RESEARCH PAPER

Tympanometry Changes Following Adenoidectomy in Children with Adenoid Hypertrophy-A Pre and Post-Operative Evaluation

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ABSTRACT

Introduction: Adenoid hypertrophy is one of the common diseases noted among the childhood population. And this enlargement of the adenoid was found to be associated with the development of otitis media with effusion, and this is a common cause of the reversible hearing loss in children. The OME is found to be associated with language and speech delays, and is also linked to poor school performance. Additionally, it is found to affect the quality of life of the patients. Tympanometry is used in the diagnosis of OME cases.

Aim: To evaluate the tympanometry changes following adenoidectomy in children with adenoid hypertrophy via pre- and post-operative assessment.

Methods: This prospective observational study was conducted in the department of ENT at a tertiary care centre in Puducherry. Patients aged 5 to 15 years with symptoms of adenoid hypertrophy were included in the study. After the initial assessment, all patients underwent pure tone audiometry and tympanometry, followed by the adenoidectomy procedure. After six weeks in the postoperative period, the auditory evaluation was conducted and compared. The data analysis was conducted using SPSS version 25 software.

Results: A total of 36 patients (72 ears) participated in the study. The majority of patients were found to be between 5 and 10 years old (61.1%), and male patients (66.7%) outnumbered female patients. The study revealed a significant correlation between the grading of the adenoids and the tympanometry findings. The study also noted that the majority of patients in the preoperative period had a type B tympanogram, which changed to a type A tympanogram in the postoperative period. The study also noted a significant improvement in the hearing threshold in the postoperative period compared to the preoperative period ($p < 0.001$).

Conclusion: Chronic adenoid hypertrophy is a significant contributor to the development of OME. The study recommends that all patients with adenoid enlargement be screened for tympanometry to identify at-risk individuals and take appropriate action at the earliest opportunity to prevent complications.

Keywords: Adenoid, OME, audiometry, tympanogram

How to cite this article: Krishna Prasad S, Velayutham P, John J. Tympanometry Changes Following Adenoidectomy in Children with Adenoid Hypertrophy-A Pre and Post-Operative Evaluation. Int J Drug Deliv Technol. 2026;16(62s): 616-620. DOI: 10.25258/ijddt.16.62s.71

MATERIALS AND METHODS

Study Design: This prospective observational study was conducted among patients attending the outpatient and inpatient departments of Otorhinolaryngology in a tertiary care centre in Puducherry from October 2025 to December 2025.

Sampling: The study by Rajasekhar et al. investigated the tympanometric changes following adenoidectomy in children with adenoid hypertrophy and found that adenoid hypertrophy was present in approximately 30% of the cases.[9] The minimum sample size was determined to be 36 patients (72 ears) using the study's power of 80% and a 95% confidence interval with a 15% permitted margin of error. Additionally, the study included patients of both sexes who were between the ages of five and fifteen and who had at least three symptoms of adenoid hypertrophy, including mouth breathing, snoring, nasal obstruction, hyponasal speech, decreased attention, and a history of recurrent upper respiratory tract infections, as well as patients whose X-ray nasopharynx lateral view showed more than 50% of the obstruction. The patient who had craniofacial abnormalities, a tympanic membrane perforation, and an acute upper respiratory tract infection was not allowed to participate in the trial.

Interventions: After obtaining informed and written consent, a complete history and examination of the patient were done. And then all the patients had undergone the tuning fork test. And then the patient had been subjected to the preoperative pure tone audiometry and tympanometry. Biochemical analyses, including a complete blood count, renal function test, liver function test, sugar profile, and clotting profile, were performed on the patients before proceeding with the adenoidectomy. And then the patient had been subject to the adenoidectomy under general anaesthesia. After a six-week follow-up period, the patients underwent repeat pure tone audiometry and tympanometry.

Ethical declaration: All procedures in this study involving human participants were conducted in accordance with the ethical standards of the Institutional Internal Human Ethics Committee and the Scientific Research Committee of the institute, as referenced in document number 200/SVMCH/IEC-Cert/Oct.25 dated 04.10.2025 and National Research Committee, 1964: Helsinki Declaration and its latest amendments.

STATISTICAL ANALYSIS

All the data were entered into Microsoft Excel and analysed using SPSS software version 25.0. The independent t-test was used to compare the means and the p-value of <0.05 is considered statistically significant.

RESULTS

A total of 36 patients (72 ears) participated in the study. The majority of patients, 61.1%, were found to be between 5 and 10 years old and male patients (66.7%) outnumbered female patients, as shown in Table 1.

Table 1: Socio-demographic details of the patient (N=36)

Variable	Frequency (n)	Percentage (%)
Age (in years)	Age (in years)	Age (in years)
5-10	22	61.1
11-15	14	38.9
Gender	Gender	Gender
Male	24	66.7
Female	12	33.3
Socio-economic status	Socio-economic status	Socio-economic status
Class I	3	8.3
Class II	5	13.9
Class III	6	16.7
Class IV	9	25
Class V	13	36.1

Based on the symptoms presented by the patient, the study noted that nasal obstruction is the most common symptom encountered among the patients, observed in 88.9% of the patients. Additionally, 83.3% of the patients were found to have hearing impairment. The other symptoms experienced by the patients include snoring (69.4%), rhinorrhea (61.1%), mouth breathing (55.6%), earache (44.4%), and sleep apnea (36.1%), as shown in Table 2.

Table 2: Distribution of the patients based on the symptom of presentation

Parameter	Frequency (n)	Percentage (%)
Mouth breathing	20	55.6
Snoring	25	69.4
Hearing impairment	30	83.3
Nasal obstruction	32	88.9
Rhinorrhea	22	61.1
Ear arche	16	44.4
Sleep apnea	13	36.1

Table 3: Distribution of the patients based on adenoid grading

Adenoid Grading	Frequency (n)	Percentage (%)
Grade 2	21	58.3
Grade 3	15	41.7

Preoperative tympanometry studies revealed that approximately 66.7% of patients with grade adenoid hypertrophy in the right ear had a type B curve. About 53.4% of patients with grade three adenoid enlargement had a type C curve, while 33.3% had a type B curve and among the left ear, the patients with grade 2 adenoid enlargement, about 71.4% were found to had type B curve and 60% of the patients with grade 3 adenoid enlargement were found to had type c tympanometry curve. The study also noted a significant association between the two, as shown in Table 4.

Table 4: Association between the adenoid grading and the preoperative tympanometry findings

Adenoid grading	Tympanometry finding	Tympanometry finding	Tympanometry finding	Total n(%)	X2	p-value
Adenoid grading	Type A	Type B	Type C	Total n(%)	X2	p-value
Right ear	Right ear	Right ear	Right ear	Right ear	Right ear	Right ear
Grade 2	5 (23.8)	14 (66.7)	2 (9.5)	21 (100)	8.382	0.015
Grade 3	2 (13.3)	5 (33.3)	8 (53.4)	15 (100)	8.382	0.015
Left ear	Left ear	Left ear	Left ear	Left ear	Left ear	Left ear
Grade 2	2 (9.5)	15 (71.4)	4 (19.1)	21 (100)	9.383	0.009
Grade 3	3 (20)	3 (20)	9 (60)	15 (100)	9.383	0.009

The preoperative and postoperative tympanometry curves of patients with grade 2 adenoids were compared, the study indicated that around 80% of patients (Right Ear) with a Type A curve preoperatively also had a Type A curve postoperatively. Approximately 85.8% of patients with a Type B curve had a Type A curve, while 7.1% of patients had a Type B curve. Among the type C curve patients, all were found to have developed a type A curve postoperatively. Among the patients with a Type A curve in the left ear, all were also found to be in the same scenario postoperatively. And 86.6% of patients with a Type B curve were found to have progressed to a Type A curve postoperatively. Among patients with a Type C curve, approximately 75% were found to have a Type A Curve, as shown in the table 5.

Table 5: Tympanometry pre-op and post op comparing the patient with grade 2 adenoid enlargement

Pre op tympanometry	Post op tympanometry	Post op tympanometry	Post op tympanometry	Total N (%)
Pre op tympanometry	Type A	Type B	Type C	Total N (%)
Right	Right	Right	Right	Right
Type A	4 (80)	0 (0)	1	5 (100)
Type B	12 (85.8)	1 (7.1)	1 (7.1)	14 (100)
Type C	2 (100)	0 (0)	0 (0)	2 (100)
Left	Left	Left	Left	Left
Type A	2 (100)	0 (0)	0 (0)	2 (100)
Type B	13 (86.6)	1 (6.7)	1 (6.7)	15 (100)
Type C	3 (75)	1 (25)	0 (0)	4 (100)

Comparing the preoperative and postoperative tympanometry curves among patients with grade 3 adenoid enlargement in the right ear, all patients were found to have a Type A curve postoperatively, regardless of their preoperative curve type. Among patients with a Type B curve, approximately 80% were found to have a Type A curve, whereas among those with a Type C curve, about 87.5% were found to have a Type A curve postoperatively. And among the Left ear patients, almost all those with Type A curves were also found to be in the same scenario postoperatively and 875% of the patients with a Type B curve were found to have progressed to a Type A curve postoperatively. Among the patients with a Type C curve, approximately 77.8% were found to have a Type A Curve, as shown in the Table 6.

Table 6: Tympanometry pre-op and post op comparing the patient with grade 3 adenoid enlargement

Pre op tympanometry	Post op tympanometry	Post op tympanometry	Post op tympanometry	Total N (%)
Pre op tympanometry	Type A	Type B	Type C	Total N (%)
Right	Right	Right	Right	Right
Type A	2 (100)	0 (0)	0 (0)	2 (100)
Type B	4 (80)	1 (20)	0 (0)	5 (100)
Type C	7 (87.5)	0 (0)	1 (12.5)	8 (100)
Left	Left	Left	Left	Left
Type A	3 (100)	0 (0)	0 (0)	3 (100)
Type B	2 (75)	1 (25)	0 (0)	3 (100)
Type C	7 (77.8)	0 (0)	2 (22.2)	9 (100)

Upon comparing the pure tone audiometry results before and after surgery for each ear, the study revealed a significant improvement in the hearing threshold in PTA in both ears, as shown in the table 7.

Table 7: Comparison of PTS between pre op and post-operative times between the ears

PTA	Pre op	Pre op	Post op	Post op	t-value	p-value
PTA	Mean	SD	Mean	SD	t-value	p-value
Right ear	42.15	5.456	18.45	3.225	22.437	<0.001
Left Ear	40.12	4.556	16.30	3.125	25.869	<0.001

DISCUSSION

Chronic middle ear effusion, also known as otitis media with effusion, is a common chronic ear condition that is more frequently found in pediatric age group patients. The primary pathophysiology involved in the development of otitis media with effusion was found to be due to alterations in the mucociliary function of the middle ear, which is caused secondarily by malfunction of the eustachian tube function. The students demonstrated that the enlargement of the adenoid was

found to be the primary causative factor leading to dysfunction of the eustachian tube, and subsequently, to the development of otitis media with effusion. And this adenoid enlargement was also found to be associated with the development of the type B and type C tympanogram patterns. And the enlargement of the adenoid causes this type of tympanogram pattern in two ways: by the direct mechanical obstruction of the eustachian tube by the enlargement of the adenoid, and also by obstructing the lymphatic vessels that drain the middle ear and the eustachian tube and so, the adenoidectomy was found to be the gold standard treatment in managing patients with otitis media with effusion, and was also found to help convert type B and type C tympanograms into standard type A tympanograms.

The majority of patients in the current study (61.6%) were between the ages of 5 and 10. Adenoid hypertrophy is shown to be more frequently observed among patients between the ages of 6 and 10 years, which is similar to our study and the study by Rout MR et al. [10], which is further corroborated by the study by Huang L et al. [11]. This suggests that adenoid hypertrophy is more frequently observed in children between the ages of 6 and 9. There were more male patients (66.7%) than female patients in our study. Another study by Nwosu et al. [4], which similarly discovered that adenoid hypertrophy is more frequently observed among the male population, corroborated the male preponderance in our study. Approximately 36.1% of patients with adenoid enlargement were found to have a low socioeconomic status, according to the modified BG Prasad Classification [5], which is consistent with the study by Jiang X et al. [12]. In our study, the most common symptom observed in patients was nasal obstruction, found in 88.9% of the patients. Followed by hearing impairment (83.3%). The other symptoms reported by patients include snoring (69.4%), rhinorrhea (61.1%), mouth breathing (55.6%), earache (44.4%), and sleep apnea (36.1%). Similar to our study, the study by Turaki et al. [7] also found that the most common symptom encountered among patients with adenoid enlargement is nasal obstruction, noted in 98.9% of the patients, followed by snoring, noted in 97.9% of the patients.

In the present study, Grade 2 adenoid enlargement was found to be the most common grade of enlargement noted in the patients, accounting for 58.3% of the patients. Additionally, 41.7% of the patients were found to have Grade 3 adenoid enlargement. Additionally, the study by Turaki et al. [7] found that grade 3 enlargement was noted in half of the patients participating in the study. It is also noted a significant association between the grading of the adenoid and the preoperative tympanometry findings. Our study noted that a higher grade of adenoid is associated with a higher prevalence of type B tympanogram development. This is further supported by a study by Orji FT et al. [8], which found that the grading of the adenoid is significantly associated with the development of a type B tympanogram in impedance audiometry. The study by Turaki et al also supports this finding. [13]. The present study also noted that the type B tympanogram is the most common type of tympanogram found among patients, followed by type A and type C patterns, which is further supported by the study by Kumar A et al. [14] Additionally, it was found that the type B tympanogram is the most common pattern noted among patients with adenoid enlargement. The study by Maw AR et al. [15] also supports the findings of this study.

In the present study, the patients with post-adenoidectomy, the results showed that type A tympanogram is the most common type, followed by type B and type C. In the present study, both the patients with Grade 2 and Grade 3 adenoid enlargement, the type A curve is found to be the most common pattern noted among patients following the adenoidectomy procedure. This is further supported by the study by Maw AR et al. [15] that also shows that the type A tympanogram is found to be the most common type of curve noted following the adenoidectomy and also the study by Turaki et al. [13] shows similar results to those in the present study.

The hearing threshold in both ears significantly improved after the adenoidectomy treatment, according to our study, when compared to the preoperative hearing threshold value. Additionally, the studies by Sharma et al. [16] and Somayaji KS et al. [17] both found a significant improvement in the postoperative hearing threshold among patients who underwent adenoidectomy supports the results of our investigation as well.

CONCLUSION

Chronic adenoid enlargement is one of the common diseases encountered among the child population and the untreated disease can leads to the development of otitis media with effusion and can progress to the development of complications which in turn affect the day to day life of the patients and in the present study the type B tympanogram was found to be most common tympanogram noted among the patient with adenoid enlargement and majority of the cases were found to revert to type A tympanogram after the procedure. The study found that early diagnosis of otitis media with effusion, as indicated by a type B tympanogram, helped identify at-risk patients and guide parents and clinicians toward early intervention to prevent complications. The study recommends that all patients with adenoid enlargement be screened for tympanometry to identify at-risk individuals and take appropriate action.

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