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Follow-up audiometry after bilateral myringotomy and tympanostomy tube insertion

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ABSTRACT

Objective: There are no evidence-based guidelines regarding timing of postoperative audiometric follow-up for children undergoing tympanostomy tube insertion. Given the variability of follow-up among physicians, we attempt to guide the timing of postoperative audiograms using objective data.
Study design: Retrospective chart review.
Methods: All pediatric patients undergoing primary bilateral myringotomy and tympanostomy tube insertion for otitis media with effusion who had audiometric data available at two follow-up times were identified from 2014. Patients were classified according to the type of audiometry performed and were further categorized into those who had tympanostomy tube insertion only and those who had concurrent adenotonsillectomies.
Results: 34 patients were included in the study. Among patients assessed by sound field audiometry, the mean sound field threshold value was 29.2 dB preoperatively and improved to 21 dB 2 weeks postoperatively and 17.9 dB 6 to 10 weeks postoperatively. The difference between the two postoperative means was significant ($p < 0.0001$). For patients evaluated by pure-tone audiometry, the mean preoperative air–bone gap was 20.1 dB; this improved to 10 dB at the first postoperative visit and 7.3 dB at the second visit. The difference between the two means was significant ($p < 0.0001$). For the subgroups in which adjunct adenotonsillectomy was performed, the greater improvement at the later follow-up was still statistically significant.
Conclusions: Progressive hearing improvement was demonstrated from 2 weeks to 6 to 10 weeks postoperatively. We recommend testing no fewer than 6 weeks after tympanostomy tube insertion. Earlier audiometry underestimates the degree of hearing improvement.

1. Introduction

The diagnosis of hearing loss in a child can be concerning to the family. When this hearing loss is likely due to an otitis media with effusion (OME), bilateral myringotomy and tympanostomy tube insertion (MTT) can be helpful in resolving the conductive hearing loss. Audiometric testing is generally used to assess abnormal hearing before MTT and to confirm normal hearing after surgical intervention. Persistent conductive hearing loss would indicate a congenital or acquired cause and warrant further workup. The timing for postoperative audiograms varies from one week to three months postoperatively depending on when the provider schedules the patient's follow-up visit. This is a reflection of the differences in training, the nature of subjective clinical experience, and the lack of an objective basis. Thus, guidelines for the timeframe of a postoperative audiogram that will correctly show whether surgery has improved hearing or whether further intervention is necessary needs to be established. To date, no such guidelines exist based on objective data. This is particularly essential in the growing child who is beginning to develop speech communication skills.

Examining hearing in children can be time-consuming and difficult, especially if it involves pure tone audiometry (PTA) in a very young patient (age ≤ 3) unlikely to tolerate wearing earphones for an extended period of time. In such cases, sound field audiometry (SFA) may offer a solution by providing a measure of hearing function. SFA can be used in concert with behavioral testing designed specifically for young infants and children such as behavioral observation audiometry, visual reinforcement audiometry, and play audiometry. Unfortunately, SFA cannot differentiate

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between conductive and sensorineural hearing loss, and the results are not ear-specific. The use of SFA as an instrument for quantifying air-conduction amplification has also been criticized in the literature for its poor test–retest reliability and poor frequency resolution [1]. However, improvement or correction to normal sound field thresholds (SFTs) following MTT would likely indicate that hearing loss was conductive or in the very least mixed. Other advantages include the greater success of behavioral audiometry with sound field than with insert earphones in infants and an excellent correlation between sound field thresholds (SFTs) and objective measures such as tone burst auditory brainstem response thresholds [2,3]. Since the choices are limited, SFA may be the best option available to date for evaluating hearing in very young children.

The effect of MTT on hearing may not accurately manifest directly following the procedure. One study reported that there is no increase in otoacoustic emissions immediately after MTT [4]. This lack of improvement may be secondary to residual inflammation and fluid in the middle ear, blood at the incision site, or medication placed in the middle ear. It may also be a reflection of edema secondary to concurrent procedures such as adenotonsillectomies. Another study showed that auditory brainstem response testing overestimated hearing thresholds after grommet insertion. This may be due to a temporary threshold shift immediately following grommet insertion. Potential causes of this persistent conductive loss include mechanical changes from surgery or reversible changes in the cochlear hair cells from intraoperative pressure or noise changes [5]. Tympanostomy tubes in themselves may add to the conductive component as well. It is important to determine the optimal timing for postoperative audiograms following MTT.

2. Methods

2.1. Tympanostomy tube insertion

All patients included in the study underwent bilateral MTT by the senior author. The procedure was performed under general anesthesia through a myringotomy in the anterior inferior quadrant of the tympanic membrane. Any middle ear effusion was suctioned, and a collar button tube was then inserted through the incision. Adenoidectomies were performed when indicated using a suction bovie or coblator. Tonsillectomies were performed when indicated using the cold steel technique or a coblator.

2.2. Chart review and analysis

Institutional Review Board approval was obtained prior to the onset of the review. The inclusion criteria were as follows: (1) Otherwise healthy children, ages from 1 to 18, who underwent primary bilateral MTT by the senior author in 2014 for conductive hearing loss caused by OME and (2) preoperative audiometry performed no more than one month prior to the surgery and postoperative audiometry completed at two weeks and six to ten weeks following the procedure for each patient. A retrospective chart review of paper medical records was conducted on all patients identified to have MTT in 2014. These records included data regarding clinical findings and audiometry. 65 patients were initially identified. Of these, a total of 34 patients were ultimately included in the study. 26 patients were excluded because of a prior history of MTT. One patient with trisomy 21 was excluded. Two patients with mixed hearing loss were excluded. One patient with stapes fixation was excluded. One patient with congenital cholesteatoma was excluded.

Of the 34 patients, all underwent MTT, 14 patients had concurrent adenotonsillectomies, and 3 patients had concurrent adenoidectomies. Patient age, gender, presence of perforation, and adenoidectomy or adenotonsillectomy status were noted. 20 children, in whom individual ear PTA scores could not be obtained, had data on SFA only, while 14 patients had data on PTA. Therefore, patients were categorized into four different groups: Patients with SFA were separated into those who underwent MTT only and those who had both MTT and adenoidectomy or adenotonsillectomy; patients with PTA were separated into those who underwent MTT only and those who had both MTT and adenotonsillectomy. Data were gathered for either SFTs or pure-tone air and bone conduction thresholds (PTTs) in both ears for frequencies within the speech range (averaged for 500, 1000, and 2000 Hz). For PTA, the mean air–bone gap (ABG) was determined. Hearing improvement was assessed by the change in SFT, pure-tone average, and ABG. The Student paired *t*-test, set at a significance of $p < 0.05$, was used to compare pre- and postoperative audiometry for each follow-up time period.

3. Results

Of the 34 patients evaluated for this study, 20 (59%) were male and 14 (41%) were female. The ages ranged from 10 months to 10 years. The mean age for children with SFA was 1.9 years; all of these children were aged 3 years or younger. The mean age for children with PTA was 6 years; all of these children were aged 4 years or older. No incidence of otorrhea, tube blockage, early tube extrusion, or other postoperative complication during the follow-up period was documented.

In the patients assessed by SFA, a preoperative SFT greater than 25 dB was considered abnormal. As Table 1 indicates, 13 patients (65%) had a preoperative SFT that was abnormal, but only one patient (7.7%) did not obtain a normal postoperative SFT, defined as 25 dB and lower, at the 2-week follow-up time. At the later follow-up period of 6 to 10 weeks, this patient also achieved a normal SFT. Among the patients who had SFA, the mean SFT value was 29.2 dB (SD 6.7) preoperatively and 21 dB (SD 3.3) 2 weeks postoperatively. This difference was significant ($p < 0.0001$). At the second audiometric evaluation, the mean SFT value was 17.9 dB (SD 3). The difference between the 2-week postoperative mean and the 6- to 10-week postoperative mean was significant ($p < 0.0001$).

Table 1
SFA results.

Procedure(s) performed	Total no. (%) of patients	No. (%) of patients		
		Preoperative SFT > 25 dB	Postoperative SFT ≤ 25 dB (2 weeks)	Postoperative SFT ≤25 dB (6 to 10 weeks)
MTT only	12 (60)	7 (58)	6 (85)	7 (100)
MTT and adenoidectomy or adenotonsillectomy	8 (40)	6 (75)	6 (100)	6 (100)
Total	20 (100)	13 (65)	12 (92)	13 (100)

Abbreviations: SFA, sound field audiometry; SFT, sound found field threshold; MTT, myringotomy and tympanostomy tube insertion.