian tube improve the net health outcome in patients with chronic (ETDD)?
The following PICOTS were used to select literature to inform this review.

**Patients**
The relevant population of interest are individuals with chronic ETDD despite medical management.

**Interventions**
The therapy being considered is balloon dilation of the eustachian tube.

**Comparators**
Comparators of interest include continued medical management, mechanical pressure equalization device, tympanostomy, and eustachian tuboplasty other than balloon dilation. Treatment for chronic ETDD includes decongestants, antihistamines, and in some cases steroid nasal sprays.

**Outcomes**
The general outcomes of interest are symptoms, change in disease status, quality of life, and treatment-related morbidity. The 7-item Eustachian Tube Dysfunction Questionnaire (ETDQ-7) is a validated, standardized, 7-item patient-reported questionnaire to assess symptom severity associated with ETD. The seven questionnaire items cover the following ear symptoms: pressure, pain, feeling clogged, cold/sinusitis problems, crackling/popping, ringing, and muffled hearing. Each item is assessed on a scale of one (no problem) to seven (severe problem), and an overall score, which is the mean of the seven item scores, is calculated. Scores in the range of one to two indicate no to mild symptoms, three to five indicate moderate symptoms, and six to seven indicate severe symptoms. Patients may also undergo middle ear functional assessments such as tympanometry, otoscopy, and performance of the Valsalva maneuver.

**Timing**
The existing literature evaluating balloon dilation of the eustachian tube as a treatment for chronic ETDD despite medical management has varying lengths of follow-up, ranging from 3, 6, 12, or 18 months. While studies described below all reported at least one outcome of interest, longer follow-up was necessary to fully observe outcomes.

**Setting**
Patients with chronic ETDD despite medical management are managed by otolaryngologists and primary care providers in an outpatient clinical setting.

**Study Selection Criteria**
Methodologically credible studies were selected using the following principles:

a. To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;

b. In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
c. To assess long-term outcomes and adverse events, single-arm studies that capture longer periods of follow-up and/or larger populations were sought. Studies with duplicative or overlapping populations were excluded.

Systematic Reviews
The evidence for balloon dilation for ETD consists of case series, systematic reviews of these case series, and two RCTs. Recent systematic reviews and meta-analyses are summarized in Tables 2 and 3. Huisman et al (2018)\(^{10}\) provided pooled results while Hwang et al (2016)\(^{11}\) provided qualitative summaries only. Most selected case series provided a follow-up of less than a year. One series with 78 patients had a mean of 12 months of follow-up, and another with 37 patients had a mean of 18 months of follow-up. All case series reported that patients experienced improvement when comparing symptoms before and after balloon dilation. The selected studies differed concerning other treatments for ETD used before and after balloon dilation. In Huisman et al (2017), revisions due to failure of the first ET balloon dilation procedure were reported in 3 of the 15 studies (n=714 patients); 122 revisions were reported.

Table 2. Systematic Review Characteristics

<table>
<thead>
<tr>
<th>Study</th>
<th>Dates</th>
<th>Included Studies</th>
<th>Participants</th>
<th>N (Range)</th>
<th>Design</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huisman (2018)</td>
<td>Through May 2016</td>
<td>15</td>
<td>Adults with ETD treated with balloon dilation</td>
<td>1155 (4-622)</td>
<td>Case series</td>
<td>11 studies &lt;6 mo; 5 studies ≥6 mo</td>
</tr>
<tr>
<td>Hwang (2016)</td>
<td>1950 to Oct 2015</td>
<td>9</td>
<td>Adults with ETD treated with balloon dilation</td>
<td>474 (7-320)</td>
<td>Case series</td>
<td>Mean follow-up, 1.5-18 mo</td>
</tr>
</tbody>
</table>

ETD: eustachian tube dysfunction; mo: month(s).

Table 3. Systematic Review Results

<table>
<thead>
<tr>
<th>Study</th>
<th>Eustachian Tube Score (Difference, Pre-Post)</th>
<th>Valsalva Maneuver(^a)</th>
<th>Abnormal Tympanic Membrane(^b)</th>
<th>Abnormal Tympanogram (Type B or C)(^c)</th>
<th>Quality of Life (SNOT-22)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled effect (95% CI)</td>
<td>MD=3.94 (2.60 to 5.27)</td>
<td>RR=0.13 (0.04 to 0.38)</td>
<td>RR=0.38 (0.07 to 2.05)</td>
<td>RR=0.47 (0.32 to 0.70)</td>
</tr>
<tr>
<td></td>
<td>(I^2) (p-value)</td>
<td>66% (p=0.05)</td>
<td>78% (p=0.001)</td>
<td>99% (p&lt;0.001)</td>
<td>84% (p&lt;0.001)</td>
</tr>
<tr>
<td></td>
<td>Range of N</td>
<td>8-40</td>
<td>4-40</td>
<td>11-40</td>
<td>4-40</td>
</tr>
<tr>
<td></td>
<td>Range of effect sizes</td>
<td>MD: 3.10-6.40</td>
<td>RR: 0.03-0.50</td>
<td>RR: 0.01-1.00</td>
<td>RR: 07-0.73</td>
</tr>
<tr>
<td>Hwang (2016)</td>
<td>Range of N(^d)</td>
<td>NR</td>
<td>NR</td>
<td>7-44</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
<td>Ability to perform improved from 15 (7%) preop to 189 (90%) postop out of 210 patients</td>
<td>135 (95%) ears preop and 55 (39%) postop</td>
<td>SNOT-22 preop mean score improved from 51.4 to 30 at 6 mo</td>
<td></td>
</tr>
</tbody>
</table>
CI: confidence interval; MD: mean difference; postop: postoperative; preop: preoperative; RR: relative risk; SNOT-22: Sino-Nasal Outcome Test.

a The lower the score, the higher the number of patients who can successfully perform a Valsalva maneuver.
b Per otoscopy.
c Per tympanometry.
d Number of patients.

**Randomized Controlled Trials**

Poe et al (2017) published the results of an RCT that compared balloon dilation of the ET with ET balloon catheter (ETBC) plus medical management to medical management alone. The balloon catheter used in the trial was a custom-designed ETBC (Acclarent). The RCT results are also described in the AERA (Acclarent) de novo summary from the Food and Drug Administration. The RCT characteristics, key results, and evidence gaps are summarized in Tables 4 through 7.

Eligible patients in Poe et al (2017) had persistent patient-reported symptoms of ETD (ETDQ-7; mean item score, ≥2.1) and abnormal tympanometry (type B or type C), and failed medical management including either a minimum of 4 weeks of daily use of an intranasal steroid spray or a minimum of one course of an oral steroid. Each investigator was required to perform three successful ETBC procedures in nonrandomized “lead-in” patients who were then followed for durability and safety outcomes. Randomization and analyses were performed at the person-level whether or not the patient had unilateral or bilateral ETD. The primary efficacy outcome (normalization of tympanometry) was assessed by both site investigators and a blinded, independent evaluator; discrepancies were resolved by a second independent evaluator. For bilaterally treated patients, both ears had to be rated as normalized for that patient to be considered normalized for the primary outcome. Patients completed follow-up visits at 2, 6, 12, 24, and 52 weeks but data from the 52-week visit have not been reported. Patients in the medical management arm were allowed to receive balloon dilation of the ET after the six-week visit. Trial enrollment was stopped early after the second preplanned look when the prespecified O’Brien-Fleming stopping boundary for the primary outcome was crossed.

At baseline, the mean ETDQ-7 score was 4.7, 43% of patients had allergic rhinitis, and 61% of patients had at least 1 prior ear tube surgery. By the second interim analysis, 162 patients had been assigned to ETBC and 141 were included in the analysis; 80 had been assigned to medical management and 72 were included in the analysis. Patients were included in the analysis if they received the study treatment for which they were randomized and had six-week follow-up data. Approximately 52% of ETBC patients experienced tympanogram normalization at 6 weeks compared with 14% of medical management patients (p<0.001). The publication reported that sensitivity analysis was performed to test the robustness of results for the impact of missing data in the analysis cohort vs an intention-to-treat cohort, but the method of sensitivity analyses was not described. It was noted there was a significant treatment by site interaction. Two sites had a higher percentage of tympanogram normalization for medical management subjects than
for ETBC subjects while the remaining sites had higher normalization for ETBC. The prespecified secondary efficacy outcome (percentage with minimal clinically important difference change of 0.5 points on ETDQ-7) was not reported in the publication but was reported in the Food and Drug Administration summary. The minimal clinically important difference change in ETDQ-7 scores was observed for 91% of ETBC patients at 6 weeks compared with 45% of medical management patients (p not reported). Fifty-six percent of ETBC patients had an ETDQ-7 mean item score of less than 2.1 at six weeks compared with about 9% of medical management patients (p<0.001).

Comparative analyses were not possible after 6 weeks because 82% of medical management patients elected to ETBC after 6 weeks. The durability of the effect is supported by analysis of tympanogram normalization in 170 patients with week 24 data (98 randomized to ETBC and 74 from the lead-in); 62% of those randomized to ETBC and 58% of lead-in patients demonstrated tympanogram normalization at 24 weeks. Data from 52 weeks have not been reported.

Adverse events were only briefly described in the publication but are more fully described in the Food and Drug Administration summary. Two-hundred ninety-nine patients who were treated with ETBC were included in the safety analysis (80 lead-in patients, 149 patients randomized ETBC, 70 patients randomized to medical management who received ETBC). There were 16 nonserious device or procedure-related adverse events in 13 patients—most commonly, epistaxis and ETD. Two patients had three potentially device-related adverse events: mucosal tear worsened ETD and conductive hearing loss. The potential device- or procedure-related adverse events were mild or moderate in severity and resolved without sequelae. Five serious adverse events were reported (four events in the balloon dilation of the eustachian tube group, one event in the medical management group); all were thought to be unrelated to device, procedure, or medications.

Meyer et al (2018) published the results of a 1-year follow-up, inclusive, prospective, multi-center RCT of balloon dilation as a treatment for persistent ETD and compared the intervention to continued medical therapy (control). Inclusion criteria required patients to be diagnosed with medically refractory, persistent ETD. Participants were randomly assigned (1:1) to intervention or control; however, control participants were offered the intervention after six weeks if their symptoms remained. The outcomes measured include primary efficacy endpoints using the ETDQ-7 scores and the rate of complications. The trial involved 60 randomized participants (31 intervention, 29 control). Mean standard deviation change in overall ETDQ-7 score at 6 weeks was 2.9 (1.4) for balloon dilation compared with 0.6 (1.0) for control: balloon dilation was superior to control (p < 0.0001). No complications were reported in either study arm. Among participants with abnormal baseline assessments, improvements in tympanogram type (p < 0.006) and tympanic membrane position (p < 0.001) were significantly better for balloon dilation than control. Improvements in the ETDQ-7 scores were maintained through 12 months after balloon dilation. Limitations of this RCT are its small sample size and the inability to blind the participants to their treatment.
Tables 4 and 5 summarize key characteristics and results for these two RCTs.

**Table 4. Summary of Key RCT Characteristics: Balloon Dilation of Eustachian Tube**

<table>
<thead>
<tr>
<th>Author; Study</th>
<th>Countries</th>
<th>Sites</th>
<th>Dates</th>
<th>Participants</th>
<th>Description of Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poe (2017) (^{12}); NCT02087150</td>
<td>U.S.</td>
<td>21</td>
<td>Mar 2014- Apr 2016</td>
<td>Age 22 y (mean, 56 y.; persistent ETDD, failed MM, abnormal tympanometry (type B or type C), ETDQ-7 2.1</td>
<td>• 162 patients (234 ears)</td>
</tr>
</tbody>
</table>

BDET: balloon dilation of the eustachian tube; ETDQ-7: Eustachian Tube Dysfunction Questionnaire; ETDD: eustachian tube dilatory dysfunction; MM: medical management. \(^{1}\) patients were allowed to continue current medication regimen.

**Table 5. Summary of Key RCT Results: Balloon Dilation of Eustachian Tube (six Weeks)**

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients with Normalization of Tympanometry (^{1}) (% of patients)</th>
<th>ETDQ-7 Symptom Scores &lt;2.1 (^{2}) (% of patients)</th>
<th>Change in mean ETDQ-7 Score (^{3}) (SD)</th>
<th>Change in Mucosal Inflammation Scores from BL</th>
<th>Increase in Ears with Positive Modified Valsalva Maneuver</th>
<th>SAEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poe (2017) (^{12})</td>
<td>N 211</td>
<td>208</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>BDET with ETBC plus MM</td>
<td>52%</td>
<td>56%</td>
<td>+22%</td>
<td>33%</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MM</td>
<td>14%</td>
<td>9%</td>
<td>-5%</td>
<td>3%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Tx effect (95% CI)</td>
<td>RR=NR</td>
<td>RR=NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>p</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NNT (95% CI)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td></td>
</tr>
</tbody>
</table>

| Meyer (2018) \(^{14}\) | | | | | | |
| N | 28 | | | | | |

BDET: balloon dilation of the eustachian tube; BL: baseline; CI: confidence interval; ETBC: eustachian tube balloon catheter; ETDD: eustachian tube dilatory dysfunction; ETDQ-7: 7-item Eustachian Tube Dysfunction Questionnaire; MM: medical management; NNT: number needed to treat; NR: not reported; RR: relative risk; SAE: serious adverse event; Tx: treatment. \(^{1}\) Primary outcome for Poe. 
\(^{2}\) The prespecified secondary outcome was the proportion of subjects achieving an improvement of at least a minimal clinically important difference of 0.5 points; it was not reported. 
\(^{3}\) Primary outcome for Meyer.
The purpose of gaps tables (see Tables 6 and 7) is to display notable gaps identified in each study. This information is synthesized as a summary of the body of evidence following each table and provides the conclusions on the sufficiency of the evidence supporting the position statement.

**Table 6. RCT Relevance Gaps**

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Intervention</th>
<th>Comparator</th>
<th>Outcomes</th>
<th>Follow-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poe (2017)</td>
<td>MM not clearly described, nasal steroids and other medications initiated or continued; other medications with clinical discretion</td>
<td>1. Limited information on harms provided in the primary publication vs. FDA dossier</td>
<td>1, 2. Only 6 wk of comparative data; longer follow-up of BDET to 24 wk in subset of patients. 52-wk data not reported.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meyer (2018)</td>
<td>Study enrollment criteria did not require abnormal middle ear functional assessments</td>
<td>1. MM not clearly described, nasal steroids and other medications initiated or continued; other medications with clinical discretion</td>
<td>1. Primary outcome limited to ETDQ-7 symptom score</td>
<td>1.2 Comparative outcomes limited to 6 weeks</td>
<td></td>
</tr>
</tbody>
</table>

**Key**

- 1. Intended use population unclear
- 2. Clinical context for treatment is unclear
- 3. Study population unclear
- 4. Study population not representative of intended use
- 5. Study population is subpopulation of intended use

<table>
<thead>
<tr>
<th>Study</th>
<th>Allocation</th>
<th>Blinding</th>
<th>Selective Reporting</th>
<th>Follow-Up</th>
<th>Power</th>
<th>Statistical</th>
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<tbody>
<tr>
<td>Poe (2017)</td>
<td>1. Blinding of patients not possible; may bias patient-reported</td>
<td>1. Not clearly defined</td>
<td>1. Treatment effects and CIs not reported</td>
<td>5, 6. Analysis was not ITT; excluded patients who did not receive assigned treatment. Due</td>
<td>3. Treatment effects and CIs not reported</td>
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</table>

BDET: Balloon dilation of the eustachian tube; FDA: Food and Drug Administration; MM: medical management.
measures to early stopping, only a subset of patients had 6-wk follow-up

Meyer (2018)\textsuperscript{14}.

1. Blinding of patients not possible; may bias patient-reported measures
2. Analysis was not ITT; excluded patients who did not receive assigned treatment.

Key
1. Participants not randomly allocated
2. Allocation not concealed
3. Allocation concealment unclear
4. Inadequate control for selection bias
5. Not blinded to treatment assignment
6. Not blinded outcome assessment
7. Outcome assessed by treating physician
8. Not registered
9. Evidence of selective reporting
10. Evidence of selective publication

Observational Study

Satmis et al (2018) published a retrospective cohort study of 42 consecutive adult patients with chronic ETDD.\textsuperscript{15} Patients in a tertiary referral hospital setting who received transnasal balloon dilation of the ET were evaluated. Objective outcome measures included the ETDQ-7 score, bone conduction threshold, and tympanic membrane and middle ear conditions, which were pre and postoperatively collected. Mean ETDQ-7 scores improved from 4.28 to 3.09 and from 4.10 to 2.96 postoperatively at 1 and 3 months respectively. There was a 62.0% improvement in the tympanic membrane and middle ear condition. No serious procedure-related complications were reported.

Section Summary: Balloon Dilation for ETD

Balloon dilation of the eustachian tube has been evaluated in case series, systematic reviews of case series, a retrospective cohort study, and two published RCTs. Most case series provided follow-up of less than a year and all showed short-term improvement comparing symptoms before and after balloon dilation. The number of revisions needed due to the failure of the initial ET balloon dilation
procedure was reported in 3 case series (n=714 patients); 122 revisions were reported. In one published RCT, balloon dilation plus medical management was compared with medical management alone, with comparative data available at six weeks of follow-up. The trial was stopped early due to the significant benefit of the balloon dilation compared with medical management at the second preplanned analysis. A greater proportion in the balloon dilation group demonstrated tympanogram normalization (52%), the primary outcome, compared with the medical management group (14%) at 6 weeks and reported a reduction in symptoms at 6 weeks on a validated questionnaire, ETDQ-7. The tympanogram outcome was assessed by blinded evaluation, but the symptom scores were patient-reported, and patients were not blinded (ie, there was no sham procedure); therefore, results could have been biased. In addition, the study was stopped at 6 weeks because 82% of the medical management arm crossed over to the balloon dilation intervention when it was allowed at this point in the study. Intention-to-treat analyses were not shown, but a sensitivity analysis showing the robustness of the results to missing data was reportedly performed. There was variability in the treatment effect as 2 (of 21) sites did not show benefit for balloon dilation, which the investigators suggested could have been due to the device and procedural learning curve of the study staff or problems with protocol compliance. The rate of adverse events was low, and none of the serious adverse events was thought to be related to the device or procedure. The trial was designed to follow patients for 52 weeks, but long-term data have not yet been reported. The durability of effect, rates of reoperation or revisions, and safety data over the first year are needed. The second RCT enrolled patients with moderate to severe ETD based on the ETDQ-7 but who were not required to have abnormal middle ear functional assessments. Symptom score change was the primary outcome and mean score decrease was greater in the balloon dilation group than the medical management group. In both RCTs, the initiation, concomitant or continued use of medical therapy of multiple drug classes was at the discretion of the investigators.

**Summary of Evidence**

For individuals who have chronic ETDD despite medical management who receive balloon dilation of the ET, the evidence includes case series, systematic reviews of case series, a retrospective cohort study, and two RCTs. The relevant outcomes are symptoms, change in disease status, quality of life, and treatment-related morbidity. The criteria for diagnosing ETDD are not standardized. Several medical and surgical treatments are used for ETDD, but there is limited evidence for available treatments. Most case series assessed provided follow-up of less than a year and all showed short-term improvement comparing symptoms before and after balloon dilation. The number of revision procedures required due to the failure of the first ET balloon dilation procedure was reported in 3 case series (n=714 patients); 122 revisions were reported. In one published RCT evaluating balloon dilation of the ET, patients were eligible if they reported persistent ETDD symptoms as measured on the ETDQ-7, a tool to assess symptoms, and had abnormal tympanometry. A greater proportion of patients in the balloon dilation group demonstrated tympanogram normalization (52%) compared with the medical management group (14%) at 6 weeks and reported a reduction in
symptoms at 6 weeks on the ETDQ-7. The durability of effect at 24 weeks was
demonstrated in a subset of patients. The rate of adverse events was
low, and none of the serious adverse events were thought to be related to the
device or procedure. The 52-week follow-up data have not been reported. The
second RCT enrolled patients with moderate to severe ETD based on the ETDQ-7
but who were not required to have abnormal middle ear functional assessments.
Symptom score change was the primary outcome and mean score decrease was
greater in the balloon dilation group than the medical management group. In
both RCTs, the initiation, concomitant or continued use of medical therapy of
multiple drug classes was at the discretion of the investigators. The durability of
effect, rates of reoperation or revisions, and safety data over the first year are
needed. The evidence is insufficient to determine the effects of the technology on
health outcomes.

SUPPLEMENTAL INFORMATION

Practice Guidelines and Position Statements

National Institute for Health and Care Excellence
The National Institute for Health and Care Excellence (2011) published guidance
on balloon dilation of the eustachian tube. The guidance stated:

“Current evidence on the efficacy and safety of balloon dilatation of the Eustachian
tube is inadequate in quantity and quality. Therefore, this procedure should
only be used in the context of research, which should address the efficacy of the
procedure in the short and longer term, and also document safety outcomes.”

U.S. Preventive Services Task Force Recommendations
Not applicable.

Medicare National Coverage
There is no national coverage determination. In the absence of a national coverage
determination, coverage decisions are left to the discretion of local Medicare
carriers.

Ongoing and Unpublished Clinical Trials
A January 2019 search did not identify any ongoing or unpublished trials that
might influence this review.

REFERENCES
1. Schilder AG, Bhutta MF, Butler CC, et al. Eustachian tube dysfunction: consensus statement on
PMID 26347263
Dec 2006;39(6):1221-1235. PMID 17097443


15. Satmisi MC, van der Torn M. Balloon dilatation of the Eustachian tube in adult patients with chronic dilatory tube dysfunction: a retrospective cohort study. Eur Arch Otorhinolaryngol. Feb 2018;275(2):395-400. PMID 29285624


### Billing Coding/Physician Documentation Information

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<td>69799</td>
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### ICD-10 Codes

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<td>H69.80</td>
<td>Other specified and unspecified disorders of Eustachian tube code range</td>
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<tr>
<td>H65.00</td>
<td>Nonsuppurative otitis media code range</td>
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<td>Suppurative and &amp; unspecified otitis media code range</td>
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<td>Perforation of tympanic membrane code range</td>
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Meniere's disease code range

Peripheral and Central vertigo code range

Other and unspecified hearing loss code range

Vasomotor and Allergic rhinitis

Chronic rhinitis and Sinusitis range

Additional Policy Key Words

N/A

Policy Implementation/Update Information

4/1/18 New Policy. Considered Investigational.
10/1/18 No policy statement changes.
4/1/19 No policy statement changes.

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