The high prevalence of otitis media with effusion in children with cleft lip and palate as compared to children without clefts

Traci Flynn a,*, Claes Möller b, Radoslava Jönsson c, Anette Lohmander d

aDepartment of Audiology, Institutionen for Neuroscience and Physiology, Sahlgrenska Academy with Gothenburg University, Box 452, 405 30 Gothenburg, Sweden
bDepartment of Audiology/The Swedish Institute for Disability Research Örebro University Hospital 70185 Örebro, Sweden
cDepartment of Audiology, Sahlgrenska University Hospital, 413 45 Gothenburg, Sweden
dCLINTEC, Institution for clinical science, intervention and technique, Karolinska Institute, 171 77 Stockholm, Sweden

ARTICLE INFO

Article history:
Received 8 May 2009
Received in revised form 16 July 2009
Accepted 17 July 2009
Available online xxx

Keywords:
Otitis media with effusion
Cleft (lip and) palate
Tympanometry
Hearing sensitivity
Audiometry

SUMMARY

Objectives: Children with cleft lip and palate universally present with otitis media with effusion. This prevalence has not been systematically studied. The purpose of the present study was to examine and compare the prevalence of otitis media with effusion, hearing sensitivity, and audiometry method utilised for assessment in children with and without clefts.

Methods: Two groups of children [children with unilateral cleft lip and palate, N = 22, and children without clefts, N = 20] were followed prospectively and longitudinally from 1 to 5 years of age. Data were collected at four points (1, 1.5, 3, and 5 years of age). Assessments at each of the four points included: (1) otomicroscopy, (2) tympanometry, and (3) hearing assessment.

Results: Overall the children with unilateral cleft lip and palate demonstrated a significantly higher prevalence of otitis media with effusion (121 ears, 74.7%) than children without clefts (31 ears, 19.4%) (p < 0.001). This higher prevalence was also significant at 1, 1.5, 3, and 5 years of age (p < 0.001). Of those ears with otitis media with effusion, 83.1% of the ears exhibited a hearing loss (PTA > 20 dB), with this loss more prevalent in the cleft group (89.7% UCLP and 70.0% non-cleft). The hearing loss was significantly more pronounced in the cleft group (35.71 dB HL UCLP and 26.41 dB HL non-cleft group). Children with unilateral cleft lip and palate utilised a lower age-appropriate audiometry testing method than age-matched children with no cleft at 1, 1.5, and 3 years of age.

Conclusions: Children with unilateral cleft lip and palate present with a significantly higher prevalence of otitis media with effusion than children without cleft. Also, the hearing loss associated with otitis media with effusion is demonstrated in this study. Furthermore, the method of audiometry has been examined and children with unilateral cleft lip and palate had to be assessed with a lower level of method than children without cleft.

© 2009 Published by Elsevier Ireland Ltd.
present with OME until the age of 7 years [8,15]. After the age of 7, morphological changes in the Eustachian tube occur which result in improved tubal function [8]. Ninety-one percent of all children experience at least one episode of OME before their second birthday [17].

Recommended management for OME includes watchful waiting and surgery [20]. Children who are not at risk for OME should be watched for 3 months from the date of OME onset or diagnosis. Children should be re-examined every 3–6 months until effusion is no longer present, significant hearing loss is identified, or structural abnormalities in the middle ear or eardrum are suspected. Following persistent OME or significant hearing loss, surgical intervention may be an option. The surgical insertion of a pressure equalising tube can provide aeration and equalisation of pressure to the middle ear cavity and thus allow the fluid drain and decrease secretion from the mucosa.

The majority of the current research on the prevalence of OME in children with CLP has been conducted retrospectively with data collected through medical records and/or surveys [21,22,28]. Four studies have prospectively gathered data on children with CLP and demonstrated a higher prevalence of OME in children with CLP though abnormal tympanometry or abnormal otomicroscopy [6,12,23,24]. However, these studies either examined children which were younger than the documented peak of prevalence of 4–6 years of age [8], or they were older and not longitudinally followed. Children need to be followed longitudinally from birth to age 5 or 6 to confirm this later peak of prevalence of OME.

Another aspect to consider when investigating the prevalence of OME is the sensitivity of hearing. OME is associated with a mild to moderate conductive hearing loss with levels fluctuating between 0 and 55 dB across the speech frequencies [14]. In the four previously cited studies, all have reported hearing sensitivity, with only two relating it to OME [12,24]. The two studies had opposing findings. Vahtonen et al. [24] found ears with OME demonstrated a low percent of hearing loss (PTA > 15 dB); while Broen et al. [12] found children with clefts and who had failed tympanometry demonstrated poorer hearing thresholds than children who passed tympanometry.

It is also important to compare the prevalence of OME in children with and without CLP. Since OME is a common childhood ailment, it is integral to have a group of children without CLP to obtain an estimation of the difference in prevalence of OME. Only three studies to date have compared children with CLP to children without cleft [12,24,25], but these studies have included different subject groups, different types of clefts, and did not examine the children for the length of time required to explore the prevalence of OME in regards to age. This needs to be completed to give insight into providing the best audiological and otological management for children with cleft lip and palate with a comparison to children without cleft over the first several years of life.

The aims of the present study were to investigate:

- Do children with CLP present with a higher prevalence of OME compared to children without CLP from 1 to 5 years of age?
- Is the hearing sensitivity of children with CLP more severe than in children without CLP?
- Is the audiometry methods utilised different between children with CLP than in age-matched children without CLP?

2. Materials and methods

2.1. Materials

Two groups of children were followed prospectively and longitudinally from 1 year of age to 5 years of age. There were 22 children with unilateral cleft lip and palate (UCLP/cleft group) (13 males and 9 females) and 21 healthy children without cleft lip and palate (non-cleft group) (10 males and 11 females). The children in the cleft group were a consecutive series which presented with a unilateral cleft lip and palate and were treated by the Gothenburg Cleft Palate Team. The cohort of children with UCLP was born between 1997 and 2002 in the western region of Sweden. Participants were part of a larger randomised trial on palatal surgery (the Scandcleft project) study [26]. Children in the non-cleft group were born in 2001 in Gothenburg. Three local well-baby clinics were randomly selected and all parents to children born in 2001 were invited to participate in the study. Medical and audiological management have been the same since the main project (Scandcleft project) started 1997 and were thus similar between the UCLP and non-cleft group.

Participating children did not present with an identified syndrome or other physical impairments. At least one parent spoke native Swedish at home. Children with a UCLP underwent lip closure and posterior palatoplasty at a mean age of 4.3 months (range: 3–6 months) and hard palate closure at 23.28 months (range: 11.56–37.06 months).

2.2. Methods

All children with a UCLP and all children with non-cleft were examined. Data were collected when the children were 1 year, 1.5 years, 3 years, and 5 years of age (±2 weeks). Assessments included otomicroscopy, tympanometry, and hearing sensitivity. Each assessment was performed at each visit, unless there was non-compliance.

Children in the UCLP group attended these appointments as part of a routine clinical day with several appointments including, speech-language pathologist, plastic surgeon, orthodontist, audiologist, and ENT physician. The children in the non-cleft group visited the hospital one day close to the chosen age of for examination (±2 weeks) and had appointments and testing in a speech-language pathologist, audiologist, and ENT physician.

2.2.1. Otomicroscopy

Paediatric otolaryngologists performed otomicroscopy at each visit. The otolaryngologists were specialists in seeing children with cleft lip and palate, as the otomicroscopy was completed on a normal cleft palate team day at the hospital. Results from otomicroscopy were classified as normal or abnormal (fluid filled middle ear cavity or pressure equalising tubes in situ).

2.2.2. Tympanometry

Tympanometry was completed at each visit with an Interacoustics MT10 tympanometer to evaluate the status of the middle ear. A 226-Hz probe frequency was utilised. Tympanograms were classified as normal (type A, CI, and C2), abnormal (type B; no discernable peak), or if the child had pressure equalising tubes [25].

2.2.3. Hearing sensitivity

Hearing sensitivity was tested using warble tones or a narrow-band noise in sound-field or under head-phones at each visit with an Interacoustics AD2296 audiometer. Narrow-band noises include sounds that have been filtered and are a bandwidth of one octave around the centre frequency. An example of sounds for the different frequencies include: a dog barking at 500 Hz, a rooster crowing at 1000 Hz, a phone ringing at 2000 Hz, and a bird singing at 4000 Hz.

Behavioural, visually reinforced, or conditionned-play audiometry was utilised to obtain ear and frequency specific thresholds. Testing was chosen by an experienced paediatric audiologist and also dependent on the child's ability to complete the assessment. For behavioural and visually reinforced audiometry, testing was conducted in a sound-proof booth with the audiologist in the booth with the child and parent. Stimuli were presented through two
calibrated loudspeakers in the sound-field positioned at 45° angles (45° and 315°). When the child responded correctly to a sound, the child was visually reinforced with a doll that lights up and moves. For conditioned play audiometry, the child was seated in the sound-proof booth with a parent and the audiologist was either inside the booth or outside the booth.

Ear specific thresholds were obtained for 500, 1000, 2000, and 4000 Hz. A four frequency pure-tone average was calculated for each ear unless children were non-compliant. If the child was non-compliant, thresholds at less than four frequencies were obtained. In order to be included in the study, thresholds at three frequencies or screening at three frequencies were required. Normal hearing was considered to be 0–20 dB HL, mild hearing loss 21–40 dB HL, and moderate hearing loss 41–60 dB HL.

2.2.4. Otitis media with effusion

In this study, OME was deemed to be present if at least one of three conditions were met:

- abnormal tympanometry (Type B; flat curve with no discernable peak [20]),
- tympanostomy tubes in situ (in guidelines with American Academy of Pediatrics [20]),
- abnormal otomicroscopy and hearing sensitivity indicating the presence of OME.

All data were jointly examined by two of the authors.

2.3. Statistical description and analysis

Statistical analysis of the results was performed using a Generalized Estimating Equation Model and a Chi Square test to analyse the association between the UCLP and non-cleft groups, as data was nominal and taken at four discrete time points. The data were analysed using SPSS for Windows (Version 17.0).

Ethical approval was obtained by the Gothenburg Regional Ethical Board on 1997-06-16 (R257-97). All parents of children in the UCLP and non-cleft group gave consent to participate in the present study.

3. Results

Data were analysed by ears. Of a possible 344 ears, 322 were included in the analysis (162 ears of children with UCLP and 160 ears of children in the non-cleft group). Missing data was due to either a missed appointment or non-compliance for participation in testing. See Table 1 for details on the number of ears in each group at each age. Included in the analysis were ears with otomicroscopy, tympanometry, and hearing sensitivity data.

3.1. Prevalence of otitis media with effusion

Otitis media with effusion was prevalent in 152 ears (121 in the UCLP group and 31 in the non-cleft group). See Table 2 for a more detailed description of the classification of OME in the ears.

![Prevalence of OME](Fig. 1. Prevalence of OME (in percentage) between groups (UCLP, n = 22; non-cleft, n = 21) at the studied four ages. Children with UCLP demonstrate significantly higher prevalence of OME than children in the non-cleft group (1 year, p < 0.001; 1.5 years, p = 0.001; 3 years, p = 0.001; 5 years, p = 0.004).

Table 1

<table>
<thead>
<tr>
<th>Age of children</th>
<th>UCLP</th>
<th>Non-cleft</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>38</td>
<td>42</td>
<td>80</td>
</tr>
<tr>
<td>1.5 years</td>
<td>42</td>
<td>38</td>
<td>80</td>
</tr>
<tr>
<td>3 years</td>
<td>41</td>
<td>40</td>
<td>81</td>
</tr>
<tr>
<td>5 years</td>
<td>41</td>
<td>40</td>
<td>81</td>
</tr>
<tr>
<td>Overall</td>
<td>162</td>
<td>160</td>
<td>322</td>
</tr>
</tbody>
</table>

* UCLP (children with unilateral cleft lip and palate).

Table 2

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCLP</td>
<td>23</td>
<td>76</td>
<td>22</td>
</tr>
<tr>
<td>Non-cleft</td>
<td>15</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>85</td>
<td>29</td>
</tr>
</tbody>
</table>

OME was deemed to be present if one of three conditions were met: (1) abnormal tympanometry (Type B; flat curve with no discernable peak [20]), (2) tympanostomy tubes in situ (in guidelines with American Academy of Pediatrics [20]), or (3) abnormal otomicroscopy and hearing sensitivity indicating the presence of OME.

Please cite this article in press as: T. Flynn, et al., The high prevalence of otitis media with effusion in children with cleft lip and palate as compared to children without clefts, Int. J. Pediatr. Otorhinolaryngol. (2009), doi:10.1016/j.ijporl.2009.07.015
When dependency of ears over time was taken into account through a generalised estimating equation, the children with UCLP demonstrated a significantly higher prevalence of OME (121 ears, 89–50%) than the children in the non-cleft group (31 ears, 14–26%) (p = 0.001–0.004) at each of the four data points (Fig. 1).

The odds ratio for children in the UCLP is greater for having OME than children in the non-cleft group at each age (Table 3).

When considering tympanostomy tubes, children with UCLP exhibited a significantly higher number of tympanostomy tubes in situ than children in the non-cleft group overall and at each data point (p < 0.001) (Fig. 2).

### 3.2. Hearing sensitivity

Fifty-nine of 67 ears exhibited OME (excluding those with tympanostomy tubes in situ) and had audimetric data (39 UCLP; 20 non-cleft). Of these ears, the number of ears at the different data points and type of audiometry utilised are listed in Table 4.

Of those ears with OME (excluding those with tympanostomy tubes in situ), 83.1% exhibited a hearing loss (PTA >20 dB HL). This loss was more prevalent in the UCLP group (89.7% UCLP and 70.0% non-cleft). The average PTA for ears with OME and hearing loss in the UCLP group (N = 35) was 35.71 dB HL (21.67–47.5 dB HL) and 26.41 dB HL (21.25–31.25 dB HL) in the non-cleft group (N = 14) (Fig. 3). This difference in PTA between the groups is significant (p < 0.05). The average PTA for ears with OME and no hearing loss in the UCLP group (N = 4) was 18.13 dB HL (15–20 dB HL) and 19.38 (16.25–20 dB HL) dB HL in the non-cleft group (N = 6).

### 3.3. Audiometry method

At three of the data points (1, 1.5 and 3 years), the chosen method of audiometry used for assessing hearing sensitivity was significantly different between the UCLP and non-cleft group. At 1 year and 1.5 years of age, children with UCLP demonstrated a significantly higher use of behaviour observational audiometry (BOA) and visual reinforcement audiometry (VRA) conditioned play audiometry (CPA) compared to children without clefts (p < 0.001) (Fig. 4).

### 4. Discussion

The present study expands the current knowledge and gives new insight into the prevalence of OME in children with CLP, as well as hearing sensitivity and audiometry methods to be used. This is achieved through utilisation of a valid experimental group and a stringent methodology.

First, this study includes a representative group of children with UCLP. The UCLP group included all children born in the western region of Sweden with UCLP and no additional disabilities. The children in the non-cleft group were asked to participate through well-baby clinics in Gothenburg and had no identified additional disabilities. Parents from the non-cleft group who were interested in participating in the study demonstrated a higher level of education and income than parents of children in the UCLP group.

Second, the methods employed in this study were the most rigorous when investigating the presence of OME. The inclusion of a stringent methodology.

**Table 3**

<table>
<thead>
<tr>
<th>Age</th>
<th>Odds ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45.3</td>
<td>6.8–300.3</td>
</tr>
<tr>
<td>1.5</td>
<td>12.0</td>
<td>2.9–50.3</td>
</tr>
<tr>
<td>3</td>
<td>11.5</td>
<td>2.8–47.0</td>
</tr>
<tr>
<td>5</td>
<td>5.9</td>
<td>1.8–19.9</td>
</tr>
</tbody>
</table>

**Table 4**

<table>
<thead>
<tr>
<th>Data point</th>
<th>UCLP</th>
<th>Non-cleft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>18 (51.43%)</td>
<td>1 (7.14%)</td>
</tr>
<tr>
<td>1.5 years</td>
<td>11 (31.42%)</td>
<td>6 (42.86%)</td>
</tr>
<tr>
<td>3 years</td>
<td>5 (14.29%)</td>
<td>4 (28.57%)</td>
</tr>
<tr>
<td>5 years</td>
<td>1 (2.86%)</td>
<td>3 (21.43%)</td>
</tr>
</tbody>
</table>

**Fig. 2.** The prevalence of tympanostomy tubes in situ (in percentage) for each group (UCLP, N = 22, and non-cleft, N = 21) overall and at the four studied ages. Children in the UCLP group have a significantly higher number of tympanostomy tubes than children in the non-cleft group (p < 0.001). OME was deemed to be present if the tympanostomy tubes in situ, 83.1% exhibited a hearing loss (PTA >20 dB HL). This loss was more prevalent in the UCLP group (89.7% UCLP and 70.0% non-cleft). The average PTA for ears with OME and hearing loss in the UCLP group (N = 35) was 35.71 dB HL (21.67–47.5 dB HL) and 26.41 dB HL (21.25–31.25 dB HL) in the non-cleft group (N = 14) (Fig. 3). This difference in PTA between the groups is significant (p < 0.05). The average PTA for ears with OME and no hearing loss in the UCLP group (N = 4) was 18.13 dB HL (15–20 dB HL) and 19.38 (16.25–20 dB HL) dB HL in the non-cleft group (N = 6).

**Fig. 3.** Boxplots showing maximum, median, and minimum pure-tone averages (PTA in dB HL) and first and third quartile for ears with OME and hearing loss by group (N = 35 for UCLP group and N = 14 for non-cleft group). PTA (calculated at least 3 of the 4 frequencies: 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz) by group and hearing loss.
4.1. Prevalence of OME

Otitis media with effusion (OME) is universally present in children with CLP [2-9] and is often present within the first 6 months of life [3,5,9]. The previously reported increase in prevalence of OME in children with CLP over children without clefts [12,24,25] was supported in this study when the UCLP group and the non-cleft group were compared between the four age groups (1, 1.5, 3, and 5 years of age). Children with clefts need to be closely followed for OME more than 5 years of age, as there is still a high prevalence of OME at the age of 5 years (Fig. 1).

Children with tympanostomy tubes were included in the group with OME, since children with tympanostomy tubes have had signs of ongoing OME. In Gothenburg’s clinical protocol, tympanostomy tubes are inserted in children at risk for OME following an average of 3 months of OME. Children who are not at risk for OME typically receive tympanostomy tubes following 6 months with OME. Even though children at risk for OME receive tympanostomy tubes 3 months earlier than children who are at risk, both groups in this study were under more rigorous medical care than normal. Both groups of children most likely received tympanostomy tubes if they were warranted and perhaps earlier than 6 months if they were in the non-cleft group, as they were examined frequently as part of the study protocol. Children with UCLP demonstrated a significantly higher number of tympanostomy tubes than children in the non-cleft group (Fig. 2). Therefore, it may be concluded that children with UCLP may have a higher prevalence of OME than children without cleft lip and palate [12,24,25].

Over 50% of the children in the UCLP group with OME had tympanostomy tubes in situ at 5 years of age, indicating the presence of OME at older ages. This could lead to several different sequelae which could include a permanent perforation of the tympanic membrane, a retracted, non-ventilated ear (if the tube is not working), or chronic OME. These conditions may lead to the development of a cholesteatoma. The long-term outcomes of OME on the health of the middle ear need to be investigated as the present study demonstrates a high prevalence OME is still present at 5 years of age in children with UCLP [20].

4.2. Hearing sensitivity

Children with OME should have their hearing sensitivity carefully watched as the presence of OME is associated with a mild to moderate conductive hearing loss [14]. The results from the present study further document a hearing loss when OME is also present in children (Table 4). This is in line with Broen et al. [12] who also examined hearing sensitivity in relation to OME, which demonstrated children with cleft who failed tympanometry demonstrated poorer hearing thresholds than children who passed tympanometry.

The 10 dB difference in the pure-tone averages between the two groups in the present study (35.71 dB in the UCLP group and 26.41 dB in the non-cleft group) should be audiologically managed. This difference could be confounded by several factors such as age at testing and the audiometry method utilised which should be considered when testing children with UCLP. Younger children demonstrate higher levels of thresholds than older children; thereby potentially leading to a higher PTA [27].

Secondly, the audiometry method utilised may confound the hearing sensitivity. More ears in the UCLP group were assessed with behavioural reinforced audiometry (17%) and visual reinforcement audiometry (69%) while the ears in the non-cleft group were assessed with visual reinforcement audiometry (50%) and conditioned play audiometry (50%). Conditioned play audiometry provides a more accurate threshold over visual reinforcement audiometry and the same is true for visual reinforcement audiometry over behavioural observational audiometry [27]. Therefore, the difference in the PTA between the two groups could potentially be due to age and audiometry method. However, further research needs to be conducted in this area to clearly understand this difference.

Another explanation in the greater PTA in the UCLP group could be due to the viscosity of the fluid when OME is present. Children with UCLP may present with thicker fluid due to a persistent failure to ventilate the middle ear from birth as compared to children without cleft. If the fluid was thicker, the PTA would be greater as the middle ear would not transduce sound as efficiently as with thinner fluid.

Children in the UCLP group may have a hearing loss other than conductive, i.e. sensori-neural hearing loss. Because bone conduction thresholds were not consistently assessed in the present study, it is unknown what type of hearing loss exists in these children. Studies have reported a small prevalence of sensori-neural hearing loss in children with CLP [7,28].

4.3. Audiometry method

The method of audiometry utilised with children with UCLP should be considered to ensure accurate thresholds are obtained when testing hearing sensitivity to allow appropriate audiological management. At age 1, 1.5 and 3 years, the assessment method for examining hearing sensitivity was significantly different between the number of ears of children with UCLP as compared to the number of ears of children in the non-cleft group (Table 2).

Several factors can contribute to the selection of audiometry method. In the present study, this included fatigue on day of testing, choice of method by the audiologist, or the cognitive/linguistic status of the children. First, testing for hearing sensitivity for the children with UCLP was performed during their routine clinical day at the hospital. Audiometry is just one visit among several other professionals assessing the children. While the children in the non-cleft group came in on a specific day for testing and had less appointments than the children with UCLP (e.g., no plastic surgeon or orthodontist appointment).

Secondly, the testing method was selected by an experienced paediatric audiologist and the higher level of audiometry was not always attempted. Therefore, the choice of method was influenced by the audiologist’s perception of the child. The children with UCLP may have presented as requiring a lower age-appropriate level of testing technique.

Thirdly, children with UCLP may present with lower cognitive status than children in the non-cleft group. Several studies describe people with CLP to have IQ levels within the average range, but lower to moderate hearing loss compared to children without clefts, Int. J. Pediatr. Otorhinolaryngol. (2009), doi:10.1016/j.ijporl.2009.07.015
than non-cleft control groups [30–32]. This lower range of cognitive abilities has been speculated to be due to the children’s verbal abilities. The difference in verbal abilities could be due to an increased prevalence of OME with an associated hearing loss, as the hearing loss may affect the development of speech and language and therefore lead to lower verbal abilities [33–35]. Broen et al. [33] demonstrated this link with examining cognitive status in relation to language and hearing sensitivity. When language and hearing sensitivity were considered, the difference observed on the cognitive measures was no longer significant. Hearing loss was highly associated with the presence of OME in the present study.

5. Conclusions

This study demonstrates a significantly higher prevalence of OME in children with UCLP than in children in the non-cleft group from 1 to 5 years of age. The children with UCLP also presented with a higher rate of in situ tympanostomy tubes than the children in the non-cleft group, which may indicate more persistent OME. In Sweden, tympanostomy tubes are generally placed following OME for at least 3 months. When OME was present, children in both groups were likely to exhibit a mild hearing loss; however, children in the UCLP group demonstrated a higher level of loss than children in the non-cleft group. Children with UCLP also utilised a lower age-appropriate level of audiometry method when assessing hearing sensitivity. These results confirm previous studies on the prevalence of OME [2-5,7,8,12] and support the need to complete further investigations into the area of associated hearing loss with OME in children with clefts and also into audiometry testing with children with clefts.

The results from this study expand on current knowledge in this area of cleft palate. The significantly higher prevalence of OME in children with cleft is confirmed by these data. Also, the hearing loss associated with OME is evident and demonstrates that there is a high prevalence of a mild conductive hearing loss when OME is present. Furthermore, the method of audiometry has been examined and demonstrates a lower level of age-appropriate testing method for children with cleft than children without cleft.

This has not been previously reported.

References