"A STUDY OF TYMPANOGRAM CHANGES IN CHILDREN UNDERGOING ADENOIDECTOMY- A PRE AND POSTOPERATIVE EVALUATION"

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ABSTRACT

BACKGROUND:

Adenoids serve as a reservoir for upper respiratory tract infections, leading to oedema and block of the Eustachian tube's nasopharyngeal end. One important factor in the pathophysiology of Otitis Media with Effusion is adenoid hypertrophy. Prolonged Otitis media with effusion can lead to delayed speech, low academic performance, and delayed language development. Because young children are unable to communicate their issues, including hearing loss, otitis media with effusion often remains undiagnosed for a long time. This is the reason why we require an investigative modality to study this disease.

Examining the ear of children at the earliest along with a detailed clinical history is highly essential and for this purpose, audiological assessment is helpful.

OBJECTIVE:

To study the tympanogram changes in children undergoing adenoidectomy.

METHODOLOGY:

52 children between 5-15 years age group, who visited the ENT OPD with complaints suggestive of adenoid hypertrophy at Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi were selected. Thorough clinical history and complete ENT examination were followed by X-Ray nasopharynx and tympanometry. Adenoidectomy was done and tympanometry was repeated 6 weeks post-surgery. The results were compared with the preoperative tympanograms.

RESULTS:

The study population of 52 had no gender preponderance. Based on the preoperative X-Ray Nasopharynx findings, majority of the children (69.2%) were seen to have grade 2 adenoid hypertrophy. McNemar's test was used for statistical analysis. In our study we found three sets of patients whose graphical representation were done in the form of Type A, Type B and the remaining tympanograms which deviated from Type A and B were combined and given a common description as Type O (Indeterminate type), for easier representation. Clinical symptoms, signs and tympanograms of the children were compared and analysed both preoperatively and 6 weeks postoperatively. Majority of the children with Type B tympanogram have shown significant change into Type A curve following adenoidectomy. Their symptoms also improved remarkably. The children with Type A tympanogram maintained the same curve post adenoidectomy and also showed subjective improvement with respect to the symptoms considered in the study.

CONCLUSION:

Our study shows that adenoidectomy plays a major role in determining middle ear impedance. It is a known fact that prolonged otitis media with effusion and hence decreased hearing can result in speech delay as well as unsatisfactory academic and language development. Otitis media with effusion is a condition that goes undiagnosed for a long time because young children are unable to communicate their issues or symptoms, including hearing loss. Therefore, early audiological assessment which includes tympanometry, is a good tool that is essential before and after adenoidectomy to aid in the overall well-being of the children.

LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
ENT	Ear, Nose, Throat (Otorhinolaryngology)
OPD	Outpatient Department
OME	Otitis Media with Effusion
Mm	Millimetres
Ig	Immunoglobulin
AD	Adenoid Depth
NR	Nasopharyngeal Depth
ANR	Adenoid-to-Nasopharyngeal Ratio
SPSS	Statistical Package for Social Sciences
Hz	Hertz

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INTRODUCTION

The adenoid is a component of the lymphoid tissue- Waldeyer's ring near the start of the aerodigestive tract. Adenoid growth advances quickly during infancy and reaches a plateau between the ages of 2 and 14. After the age of 15, the adenoid begins to quickly regress.

The adenoid is associated with upper airway obstruction, as a focus of sepsis, and also with the persistence of otitis media with effusion. [1] Chronically infected adenoids serve as a reservoir in upper respiratory tract infections with oedema and causes obstruction of nasopharyngeal end of Eustachian tube. [2] The most prevalent cause of hearing loss in young children is Otitis Media with Effusion, and a major contributing component in its pathophysiology is adenoid hypertrophy.

The definition of Otitis media with effusion (OME) is stated by the current guidelines as “fluid in the middle ear without signs or symptoms of infection.” [3] Over a long period, it predisposes to delayed speech, poor academic and language development. [4]

A useful screening tool for identifying negative middle ear pressure is tympanometry. It is a graphical depiction of the middle ear's compliance, or admittance. The functioning Eustachian tube maintains the middle ear pressure at or near atmospheric pressure under typical circumstances. Tympanometry helps in identifying any deviation from the normally expected values, thereby serving as a reliable screening test. [2]

Principle of Tympanometry:

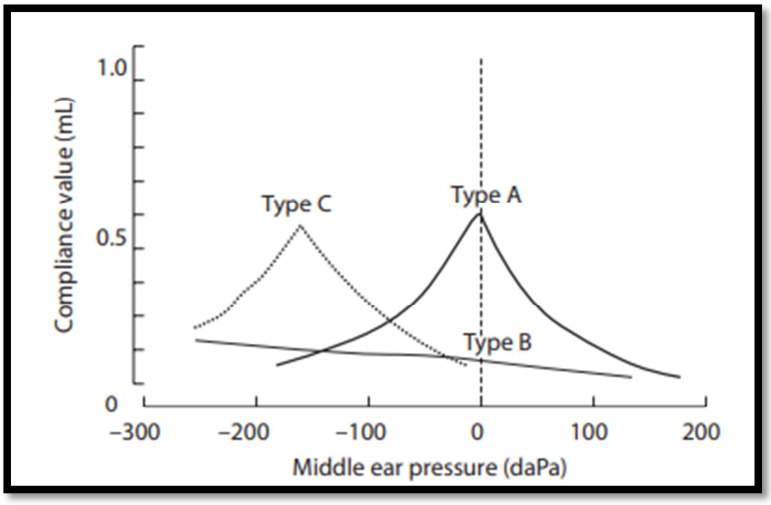
The middle ear functions as an impedance matching device to provide minimal sound energy loss at the air-fluid interface, hence facilitating proper passage of sound energy from air to the cochlear fluid.

The electroacoustic bridge measures the middle ear's effectiveness in carrying out this function by calculating the sound energy passing through the middle ear to the cochlear fluid and the amount of presented sound that is reflected back. [5]

As shown in Figure 1, tympanograms can be divided into three types namely:

- Type A tympanogram with a middle ear pressure of +200 to -99 mm of water and a sharp peak at 0 mm of water seen in normal patients and in otosclerosis.
- Type B tympanogram with less or no compliance and with a flat curve, seen in serous otitis media, adhesive otitis media and perforated tympanic membrane.
- Type C tympanogram with significantly negative middle ear pressure (-100 to -400 mm of water) and normal compliance seen in cases of uncomplicated Eustachian tube obstruction. [1]

FIGURE 1: TYPES OF TYMPANOGRAMS: [1]



Need for study:

Since young children are unable to voice their symptoms including hearing loss, otitis media with effusion remains masked, affecting the scholastic performance of children and eventually in the long run, the society as a whole. Additionally, this may go unnoticed because parents frequently fail to identify their child's hearing impairment.

Hence needs to be unmasked early for its appropriate management. Therefore, audiological assessment is highly essential for this purpose.

Parents as well as children need to be educated about this problem so as to make early detection possible and to enable correction of this reversible hearing loss. [6]

In addition, there are no studies on tympanometry done in our region hence we wanted to conduct this study to appreciate tympanogram changes following adenoidectomy. Through clinical examination, we also wanted to observe the effects of varied abnormalities of adenoid tissue that includes, enlargement, infection and fibrosis, on the eustachian tube.

AIM AND OBJECTIVE

To study the tympanogram changes in children undergoing adenoidectomy.

REVIEW OF LITERATURE

DEVELOPMENT OF ADENOID:

Between 4 to 6 weeks of gestational age, lymphoid tissue is visible within the posterior wall and mucous membrane of the roof of the nasopharynx. It is easy to identify the adenoid during the third month of pregnancy. The lymphoid tissue of the adenoid may reach the Eustachian tube aperture and Fossa of Rosenmuller as Gerlach's tonsil. A layer of stratified squamous epithelium covers the membrane. The thyrocervical trunk, as well as the facial and maxillary artery branches, provide the adenoid with a rich arterial supply. Venous drainage is to the facial and internal jugular veins. The retropharyngeal lymph nodes and upper deep cervical nodes, in particular, the posterior triangle of the neck, receive lymphatic drainage. Nerve supply is through sensory branches of the glossopharyngeal and vagus nerves. [1]

Growth continues quickly from infancy and reaches a plateau between the ages of two and fourteen. In most children, the adenoid rapidly regresses beyond the age of fifteen. The adenoid is at its relative greatest in relation to the volume of the nasopharynx in the seven year old age group. Because of the relative small volume of the nasal cavity and the higher frequency of upper respiratory tract infections, clinical symptoms are more common in younger age groups. [1]

Immune Function of the Adenoid:

B cells, IgG and IgA plasma cells are produced by the adenoid. One of the main components of early childhood natural acquired immunity is exposure to antigens through the mouth and nose. In younger children, the adenoid is a key factor for the development of "immunological memory." [1]

Adenotonsillectomy does not seem to result in a major immunological deficit in children aged 4 to 10 years, but a little drop in IgG, IgA, and IgM levels was discovered four to six weeks following surgery. The scientists came to the conclusion that this was the immune system's compensating response after chronic antigen stimulation was reduced.

A particular decrease in IgG could be a sign of less antigenic stimulation. After adenoidectomy, there does not seem to be a drop in IgE levels. [1]

PATHOLOGICAL EFFECTS OF THE ADENOID:

Due to sepsis or partial blockage of the nasal choanae, the adenoid may be implicated in upper respiratory tract disease. Symptoms of pathology consist of otitis media, rhinosinusitis, rhinitis, and otitis media with effusion. Some believe that adenoiditis, whether acute or chronic, is a different but similar infectious entity. [1]

ASSESSMENT AND MANAGEMENT:

Clinical History:

A comprehensive paediatric ENT history should include the history, paying particular emphasis to middle ear and nasal obstruction symptoms. Inquiries about atopic symptoms, food disorders, and sleep disruption are significant. It is crucial to have a complete medical history, including prescription, over-the-counter, complementary, and alternative medications. It is also important to rule out any family history or unusual bleeding or bruises in children who are considering an adenoidectomy because a regular clotting check might miss mild Von Willebrand disease. Also to be taken into account are heart defects and possible atlantoaxial instabilities in children with Down syndrome. [1]

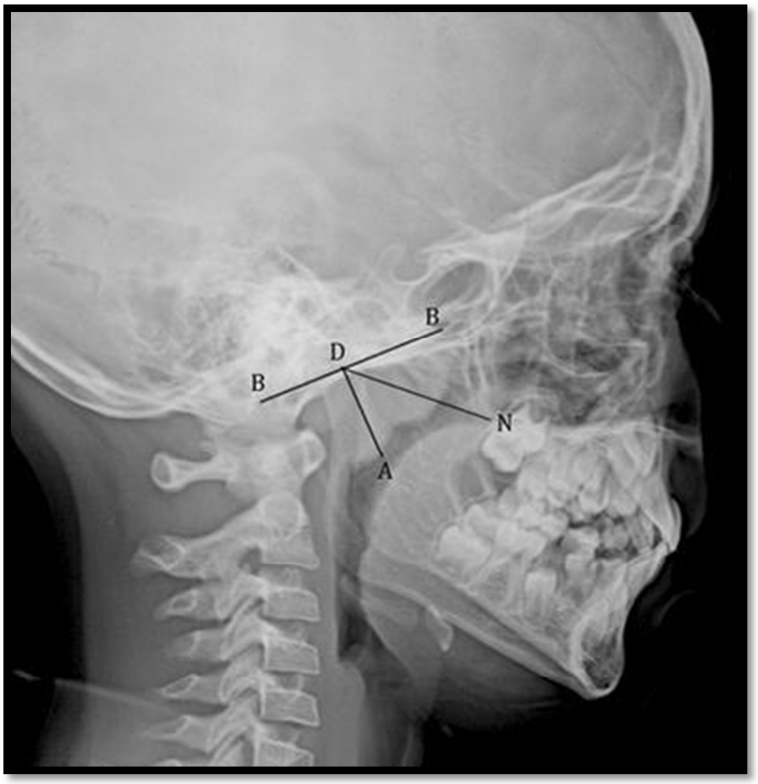
Clinical Examination:

An ENT exam was performed routinely. A halogen light otoscope with a big speculum can be used for simple anterior rhinoscopy in small children, and it is more tolerable than the Thudicum's nasal speculum. When choosing whether to proceed with surgery, an evaluation of the adenoid should be done in cases when an adenoidectomy is the only recommended surgical procedure. In an outpatient context, nasal endoscopy is a highly accurate way to evaluate the state of the adenoids. Adenoid size can be measured using lateral soft-tissue radiographs of the nasopharynx in cases where endoscopy is not tolerated.

These results have a strong correlation with endoscopic evaluation of the adenoid size. [1]

The X-rays were evaluated in accordance with the criteria supplied by Fujioka et al. This is the most widely recognised and utilised approach for interpreting X-rays of the Nasopharynx (Lateral view) in order to evaluate Adenoid hypertrophy. The measurement of adenoid depth (AD) thickness involves drawing a line perpendicular to the most convex region of adenoid hypertrophy from a line drawn along the straight section of the front edge of the basi-occiput, as illustrated in Figure 2. By drawing a second line from the posterosuperior edge of the hard palate to the spheno-occipital synchondrosis, one can compute the nasopharyngeal depth (ND). The adenoid-to-nasopharyngeal ratio (ANR) is derived by dividing AD by ND. The value is then multiplied by 100 to get the percentage. According to the ANR, the adenoid hypertrophy can be categorized into 4 grades; Grade 1: 0–25%, Grade: 25–50%, Grade 3: 50–75% and Grade 4: 75–100%. [7]

FIGURE 2- MEASURING THE ADENOID-TO-NASOPHARYNGEAL RATIO (ANR)



(The ANR calculation is demonstrated in a plain radiograph of the nasopharynx in lateral view. The lines BB, AD, and ND represent the straight portion of the anterior margin of the basiocciput, the most convex portion of the adenoid pad, and the line between the spheno-occipital synchondrosis and the posterior edge of the hard palate, respectively. The ANR is computed by dividing AD by ND

AD- Adenoid Depth, ND- Nasopharyngeal depth, ANR- Adenoid-to-Nasopharyngeal Ratio)

Nasal endoscopy is the gold standard for measuring adenoid size at the time of operation; palpation is a poor indicator of adenoid hypertrophy, and mirror inspection understates choanal obstruction. Based on its size and blockage, the adenoid can be categorised on endoscopy as shown in Table 1: [1]

TABLE 1: CLINICAL GRADING OF ADENOID SIZE (REPRINTED FROM CLEMENS ET AL. WITH PERMISSION FROM ELSEVIER)

GRADE	DESCRIPTION
GRADE 1	Adenoid tissue filling one-third of the vertical portion of the choanae
GRADE 2	Adenoid tissue filling from one-third to two-thirds of the choanae
GRADE 3	From two-thirds to nearly complete obstruction of the choanae
GRADE 4	Complete choanal obstruction

ADENOIDECTOMY:

Surgical procedures employed in children with adenoid hypertrophy include adenoidectomy, with or without tonsillectomy and/or ventilation tube insertion. Various methods can be employed for performing adenoidectomies which include digital palpation and curettage, suction diathermy, coblation, microdebrider-assisted etc. Complications of adenoidectomy include bleeding, dental trauma, infection, retained swab, nasopharyngeal blood clot, cervical spine injuries, velopharyngeal dysfunction and regrowth of adenoid. [1]

OTITIS MEDIA WITH EFFUSION:

Definition:

Otitis media with effusion (OME) is the accumulation of mucus within the middle ear and sometimes the mastoid air cell system. Persistence of the fluid for 3 months or more is considered as chronic. Acute otitis media preceded by a well-defined history of otalgia and respiratory tract infection may be present. [1]

OME can cause balance problems, unsatisfactory social behaviour, decreased speech and language development, and decreased hearing in children. The term "glue ear" is commonly used to describe the illness by both doctors and the general population. [1]

A study done by Wenjing Chen et al. concluded that young age, high adenoid grade, non-breastfed status, comorbid Allergic rhinitis, and the presence of S. pneumoniae in the oropharynx are risk factors for Otitis media with effusion in paediatric patients with Adenoid hypertrophy. [8]

Etiology and Pathogenesis:

The processes behind the development and maintenance of the fluid collection in OME are chronic inflammation within the middle ear and dysfunction of the Eustachian tube.

Middle-ear pressures become progressively negative as a result of insufficient gas exchange into the middle ear space brought on by Eustachian tube malfunction, causing a transudate to form that is unable to be cleared. [4]

Ciliated, pseudostratified, columnar respiratory epithelium, lines the Eustachian tube and anterior mesotympanum. There are both goblet cells and glands that are responsible for the production of a mucus or serous effusion. [1]

Anatomical reasons, inflammatory disorders, and muscular abnormalities are the causes of eustachian tube dysfunction. Children's Eustachian tubes are more flexible, smaller, and have a more horizontal orientation in comparison to adults, which could potentially account for children comparatively having a greater prevalence of otitis media with effusion. Also, anatomic obstruction of the Eustachian tube can result from prominent adenoid tissue hypertrophy. [4]

TYMPANOGRAM FINDINGS IN OTITIS MEDIA WITH EFFUSION:

Tympanometry, which uses an automated impedance meter, has been a commonly used technique for over 30 years to identify OME. Although obtaining an acoustic seal can be challenging at times, bilateral tympanograms can typically be obtained in 98% of children aged 3.5 to 7 years, in 90–94% of newborns aged 2–11 months, and in 78–88% of infants aged 12–24 months. [1]

The accuracy of tympanometry in detecting fluid in the middle ears of children was studied by Khurshid Anwar et al. and it was concluded that the diagnostic value of tympanometry was: Sensitivity- 85.85%; Specificity- 72.22%; Positive predictive value- 94.44%; Negative predictive value- 48.14%; Accuracy-83.76%. [9]

OME is typically linked to a type B tympanogram; type A is rarely linked to OME, and type C is in the middle. [1] Numerous level 1 evidence studies indicate that the Type B tympanogram has a sensitivity of between 56% and 73% and a specificity of between 50% and 98% in detecting OME confirmed at the time of myringotomy, when compared to all other forms. 98% is the combined sensitivity when OME is suggested by otoscopy and a type B tympanogram. When otoscopy indicates the absence of OME and is coupled with a type A tympanogram, 98% of the cases are specific. [1]

The process of a child's normal speech and language development during childhood is complex and dependent on several factors, including the child's age, ethnicity, and verbal communication with other family members and the primary carer.

Normal speech and language development are likely to be hampered by hearing impairment, especially that caused by OME. [1]

ROLE OF ADENOIDECTOMY IN OTITIS MEDIA WITH EFFUSION:

The alleviation of anatomical obstruction of the Eustachian tube has long been considered the advantage of adenoidectomy in the treatment of otitis media with effusion. Even while this might play a role, it is evident that when the adenoid is small, the benefit from adenoidectomy cannot be explained by the size of the adenoid or the physical obstruction alone. Children with and without OME do not exhibit a significant difference in adenoid size. [1]

Adenoidectomy is advised when a child has recurrent surgery for OME, as it results in a 50% decrease in the need for additional procedures. This excludes the case of an overt or submucous cleft palate. The advantage of adenoidectomy is apparent as early as age two, peaks in children three years of age and older, and is independent of adenoid size.

Concurrent with adenoidectomy is the insertion of a tympanostomy tube and myringotomy that is usually done. [3] Children with OME are likely to have squamous cell metaplasia, reticular epithelium extension, fibrosis of the interfollicular interconnective tissue, and reduced mucociliary clearance compared to those without OME due to recurrent acute or chronic inflammation of the adenoid and increased bacterial load, especially of Haemophilus influenzae.

These changes cause a rise in bacterial adhesion, which encourages the development of an infection known as "biofilm" and ultimately leads to middle ear effusion. A biofilm infection is defined as ‘a structured community of bacterial cells enclosed in a self-produced polymeric matrix and adherent to an inert or living surface.’ [1]

A study conducted in 2018 by Rajashekhar P et al. revealed that patients with adenoid hypertrophy had a significant prevalence of Otitis Media with Effusion. The majority of individuals with otitis media with effusion respond well to adenoidectomy, as evidenced by the post-adenoidectomy tympanogram. Prior to adenoidectomy, the median negative middle ear pressure was substantially higher than it was following the procedure.

Percentage of abnormal tympanograms becoming normal (Type A), 6 weeks after adenoidectomy was 71.4%. [2]

According to a study conducted in 2020 by Navin Agrawal et al., patients with adenoid hypertrophy had a noticeably increased risk of OME. The most common tympanogram was Type B. The more severe grade of adenoid hypertrophy was more prevalent and it was shown to be statistically significant with OME, thus being a significant risk factor for OME in children. [10]

A 2016 study by Abhilasha S et al. found that otitis media with effusion was suggested by a type B or C curve in 43 percent of children with chronic adeno tonsillitis. Persistent adeno tonsillar hypertrophy and hearing loss are strongly positively correlated. Hearing loss ranging from 16-70 dB HL is noted in cases of chronic adeno tonsillitis in which majority of them belongs to minimal hearing impairment which will be asymptomatic and if it is prolonged can cause significant hearing loss and might result in subsequent delay of speech, language, communications skills and poor academic performance. [11]

In a 2016 study, Chibuike Nwosu found that among patients with Adenoid hypertrophy, the incidence of OME was 55.9%, with a higher prevalence of type B (29.4%) than type C (26.5%). The incidence of OME was almost four times higher

than that of the control group. This establishes significance of Adenoid hypertrophy as a risk factor in the pathogenesis of OME. [4]

At three and six months following adenoidectomy, improvements in tympanogram and hearing were found to be statistically significant, according to a 2013 study by H.S. Satish et al. Adenoidectomy in hypertrophied adenoids with OME is a simple and effective procedure in the resolution of OME and improvement in hearing postoperatively. [11]

According to a study conducted in 2012 by Dong-dong Ren et al., of all the children with adenoid hypertrophy, 73.4% (304/414) of the ears had middle ear effusion confirmed by otoscopy, and 75.4% (312/414) of the ears had middle ear effusion confirmed by CT. It was determined that 54.4% (223/410) of the ears had hearing loss. They concluded that practitioners should pay much attention to the middle ear condition and be aware of a possible development of severe to profound hearing loss during the course of Middle ear effusion in young children with adenoid hypertrophy. [11]

The role of adenoidectomy alone versus grommet insertion along with adenoidectomy was noted through a study done by **Nilamadhaba Prusty et al.** Postoperatively, at the end of 6 months of follow-up, patients who underwent adenoidectomy with grommet insertion had 94% normal tympanic membrane while patients who underwent adenoidectomy alone had a 72% normal tympanic membrane. [13]

MATERIALS AND METHODS:

Study design: Observational (prospective) study

Study Period: 1 year

Study Population: Children between 5 to 15 years of age, visiting the ENT OPD at Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi with complaints suggestive of adenoid hypertrophy and who are planned for adenoidectomy.

Sample size: 52

Ethical Clearance: Obtained from the Institutional Ethical Committee

Inclusion Criteria:

1. Children aged between 5 to 15 years.
2. Lateral X-ray nasopharynx for adenoids showing more than 50% obstruction in the airway
3. Children diagnosed to have adenoid hypertrophy based on history taking and clinical examination.

Exclusion Criteria:

1. Children with acute upper respiratory tract infection.
2. Children with tympanic membrane perforation.
3. Children with craniofacial abnormalities.

Methodology for Derivation of Sample Size: Based on the below mentioned data from the study done by Rajashekhar et al. as a reference [2] , sample size for our study was derived.

Reference: Twelve ears had a type A curve. Twelve ears were suggestive of Gross Serous Otitis Media with type B flat tympanogram. Tympanogram type C was seen in eight ears with simple eustachian tube blockage. Tympanogram suggestive of Eustachian tube block was present in five ears, however there was no discernible middle ear fluid accumulation. Tympanogram for three ears indicated a simple eustachian tube blockage. Thirty-two ears had normal tympanograms following adenoidectomy. Tympanogram suggestive of negative middle ear pressure with normal compliance was seen in 8 ears. [(2)]

TABLE 2: DERIVATION OF SAMPLE SIZE

	After surgery tympanogram (normal)	After surgery tympanogram (abnormal)
Before surgery tympanogram (normal)	12 (P_{11})	0 (P_{10})
Before surgery tympanogram (abnormal)	20 (P_{01})	8 (P_{00})

P_{11}= 12/40= 0.3,

P_{10}= 0/40= 0,

P_{01}=20/40=0.5,

P_{00}= 08/40= 0.2

Where P-probability

$H_{0:}$ Same success probability in both the groups

$H_{1:}$ Unequal success probability between both the groups the groups

$H_{0:}\ P_{10} = P_{01}$

H_2: P_{10} not equal to P_{01}

Where H-hypothesis

In the given formulas below, we use the notation

P disc = $P_{10} + P_{01} = 0.5$ and P diff = $P_{10} - P_{01} = -0.5$

$n = \{ \ Z_{1-\alpha/2} \sqrt{P_{disc}} + Z_{1-\beta} \sqrt{P_{disc} - P2_{diff}} \ / \ P_{diff} \ \}^2$

for $\alpha = 5\%$ (95% confidence) $Z_{1-\alpha/2} = 1.96 \sim 2$

for $\beta = 20\%$ (1- β= 80 % power), $Z_{1-\beta} = 0.84$

where α- false positive and β-false negative

Substituting the above mentioned formula, n =52

Procedure:

- Children who satisfied the inclusion criteria were taken in the study. After taking written informed consent, the children's parents were instructed to fill questionnaires pertaining to the symptoms of adenoid hypertrophy.
- The children who suited the selection criteria were identified after going through the answers. A thorough history was obtained and thorough examination of the Ear, nose and throat which included clinical hearing tests were done.
- X-Ray Nasopharynx lateral view was done for assessing the adenoid hypertrophy.

- Tympanometry was then conducted on all the patients before and 6 weeks after adenoidectomy. Tympanograms, signs, and symptoms prior to and after surgery were compared and examined.

Statistical Analysis: Data was analysed using following statistical methods:

- Diagrammatic representation
- Paired T test was used to determine the mean difference between the data collected before and after surgery.
- McNemar test was used for statistical analysis
- SPSS software was used for computing and analysing the data.

RESULTS:

After gaining informed consent, 52 patients who meet the inclusion criteria are included to the study. The mean age of patients is 10.92 ± 3.253 (Table 3).

TABLE 3: MEAN AGE OF PATIENTS INCLUDED IN THE STUDY

	Minimum	Maximum	Mean ± SD
Age	5.0	15.0	10.92 ± 3.253

Out of the total study population of 52 children, 26 were males and 26 were females- 50 percent each. (Table 4).

TABLE 4: GENDER DISTRIBUTION

		Frequency	Percent
Gender	Female	26	50.0
	Male	26	50.0
	Total	52	100.0

The children were also assessed based on their clinical symptoms before and after adenoidectomy as shown in Table 5. Postoperatively, all the children showed symptomatic improvement with respect to all the symptoms chosen in the study, thereby strengthening the evidence of the important role of adenoidectomy in relieving the symptoms. Mouth breathing, snoring and hyponasal speech were symptoms which showed complete improvement following surgery.

TABLE 5: COMPARISON OF SYMPTOMS BEFORE AND AFTER ADENOIDECTOMY

S.NO.	COMPLAINTS	NUMBER OF CHILDREN PREOPERATIVELY (OUT OF 52)	NUMBER OF CHILDREN POSTOPERATIVELY (OUT OF 52)
1)	MOUTH BREATHING	50	All improved completely
2)	SNORING	40	All improved completely
3)	NASAL OBSTRUCTION	15	All improved
4)	HYPONASAL SPEECH	2	All improved completely
5)	THROAT PAIN	42	All improved
6)	UPPER RESPIRATORY TRACT INFECTION	44	All improved

Based on the preoperative X-Ray Nasopharynx, the following findings were noted:

- Grade 2 Adenoid hypertrophy in 36 children (69.2%)
- Grade 3 Adenoid hypertrophy in 15 children (28.8%)
- Grade 4 Adenoid hypertrophy in 1 child (0.019%)

A total of 52 children taken for the study which meant examination and comparison of 104 ears before and after adenoidectomy as shown in Table 6.

TABLE 6: COMPARING PREOPERATIVE AND POSTOPERATIVE TYMPANOGRAMS

Type of tympanogram	Number of preoperative ears (Total- 104)	Number of postoperative ears (Total-104)
Type A	80	97
Type B	17	1
Type O (Indeterminate)	7	6

Preoperatively, 80 ears showed a type A curve; postoperatively, this number rose to 97 ears. Only one ear showed signs of the Type B curve after surgery, compared to 17 ears before surgery. 8 children (16 ears) had Bilateral 'B' type tympanogram preoperatively which changed to Bilateral 'A' type tympanogram, 6 weeks postoperatively. Hearing improvement was also noted symptomatically. 38 children (76 ears) had Bilateral 'A' type tympanogram preoperatively which remained as Bilateral 'A' type tympanogram, 6 weeks postoperatively. In 6 children, miscellaneous observations were made as seen in Table 7.

TABLE 7: MISCELLANEOUS OBSERVATIONS NOTED IN SIX CHILDREN

S.No.	Preop Right Ear	Postop Right Ear	Preop Left Ear	Postop Left Ear
1)	A	Ad	B	A
2)	A	C	A	B
3)	As	A	As	As
4)	As	C	A	A
5)	As	A	As	A
6)	As	As	As	As

All the children who underwent adenoidectomy showed symptomatic improvement. Comparison of preoperative and postoperative tympanograms in both right and left ears is shown in Table 8. The tympanograms other than Type A and Type B were combined together and given the term "Type O" (Indeterminate type) for easy representation. Graphical representation, were done comparing the preoperative and postoperative Type A, Type B and Type O tympanograms in right and left ears as shown in Figures 3 and 4.

TABLE 8: TABULAR REPRESENTATION OF PREOPERATIVE AND POSTOPERATIVE TYMPANOGRAMS IN RIGHT AND LEFT EARS

RIGHT EAR PREOPERATIVE TYMPANOGRAM			
		Number of patients	Percent
	Type A	40	76.9
	Type B	6	11.5
	Type As	6	11.5
RIGHT EAR POSTOPERATIVE TYMPANOGRAM			
		Number of patients	Percent
	Type A	47	90.4
	Type C	2	3.8
	Type Ad	1	1.9
	Type As	2	3.8
LEFT EAR PREOPERATIVE TYMPANOGRAM			
		Number of Patients	Percent
Valid	0	1	1.9
	Type A	40	76.9
	Type B	7	13.5

	Type As	3	5.8
	Type C	1	1.9
LEFT EAR POSTOPERATIVE TYMPANOGRAM			
		Number of patients	Percent
Valid	Type A	49	94.2
	Type B	1	1.9
	Type As	2	3.8
	Total	52	100

FIGURE 3: GRAPHICAL COMPARISON OF TYMPANOGRAMS OF RIGHT EAR BEFORE AND AFTER SURGERY

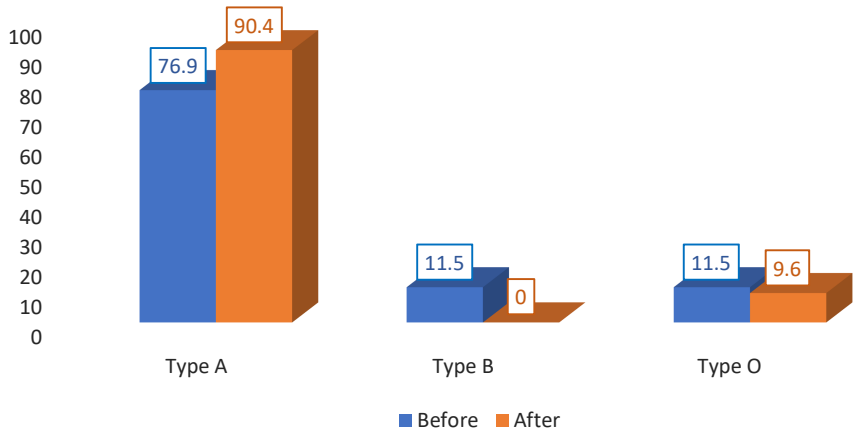
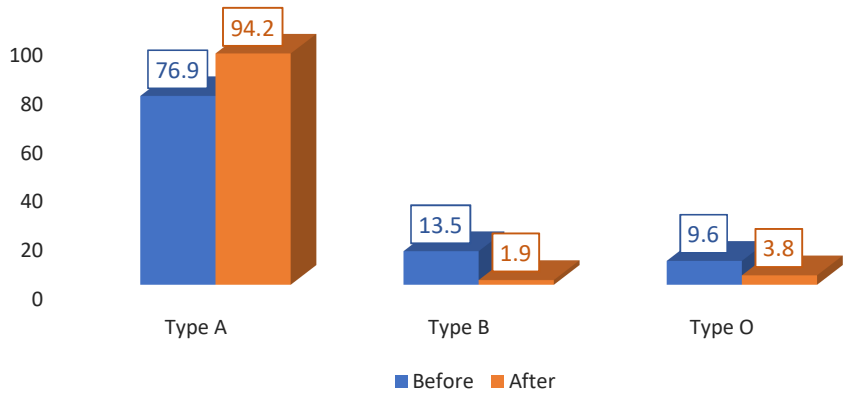


FIGURE 4: GRAPHICAL COMPARISON OF TYMPANOGRAMS OF LEFT EAR BEFORE AND AFTER SURGERY



McNemar's test was used for statistical analysis as seen in Table 9.

TABLE 9: MCNEMAR'S TEST

Before		After					
	1	%	0	%	Total	p-value	
Right							
1	38	95	2	5	40	0.65	NS
0	9	75	3	25	12		
	47		5		52		
Left	1	%	0	%			
1	39	97.5	1	2.5	40	**0.012 ***	**Sig**
0	10	83.3	2	16.7	12		
	49	94.2	3	5.8	52		

DISCUSSION

In our study, children between 5 to 15 years were included, all of them having a history of chronic adenoid hypertrophy. A study done by Runyi Hu et al. showed that younger age and duration of adenoid hypertrophy ≥12 months were risk factors of Otitis Media with Effusion (OME) in children with adenoid hypertrophy. [20] Adenoid hypertrophy is mostly seen in children below 10 years of age. The main symptoms include nasal congestion, snoring and mouth breathing at night. [15, 16]

Hearing loss and middle ear effusion, which belong to non-suppurative inflammatory diseases of the middle ear are mainly the features of OME. Obstruction of middle ear drainage and eustachian tube obstruction caused by adenoid hypertrophy for a long period leads to OME. [17, 18, 19] It may also be related to the adenoid immune abnormality that leads to pharyngeal oedema and infection, and this phenomenon causes eustachian tube dysfunction, finally leading to OME. [20, 21]

Otitis media with effusion can be either treated by adenoidectomy alone or adenoidectomy with grommet insertion. It has been demonstrated by both radiological techniques and pressure studies that adenoids obstruct the Eustachian tube and that adenoidectomy relieves the obstruction. [1]

In our study, the prevalence of otitis media with effusion was 16.34 %. In 2018, a study done by Rajashekhar et al. showed that the prevalence of Otitis Media with Effusion in patients with adenoid hypertrophy was 30%. [2] According to a 2016 study by Abhilasha et al., 43% of children with chronic adenotonsillitis had a type B or C curve, which indicates otitis media with effusion.

Majority of these children had minimal hearing impairment which will be asymptomatic and if prolonged can cause significant hearing loss. [5] A systematic

review done by Ghadi D Mashat et al. also found a correlation between adenoid hypertrophy and otitis media with effusion, which contributed to silent, progressive hearing loss in children. [22] 29.2% of the patient ears had OME confirmed; of these, 30.5% had unilateral OME instances and 13.9% had bilateral OME cases.

A study done by Ambrish et al, 100 cases were seen with adenoid hypertrophy and 200 ears were studied for tympanogram. 58 ears had type B tympanogram while 53 ears had type C. The incidence of OME was 55.9%. [23] A study conducted in 2012 by Dong-dong Ren et al. revealed that 73.4% (304/414) of the children with adenoid hypertrophy had middle ear effusions. The difference in prevalence in various studies can be explained because of the different range of age groups considered and other patient factors like compliance to treatment, parental support, demographic differences etc.

In our investigation, 70.83 percent of Type B tympanograms became Type A six weeks following adenoidectomy. Preoperatively, 80 ears showed a type A curve; postoperatively, this number rose to 97 ears. Only one ear showed signs of the Type B curve after surgery, compared to 17 ears before to surgery. Six weeks following adenoidectomy, 71.4% of aberrant Type B turned Type A, according to a research by Rajashekhar et al. Twelve ears had a Type A curve, twelve had a Type B tympanogram, and sixteen had the other types of curves preoperatively. Thirty-two ears had normal tympanograms following adenoidectomy. 8 ears showed tympanogram suggestive of negative middle ear pressure with normal compliance. [2] The evidence from other studies correlate with our study in proving that adenoidectomy certainly helps in relieving otitis media with effusion.

Our study also revealed that children presenting with complaints of speech, snoring, nasal obstruction, and hyponasality are better candidates for adenoidectomy.

Tympanometric conversion in these patients showed a notable shift from flat type B curves to peaked A curves. All the 8 children in the study who had Bilateral 'B' type tympanogram preoperatively, were found to have the above-mentioned symptoms and all had a postoperative tympanogram of bilateral 'A' type, 6 weeks after surgery. In addition to this, even the children with Type A tympanogram with the above-mentioned symptoms maintained the same Type A curve after adenoidectomy and showed subjective improvement clinically. This is on par with the 2004 clinical practice guideline on Otitis media with effusion which states that children with OME lasting four months or longer with persistent hearing loss or other signs and symptoms, as well as OME with structural damage to the Tympanic membrane or Middle ear, are candidates for surgery up to the age of twelve. [3]

Another observation made from our study was that all 52 children, irrespective of the grade of adenoid hypertrophy, improved postoperatively with respect to the symptoms taken into consideration, namely mouth breathing, snoring, nasal obstruction, hyponasal speech, throat pain and upper respiratory tract infections. Similar observations were made in the following studies. Foster Tochukwu Orji et al, concluded that adenotonsillectomy is associated with remarkable improvement in breathing difficulties and sleep disturbances in children with obstructive adenoid hypertrophy regardless of the condition whether it is mild or severe. [24] Nishanth Savery et al showed that adenoid hypertrophy has significant effect on the development of otitis media with effusion, but size of adenoids has no effect on the severity of hearing loss and tympanometry findings. [25] Explanations that can be given for the absence of correlation between the adenoid hypertrophy grade and the symptoms in both our study and the references quotes above, could be due to the

natural limitations of tympanometry or due to chronic submucosal inflammation leading to disturbing the function of the eustachian tube.

The driving force behind the need for our study was the difficulty faced by young children to explicitly share their clinical complaints. Otitis media with effusion which is usually not severe, can remain masked for a long time. This leads to decreased speech, unsatisfactory academic and language development as portrayed by the following literature. A study done by Merve Savas et al showed that the presence of OME negatively affected language development and verbal working memory. [26]

A study done by Mosaad Abdel-Aziz et al. also concluded that Otitis media with effusion has an adverse consequence on the phonological performance of preschool children, as was seen in 91.7% of children observed in the study. [27]

A systematic review done by Abdullah AL Sagr et al. showed that Otitis media with effusion is negatively associated with language acquisition and can affect different domains such as receptive or expressive language. [28] A study done by Ting Cai et al. concluded that OME imposes a series of disadvantages on hearing sensitivity and speech perception in children. [29]

Preben Homoe et al. found that OME was associated with negative effects on auditory processing, language and speech development, school readiness, social competence, psychosocial wellbeing, and sleep. [30] In order to ensure children's general well-being, OME should be routinely screened in childhood and should be closely followed, especially in children with speech and language problems, as supported by the evidence presented above from a variety of studies.

SUMMARY

Over the course of a year, children aged 5 to 15 years, who visited the ENT outpatient department at KLES Dr. Prabhakar Kore Hospital & Medical Research Centre, Belagavi, were the subjects of this prospective observational study. Examining the tympanogram alterations in the subjects having adenoidectomy was the goal. A total of 52 children who met the inclusion criteria and hence 104 ears were selected for the study. The mean age of patients was 10.92 ± 3.253, with no male or female preponderance.

The preoperative tympanograms were compared with the postoperative tympanograms done after a period of 6 weeks. Preoperatively, 80 ears showed a type A curve. Postoperatively, this number rose to 97 ears. Remarkable symptomatic improvement was seen in all of them. 17 ears which showed Type B tympanograms preoperatively reduced to just 1 ear showing Type B tympanogram postoperatively and all the patients showed symptomatic improvement.

Through our study, we would like to emphasise the following points:

1. Majority of ears belonging to Type B curve improved to become Type A (70.83%) thereby giving both subjective and objective improvements in Otitis media with effusion status. This was well documented by both the tympanometry findings and the subjective satisfaction of patients.
2. Majority of the second group of patients who had Type A preoperatively maintained the curve to be Type A postoperatively (90%) and were shown to have subjective improvement. This could be because of tympanometry not having a hundred percent reliability. It has a sensitivity of 85.85%; specificity

of 72.22%; Positive predictive value of 94.44%; negative predictive value of 48.14%; Accuracy of 83.76%. [9]

3. 33.3 % of the third group of patients who had indeterminate type of tympanograms also changed over to Type A curve postoperatively, and showed symptomatic improvement.

Taking all the above-mentioned points into consideration, it can be demonstrated that the middle ear impedance is significantly affected by adenoidectomy. Because young children find it difficult to express their problems, otitis media with effusion, which is typically not serious, might go undiagnosed for a long period. Language development and speech delay are the results of this. Over the long run, scholastic performance, job placements and in turn the economy of the nation can be affected.

Hence it is extremely essential to perform tympanometry pre and postoperatively to ensure the overall well-being of children.

CONCLUSION

Our study shows that majority of the ears with Type B tympanogram have shown significant change into Type A curve following adenoidectomy. The symptoms also improved remarkably. This proves that adenoidectomy has a significant impact on the middle ear impedance. Majority of the ears which had Type A tympanogram preoperatively maintained the same curve post adenoidectomy and also showed subjective improvement with respect to the symptoms. 5 out of 12 ears considered under the indeterminate category, also showed a changeover to A type curve postoperatively. All the patients noted improvement of the symptoms as well.

Our study also revealed that children presenting with complaints of speech, snoring, nasal obstruction, and hyponasality are better candidates for adenoidectomy. Also, the symptomatic improvement noted in all the patients had no correlation with the grade of adenoid hypertrophy. Based on our study, it was also noted that tympanometry, though not hundred percent sensitive or specific, is a good indicator to assess changes in middle ear impedance and serves as a roadmap for further management.

Prolonged otitis media with effusion predisposes to speech delay, unsatisfactory academic and language development. Since Otitis media with effusion need not always be severe and young children are unable to express their difficulties including hearing loss, OME can remain masked for a long duration. Hence early audiological assessment is definitely essential before and after adenoidectomy to prevent long term complications and to ensure the welfare of the children, and the society as a whole, as today’s children are tomorrow’s workforce and leaders of the nation.

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ANNEXURE I: ETHICAL CLEARANCE LETTER

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to- be- University)
Accredited 'A+' Grade by NAAC in (3rd Cycle) Placed in Category 'A' by MHRD (GoI)
JNMC INSTITUTIONAL ETHICS COMMITTEE
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
Website: http//www.jnmc.edu
E-Mail : dome@jnmc.edu
Phone: (+ 91-(0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref No.MDC/JNMCIEC/ 24 **Date: 27/09/2022**

To,

BE0121009

PG Student in Otorhinolaryngology and Head and Neck Surgery,
J. N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A STUDY OF TYMPANOGRAM CHANGES IN CHILDREN UNDERGOING ADENOIDECTOMY- A PRE AND POSTOPERATIVE EVALUATION.",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

(Dr. Smita Sonoli)
Member Secretary
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi.

(Dr. Harsha Hegde)
Chairman,
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi

ANNEXURE II: INFORMED CONSENT FORM

'A STUDY OF TYMPANOGRAM CHANGES IN CHILDREN UNDERGOING ADENOIDECTOMY- A PRE AND POSTOPERATIVE EVALUATION'

Name of Student/Principal Investigator:

Name of Guide/Co Investigators:

Objective: To study the tympanogram changes in children undergoing adenoidectomy.

Introduction: The present study is conducted among patients with adenoid hypertrophy attending the out-patient department of ENT & HNS in KLE's Dr.Prabhakar Kore Charitable Hospital and Medical Research Centre, Belagavi and they will be investigated for tympanometry. You are requested to participate in the study and your participation is completely voluntary.

Explanation of procedure: If you agree to participate in this study, the relevant data will be collected as per the proforma and the final diagnosis will be confirmed.

After getting inducted in the study, you will be evaluated for hearing with tympanometry done before and after surgery (adenoidectomy).

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study. **Authorization for publication of aggregated data:** Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups.

However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: "Dr _____, mobile no: _____" and the guide, Dr_____. If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **"'A STUDY OF TYMPANOGRAM CHANGES IN CHILDREN UNDERGOING ADENOIDECTOMY- A PRE AND POSTOPERATIVE EVALUATION''.** My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE III: PROFORMA

'A STUDY OF TYMPANOGRAM CHANGES IN CHILDREN UNDERGOING ADENOIDECTOMY- A PRE AND POSTOPERATIVE EVALUATION'

Date:

Name of child:

Age: OP/IP no:

Sex: Date of assessment:

Address: Date of discharge:

Name of Parent/Guardian:

Relation:

CLINICAL PROFILE:

Chief Complaints:

S.NO.	COMPLAINTS	TICK IF PRESENT
1)	MOUTH BREATHING	
2)	SNORING	
3)	NASAL OBSTRUCTION	
4)	HYPONASAL SPEECH	
5)	THROAT PAIN	
6)	UPPER RESPIRATORY TRACT INFECTION	

History of Presenting Illness:

Past History:

Personal History:

Family History:

Treatment history:

I) **General Physical Examination** -

Built:

Nourishment:

Vitals:

Temperature:

Pulse rate:

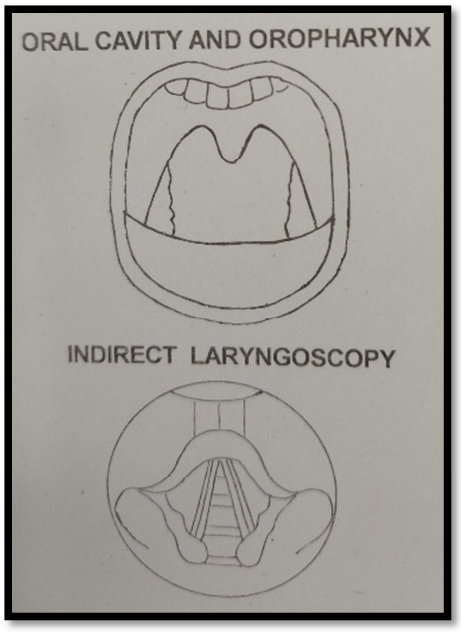
Blood Pressure:

Respiratory Rate:

Pallor/Icterus/Clubbing/Cyanosis/Lymphadenopathy/Edema

ENT Examination

1)THROAT EXAMINATION:



Oral cavity:

Oropharynx:

2) NOSE EXAMINATION

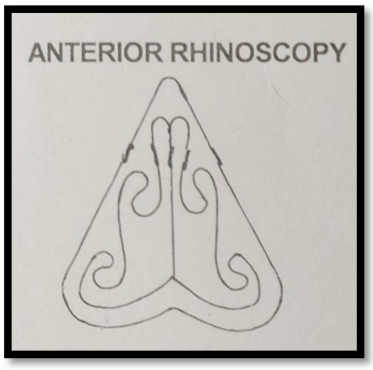
External appearance

- Root
- Bridge
- Dorsum
- Alae
- Tip
- Columella

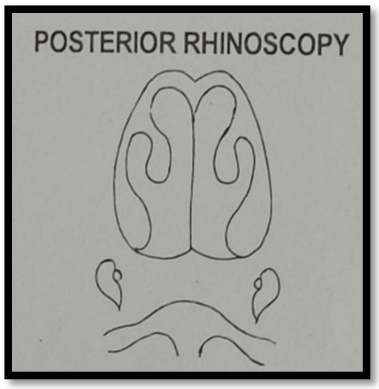
Cold spatula test:

On tip elevation:

Anterior Rhinoscopy:



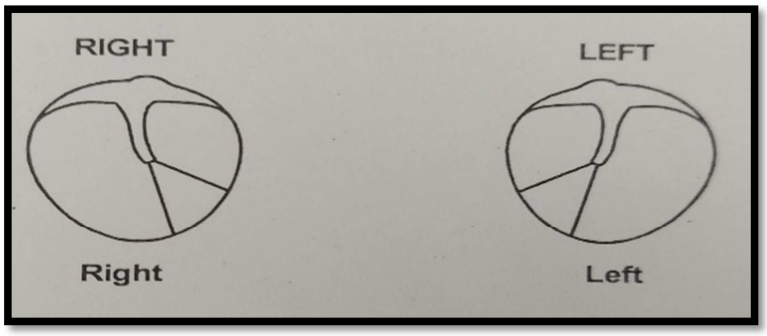
Posterior Rhinoscopy:



Paranasal Sinus Examination:

3) EAR EXAMINATION:

	Right	Left
Pinna		
Pre auricular area		
Post auricular area		
Tragal tenderness		
Mastoid tenderness		
External auditory canal		
Tympanic membrane		



TUNING FORK TESTS:

		RIGHT	LEFT
Rinne's test	256 Hz		
	512 Hz		
	1024 Hz		

Weber's test:

Absolute Bone Conduction test:

FACIAL NERVE EXAMINATION:

VESTIBULAR FUNCTION:

4)NECK EXAMINATION:

DIAGNOSIS:

XRAY NASOPHARYNX:

TYMPANOMETRY (BEFORE SURGERY): RIGHT LEFT

TYMPANOMETRY (AFTER SURGERY): RIGHT LEFT

SIGNATURE OF GUIDE AND DATE:

ANNEXURE IV: PHOTOGRAPHS

PHOTOGRAPHS OF TYMPANOMETRY REPORTS DEPICTING THE DIFFERENT TYMPANOGRAM CURVES FOUND IN THE STUDY:

IMAGE 1: TYMPANOGRAM SHOWING BILATERAL 'A' TYPE CURVES

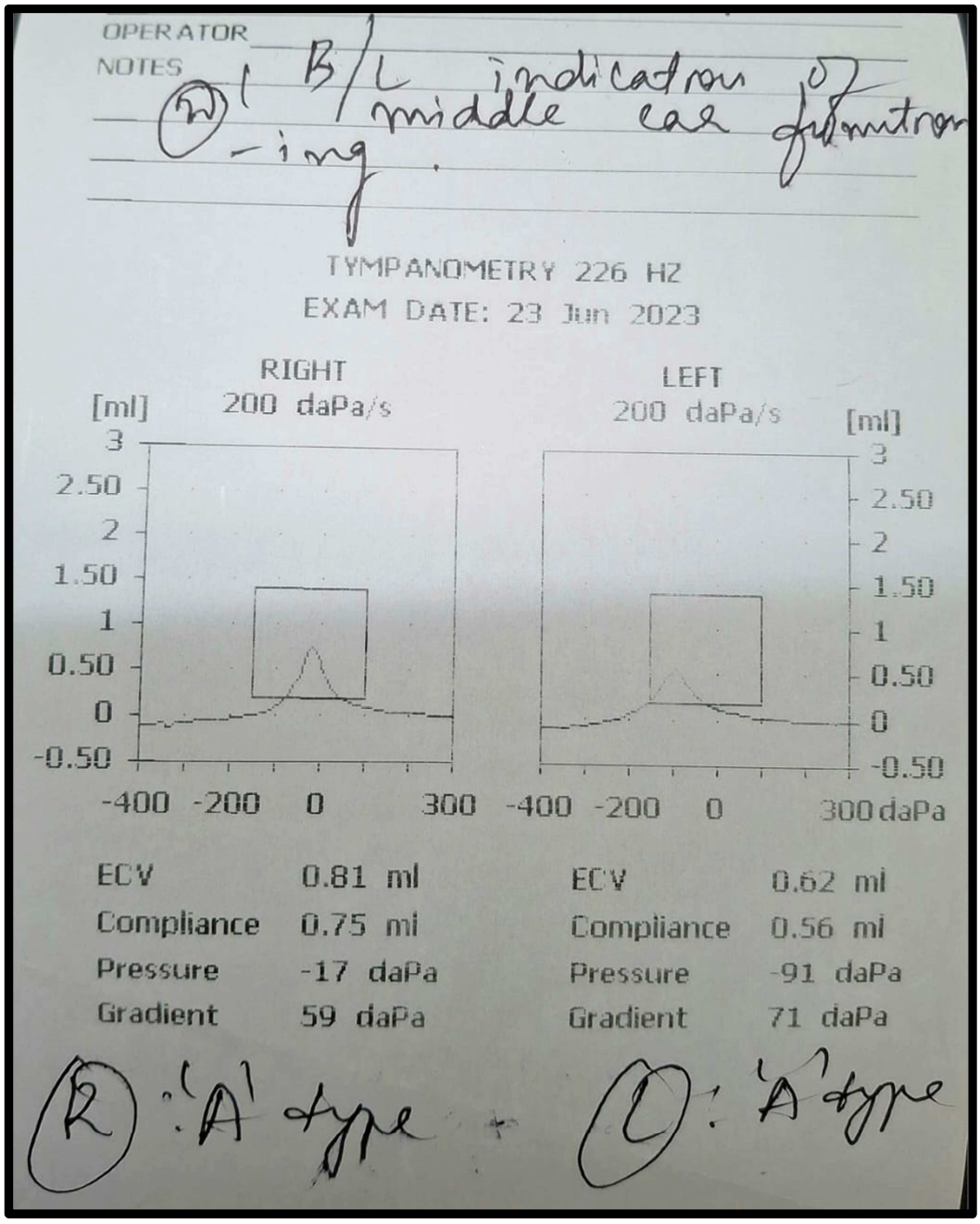


IMAGE 2: TYMPANOGRAM SHOWING BILATERAL 'B' TYPE CURVES

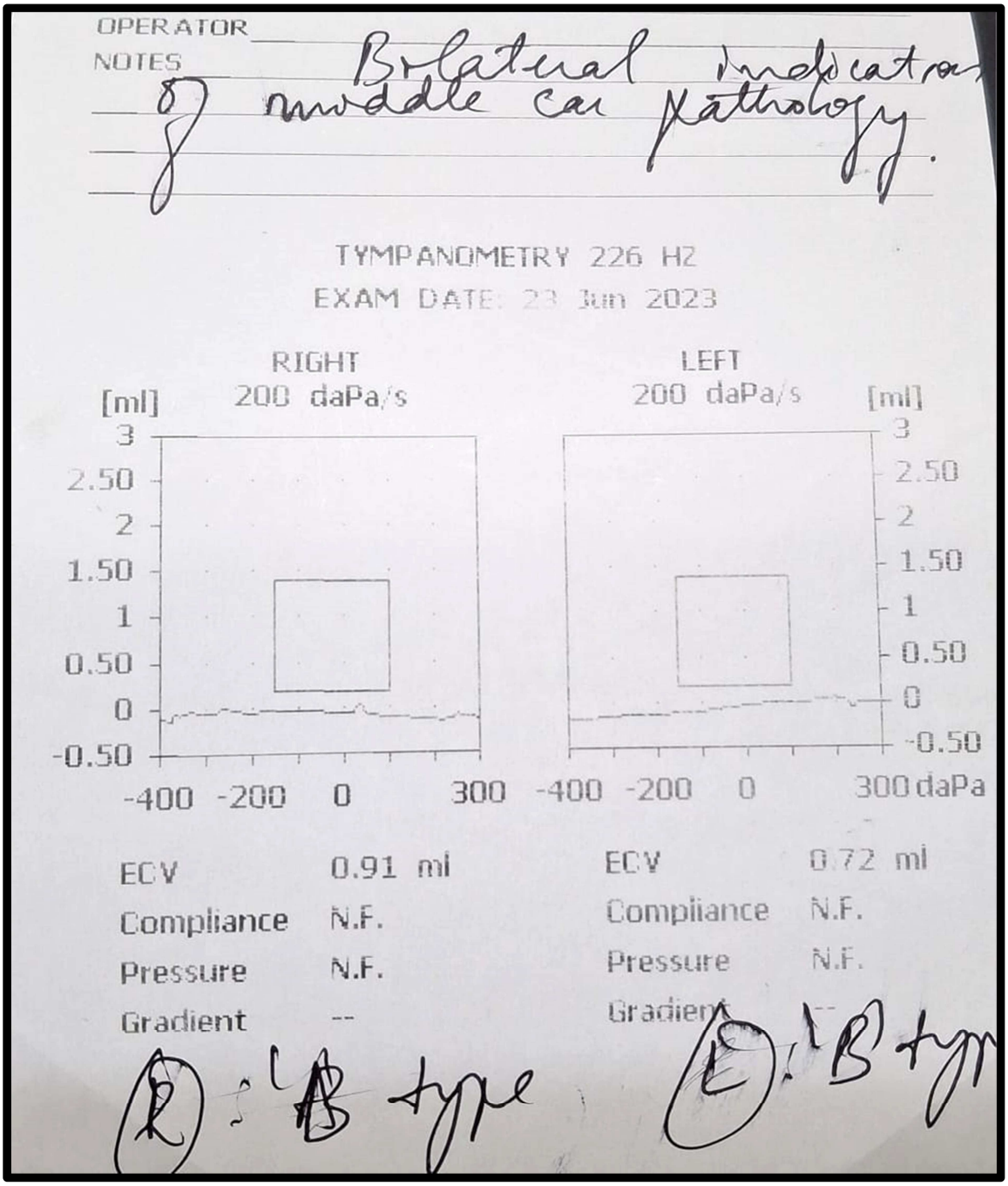
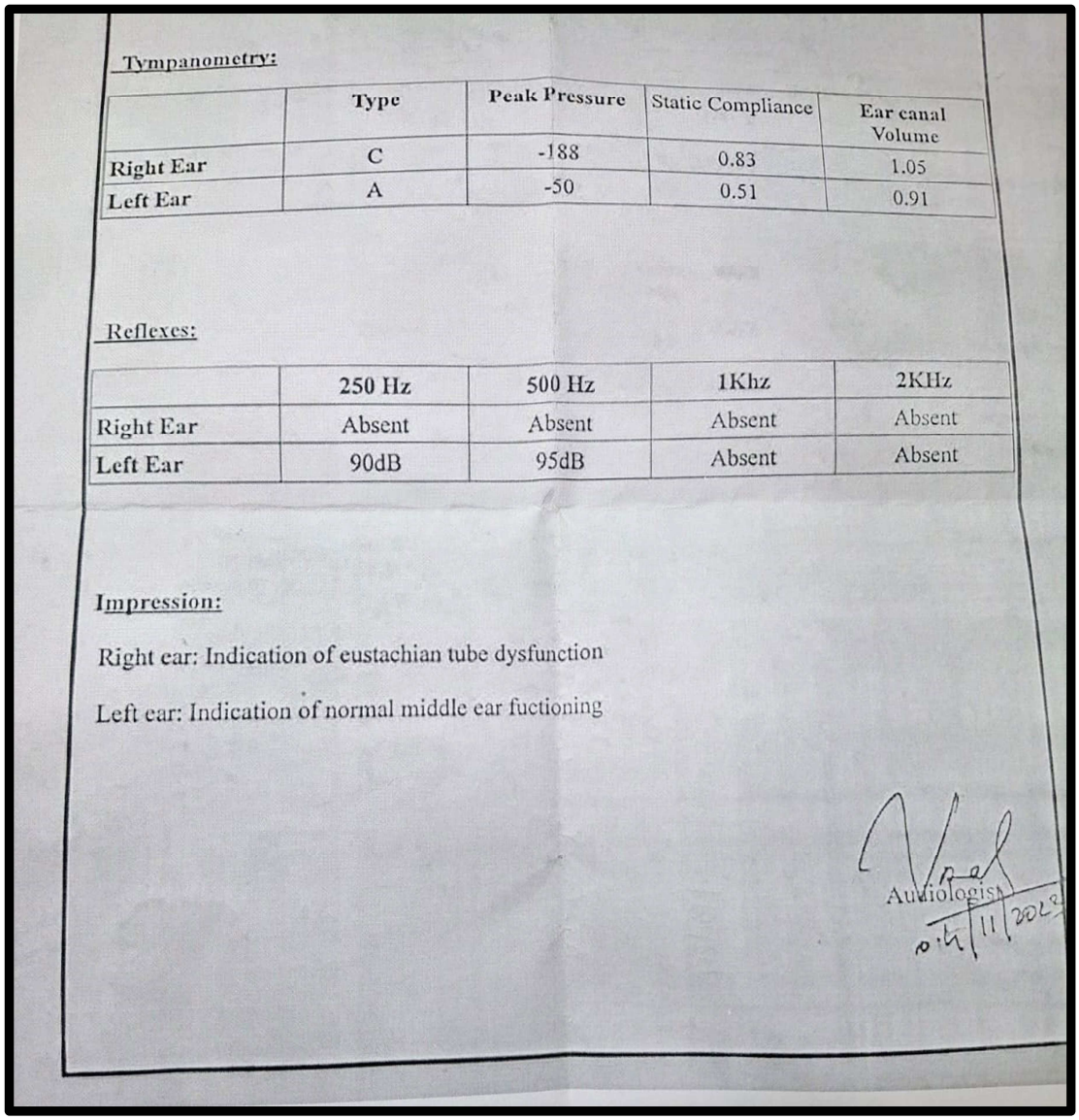


IMAGE 3: TYMPANOGRAMS SHOWING MISCELLANEOUS FINDING-

TYPE C CURVE



Tympanometry:

	Type	Peak Pressure	Static Compliance	Ear canal Volume
Right Ear	C	-188	0.83	1.05
Left Ear	A	-50	0.51	0.91

Reflexes:

	250 Hz	500 Hz	1Khz	2KHz
Right Ear	Absent	Absent	Absent	Absent
Left Ear	90dB	95dB	Absent	Absent

Impression:

Right ear: Indication of eustachian tube dysfunction

Left ear: Indication of normal middle ear fuctioning

Audiologist

04/11/2021

PHOTOGRAPHS OF X-RAY NASOPHARYNX OF TWO PATIENTS:

IMAGE 4: X-RAY NASOPHARYNX SHOWING GRADE 4 ADENOID HYPERTROPHY (BLACK ARROW)

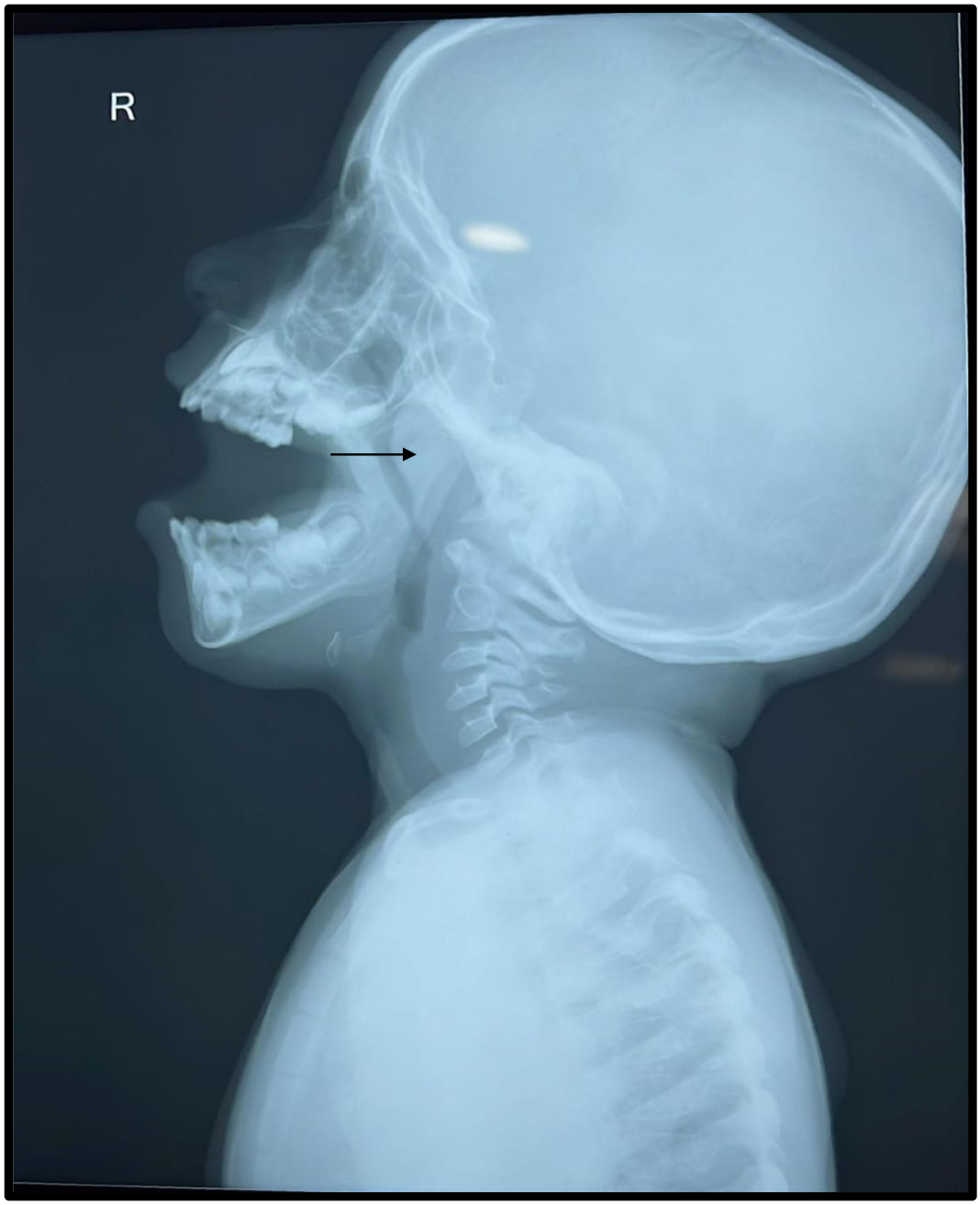


IMAGE 5: X-RAY NASOPHARYNX SHOWING GRADE 2 ADENOID HYPERTROPHY (BLACK ARROW)

IMAGE 6: OTOENDOSCOPIC IMAGE OF A CHILD'S TYMPANIC MEMBRANE SHOWING RETRACTION OF PARS TENSA

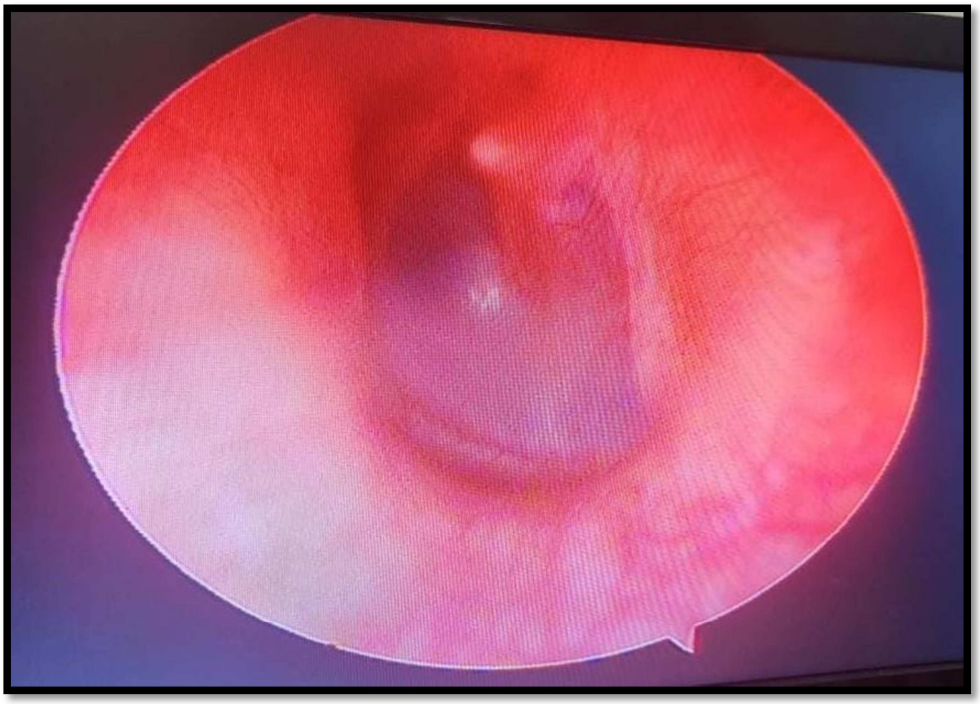


IMAGE 7: OTOENDOSCOPIC IMAGE OF ANOTHER CHILD'S TYMPANIC MEMBRANE SHOWING RETRACTION OF PARS TENSA

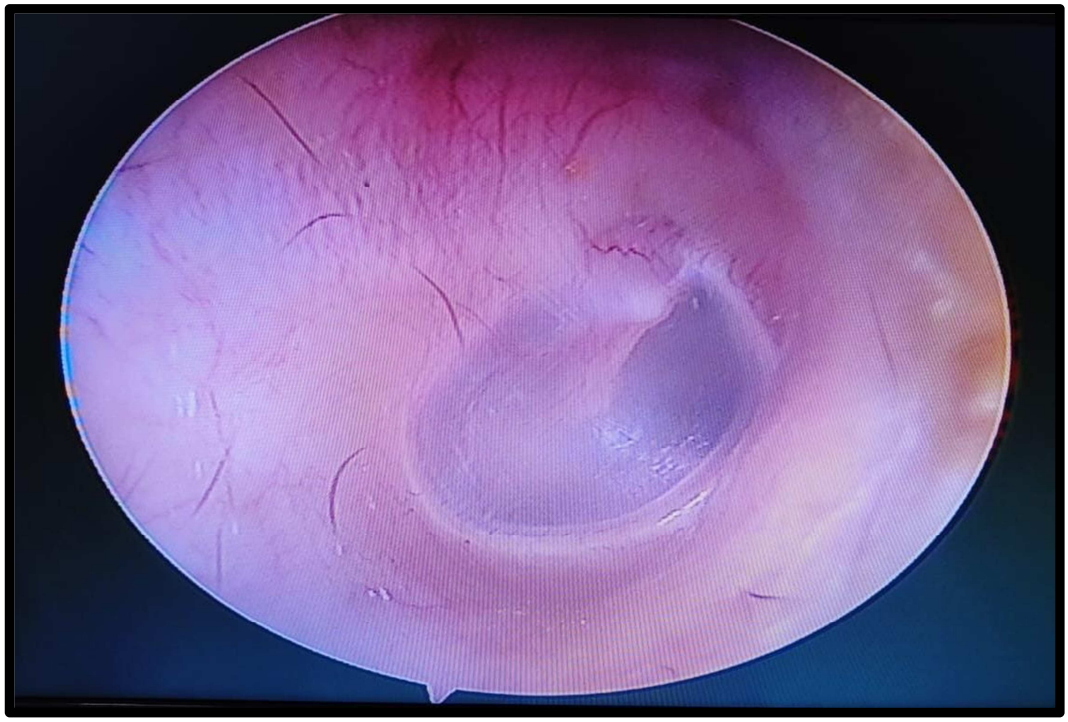


IMAGE 8: NASAL ENDOSCOPIC IMAGE SHOWING GRADE 4 ADENOID HYPERTROPHY (BLACK ARROW)

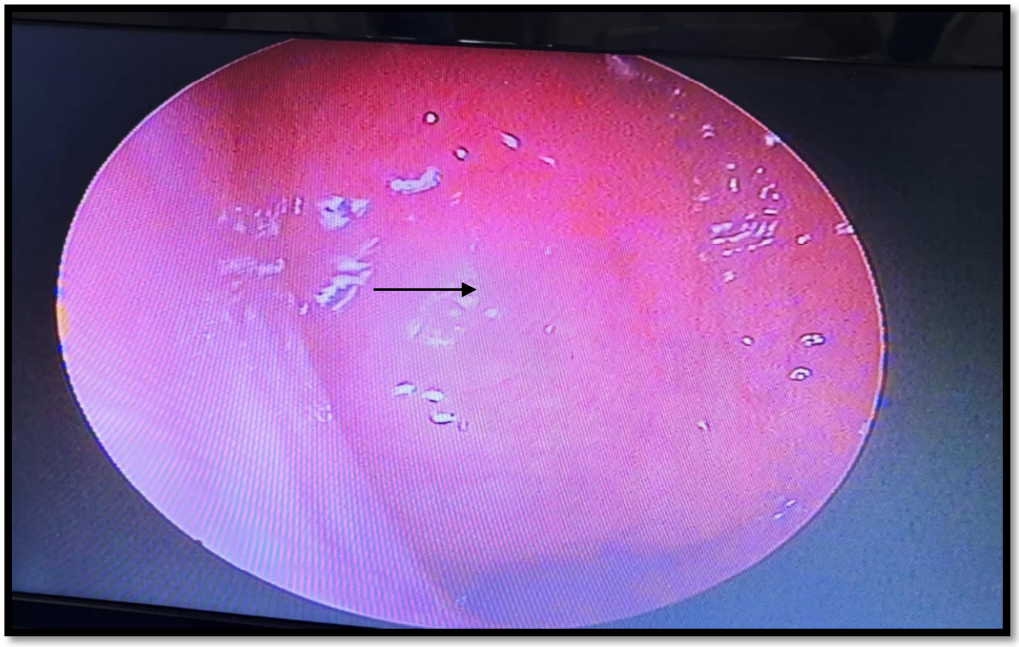
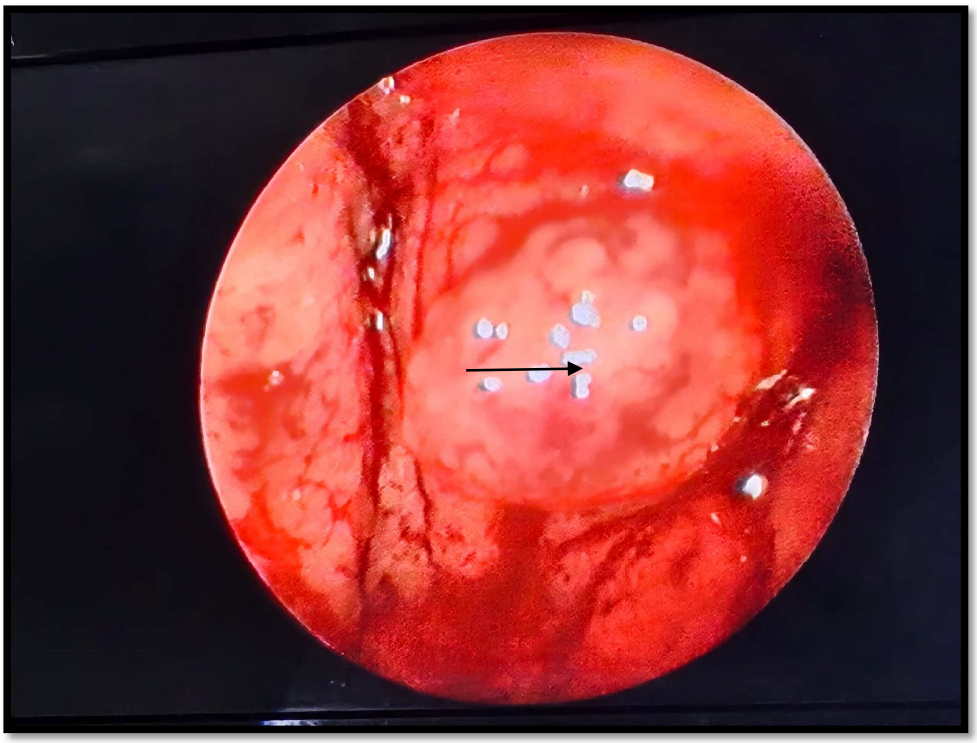


IMAGE 9: INTRAOPERATIVE NASAL ENDOSCOPIC IMAGE SHOWING ADENOID HYPERTROPHY (BLACK ARROW)



ANNEXURE V: KEY TO MASTER CHART

F-FEMALE

M-MALE

MB- MOUTH BREATHING

S- SNORING

TP- THROAT PAIN

NO- NASAL OBSTRCUTION

UR- UPPER RESPIRATORY TRACT INFECTIONS

IC- IMPROVED COMPLETELY

IP-IMPROVED PARTIALLY

ANNEXURE VI: MASTER CHART

S.NO	NAME	AGE (IN YEARS)	GENDER	IP/OP NO.	PREOPERATIVE SYMPTOMS	POSTOPERATIVE SYMPTOMS	XRAY NASOPHARYNX	RIGHT EAR PREOPERATIVE TYMPANOGRAM	RIGHT EAR POSTOPERATIVE TYMPANOGRAM	LEFT EAR PREOPERATIVE TYMPANOGRAM	LEFT EAR POSTOPERATIVE TYMPANOGRAM
1	SAI	5	M	7094955	MB,S,TP,UR +	IP	GRADE 3 ADENOID HYPERTROPHY	B	A	B	A
2	DIVYA DUKALE	12	F	1188860	MB,S,NO +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
3	ZUNAIRAH	9	F	1179488	MB,S,NO,UR +	IC	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
4	AMRUTA	11	F	1165918	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	B	A	B	A
5	ISHWARY METRI	15	F	1177376	MB,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
6	SUDHA	10	F	1183095	MB,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	B	A	B	A
7	SINDHU BASAPPA	6	F		MB,S,TP, UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
8	VIJAY HALLAPA	11	M	1180931	MB,S,TP,UR +	IP	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
9	ARIZ	11	M	1162911	MB,S,HS,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
10	SURAJ	14	M	100021561	S,NO,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	Ad	B	A
11	MAYURI	9	F	1192016	MB,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
12	SARIKA	11	F	11659271	MB,S,TP,UR+	IP	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
13	SUMIT SUBAS	12	M	1196638	MB,S,NO,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
14	TEJASHREE	6	F	4706742	MB,S,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	B	A	SEAL COULDN'T BE ACHIEVED	A
15	JAYASHREE	11	F	1181628	MB,S,TP,UR +	IP	GRADE 3 ADENOID HYPERTROPHY	A	Cs	A	B
16	MUJAFAR	11	M	1163032	MB,S,NO,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
17	HARSHA	7	M	1168685	MB,S,NO +	IP	GRADE 4 ADENOID HYPERTROPHY	B	A	Cs	A
18	UMMEHENI SHEIKH	6	F	1163190	MB,S,NO,TP,UR +	IC	GRADE 3 ADENOID HYPERTROPHY	As	A	B	A
19	SANNIDHI	10	F	1192047	MB,S,NO,UR +	IP	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
20	AZAAN	11	M	1122824	MB,S,TP +	IP	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
21	DARSHAN	13	M	1181626	MB,TP,UR +	IP	GRADE 3 ADENOID HYPERTROPHY	B	As	B	As
22	SAIRAJ VITHAL	5	M	1203860	MB,S,NO,TP +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
23	ISHWARI	12	F	1195368	MB,S,TP,UR+	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
24	VIJAY VITHAL	11	M	1195444	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	As	A	B	A
25	SHWETA	11	F	1180911	MB,S,TP+	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
26	ANVITA	5	F	1195379	MB,S,TP,UR +	IC	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
27	SANDEEP	10	M	1180932	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
28	NAVEEN JANADI	15	M	10014089	MB,S,TP,UR +	IC	GRADE 3 ADENOID HYPERTROPHY	As	A	As	A
29	PRADEEP BASAPPA	14	M	1180932	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	As	C	A	A
30	BIBI HURMAIN	12	F	1192754	MB,S,TP+	IP	GRADE 3 ADENOID HYPERTROPHY	As	A	As	A
31	MAHANTESH	13	M	1208616	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
32	DARSHAN SURESH	16	M	1205374	MB,S,NO,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	As	As	As	As

S.NO	NAME	AGE (IN YEARS)	GENDER	IP/OP NO.	PREOPERATIVE SYMPTOMS	POSTOPERATIVE SYMPTOMS	XRAY NASOPHARYNX	RIGHT EAR PREOPERATIVE TYMPANOGRAM	RIGHT EAR POSTOPERATIVE TYMPANOGRAM	LEFT EAR PREOPERATIVE TYMPANOGRAM	LEFT EAR POSTOPERATIVE TYMPANOGRAM
33	REVATI	16	F	10011173	TP,UR +	IP	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
34	SUMANGALA	10	F	10014091	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
35	JAVERIYA	7	F	1192314	MB,S,TP,UR+	IC	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
36	AKSHATHA AMBUN	14	F	10011481	MB,S,TP,UR+	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
37	PRATHAM	11	M	10008405	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
38	SOMSHEKHAR	14	M	3742122	MB,S,NO +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
39	SIDDHARTH	7	M	10002492	MB,S,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
40	KHUSHI	8	F	1000063	MB,S,HS,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
41	MADAN	8	M	12023471	MB,S,NO,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
42	RANJANA	14	F	6791137	MB,NO,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
43	SHREYAS	14	M	1200299	MB,NO +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
44	SAUMYA	16	F	10000686	MB,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
45	SUSHMA	16	F	10009079	MB,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
46	MOHAMMED NADAF	10	M	10000312	MB,S,TP,UR +	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
47	SHRUDHA	9	F	10004537	MB,S,TP,UR+	IP	GRADE 3 ADENOID HYPERTROPHY	A	A	A	A
48	POORNIMA	12	F	10006614	MB,S,TP,UR+	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
49	ASHWIK	8	M	10011426	MB,S,TP,UR+	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
50	JADISIDDA	16	M	120228	MB,S,NO,TP,UR +	IC	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
51	KALLAPPA DANGANNAVVA	16	M	10003163	MB,S,TP,UR+	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A
52	MADHAVANAND	7	M	1208630	MB,S,TP,UR+	IP	GRADE 2 ADENOID HYPERTROPHY	A	A	A	A