

Comparative Analysis of Preoperative and Postoperative Tympanometry Findings in Patients with Adenoid in Lagos State University Teaching Hospital, Ikeja

Yahaya ST, Adekoya VA & Amadasun BK

Department of Otorhinolaryngology, Lagos State University Teaching Hospital, Ikeja, Lagos State, Nigeria

DOI - DOI- <http://doi.org/10.37502/IJSMR.2022.5620>

Abstract

Background: Adenoid is the collection of sub-epithelial lymphoid tissues under the mucosa of the nasopharynx situated at the junction of the roof and posterior wall of the nasopharynx, forming part of the Waldeyer's ring of lymphoid tissues of the nasopharynx. It is also called Nasopharyngeal Tonsils and is composed of vertical ridges of lymphoid tissue separated by deep clefts, covered by ciliated columnar epithelium.

Aim: To identify the Tympanometric findings in patients with Adenoids pre and post Adenoidectomy in LASUTH, Ikeja.

Methodology: This is a Prospective interventional hospital-based clinical study was carried out at the Department of Otorhinolaryngology (ORL) of the Lagos State University Teaching Hospital, Ikeja, Lagos State, Nigeria. A structured questionnaire was distributed to all consecutive eligible patients diagnosed with adenoid hypertrophy seen at the Otorhinolaryngology Clinic who were recruited for the study. Thorough examination of the Ear, Nose and Throat and tympanometry were done a week before the Adenoidectomy and six weeks post-surgery. The analysis of data collected was done using Statistical Package for Social Sciences (SPSS) version 20.

Results: A total of 103 subjects participated with 59.2% (61) being males and 40.8% females. The male to female ratio was 1:0.7. The most frequently affected age range was ≤ 3 years accounting for 39.8% (41) of cases while the least frequently affected was 7-9 years i.e 21.4% (22) of cases. Tympanometric findings post operatively revealed type B tympanogram (OME) was found in 72.9% of the ears, with the right ear accounting for 35.0% while the left ear was at 37.9% ($p = 0.314$). Postoperatively, type B tympanogram had reduced to 34% with the right ear accounting for 11.7% while the left ear was 22.3% ($p = 0.314$). There were also differences between the preoperative and post-operative type A and C tympanometric patterns. These differences were statistically significant ($p = 0.002$, $p = 0.004$) on the right and left ear respectively.

Conclusion: Adenoid hypertrophy was more prevalent in the ≤ 3 years age range and the reduction in the frequency of type B tympanometry findings in the right and left ears postoperative was significantly less from the preoperative tympanometry findings among the subjects.

Keywords: Adenoid hypertrophy, tympanometry, Waldeyer's ring, Type B tympanogram.

1. Introduction

Adenoid is the collection of sub-epithelial lymphoid tissues under the mucosa of the nasopharynx situated at the junction of the roof and posterior wall of the nasopharynx, forming part of the Waldeyer's ring of lymphoid tissues of the nasopharynx. It is also called Nasopharyngeal Tonsils and is composed of vertical ridges of lymphoid tissue separated by deep clefts, covered by ciliated columnar epithelium¹ These lymphoid collections have no capsule or crypts and present at birth. It shows physiological enlargement up to the age of six years and then gradually atrophies at puberty and almost completely disappears at age 201.

They form part of early childhood immune system as they produce immunoglobulins A, G and M against pathogens implicated in upper airway infections¹ Hyperactivity of these lymphoid tissues leads to hyperplasia/hypertrophy which then tends to obstruct the nasopharyngeal airway. Some authors consider that adenoid, together with the tonsils constitute a reservoir or nidus of infection and recurrent infections of adenoid spread to the eustachian tube to cause inflammation of the mucosa which leads to the narrowing and blockage of the tube^{1,2} According to study by Al-Robbani et al in 2013, adenoid hypertrophy is common in children, with a prevalence of 7.7%.³ Aydin et al in their study of 10,298 primary school children aged 6-13 years in Brazil reported a prevalence of various degrees of adenoid hypertrophy as 49% whereas⁴ Santos reported a higher prevalence of 66% in primary school children in Turkey. The difference in the prevalence of both studies could be as a result of the different instruments used. Aydin diagnosed hypertrophy based on flexible nasal endoscopy, while⁴ Santos et al in their own study made their own diagnosis based on a questionnaire that included questions concerning the associated symptoms of adenoid hypertrophy.

³ Recurrent attacks of rhinitis, sinusitis, chronic tonsillitis, and allergy of the upper respiratory tract may cause chronic adenoid infection and hyperplasia.

Patients with Adenoid hypertrophy have obstructive features such as snoring, mouth breathing, hyponasality, slow feeding, recurrent rhinorrhea, sleep apnoea, otitis media with effusion (OME) and abnormal facial development. The blockage causes mechanical obstruction which subsequently causes absorption of air and negative middle ear pressure with transudate/exudate of fluid, thus resulting in otitis media with effusion. The recurrent nasal discharges with resultant eustachian tubal obstruction by adenoid masses generates negative pressure which usually results in retracted tympanic membrane and conductive hearing loss. In a 2008 study by Aydin et al⁶ in Turkey, consisting of 1246 (625 girls, 621 boys) primary school children between 5 and 14 years of age, the children were divided into three groups, with ages 5-7 in Group I, 8-10 years in Group II and age 14 in Group III. Of the 1132 questionnaires, 1090 were filled adequately and evaluated. The prevalence of adenoid hypertrophy in school children was found to be 58 in Group I (27%), 94 in Group II (19.5%) and 78 in Group III (19.9%).

Recurrent attacks of acute otitis media may occur due to the spread of inflammation via the eustachian tube. The waxing and waning size of adenoid causes intermittent eustachian tube

obstruction with fluctuating hearing loss. The adenoid enlargement can obstruct the nasal airway partially or completely.

A study done by Orji et al also reported adenoid tissue causing lateral obstruction of the eustachian tube, thereby causing eustachian tube dysfunction. Tympanometry is an evaluation of the middle ear, mobility of the tympanic membrane and the conditions of bones by creating variations of air pressure in the canal. This is an objective test of middle ear function. It is part of the hearing test. However, it measures the energy transmission through the middle ear. Sometimes, parents are not aware of their children's symptoms of hearing loss. Untreated OME may result in serious consequences in the form of poor speech and intellectual development, and permanent anatomical distortions within the middle cavity. Some of them with adenoid hypertrophy have OME, in spite of no complaint of hearing loss. This is usually neglected and so tympanometry is needed for the assessment of the middle ear function. In a study carried out by Gunel et al in 2014 to identify the effects of adenoid hypertrophy on tympanometric findings in children without hearing loss, fifty six children (26 boys and 30 girls) with ages ranging from 3 to 12 years who underwent adenoidectomy were analyzed using otoscopy, nasal endoscopy and tympanometry (1 week before and 3 months) after adenoidectomy. The result showed that median negative middle ear pressure before the adenoidectomy was significantly higher when compared to post-operative value ($p = 0.045$). The study therefore suggested that adenoid hypertrophy is associated with increase negative pressure in the middle air

The prevalence of adenoid hypertrophy is on the increase, thus affecting the lives of many children, viz a viz hearing loss, poor growth, recurrent chest infections leading to frequent hospital admissions and absenteeism at school. This is one of the commonest reasons for elective admission of children to hospitals for surgery in the USA

An Otorhinolaryngologist in the United Kingdom advises adenoidectomy as part of treatment for Otitis Media with Effusion. Adenoidectomy is being increasingly used for treatment of OME because recent studies have confirmed its effectiveness by Cumming. Also, the improvement in hearing and tympanogram post adenoidectomy at 3rd and 6th months was statistically significant. Coyte et al also concluded that adenoidectomy is a useful procedure for correction of medically resistant chronic OME and should be considered as the first line procedure when surgical treatment is chosen. Thus, the evidence supports the conclusion that adenoidectomy is effective in improving the natural history as stated by Ren DD et.al.

Aims and Objectives

Aim

To compare preoperative and postoperative changes in Tympanometry patterns in patients undergoing adenoidectomy in LASUTH, Ikeja.

Specific Objectives

i. To determine the prevalence of OME in patients with adenoid enlargement when screened with tympanometry evaluation.

ii. To determine the difference between preoperative and postoperative tympanometry evaluation.

Study Hypothesis

Null Hypothesis (Ho): There is no difference in the preoperative and postoperative tympanometry findings among patients with Adenoid Hypertrophy.

Alternate Hypothesis: There is significant difference in preoperative and postoperative tympanometry findings among patients with Adenoid Hypertrophy.

2. Methodology

It is a prospective, interventional hospital based research which was conducted on all children aged 6 months to 12 years with adenoid hypertrophy at the out-patient ORL Department of LASUTH, Ikeja, Lagos State, Nigeria between May 2015 to May 2016.

Consent was gotten and questionnaires shared to the parents/guardians

Inclusion Criteria:

- All children aged between 6 months and 12 years attending the ORL clinic of LASUTH, Ikeja and who had been diagnosed to have adenoid hypertrophy, based on clinical features and x-ray of the post nasal space.
- All patients whose parents or legal guardians consented to participate in the study.

Exclusion Criteria:

Patients with the following conditions were excluded from the study: Children with perforated tympanic membrane, otorrhoea in any ear, Down's syndrome, Cleft palate, congenital /acquired ear malformation, Children above 12 years and those whose parents/guardians refused to give their consent.

Ethical approval was obtained to conduct this study from the Health Research and Ethics Committee of the Lagos State University Teaching Hospital, Ikeja. The study was carried out in accordance with institutional guidelines, rules and regulations.

History and physical examination was done by the principal investigator and findings inputted in the patient preform. Ear wax, if any, was carefully removed and the status of the ear examined with an otoscope to ensure the patency of the tympanic membrane.

Tympanometry was carried out on both ears. This equipment used probe tone frequency of 226 Hz, a probe tone intensity of 85db \pm 1.5db, compliance range of 0.1ml to 0.6ml and a positive and negative pressure sweep. The test was performed on both ears by the investigator in the presence of a qualified audiologist in the department of ENT at LASUTH between +200 and - 400daPa.

All information obtained was collated with the aid of a proforma designed for the study.

Data was entered into Microsoft excel and analyzed using the Statistical Package for Social Sciences (SPSS) version 20.

3. Result

A total of 103 subjects who were clinically and radiologically diagnosed with adenoid hypertrophy participated in the study. Out of the 103 subjects, 59.2% (61) were males with a male to female ratio of 1:0.7. The age range of ≤ 3 was the most frequent at 39.8% (41) while 7-9 years was the least frequent at 21.4% (22). Among the major tribes in Nigeria, the Yoruba tribe was the most frequent ethnic group in the study with 59.2% (61) of the subjects while Hausa was the least at 1.9% (2). In terms of educational level, majority of the subjects were in Nursery school, accounting for 40.8% (42), while the Secondary school group was the least at 2.9% (3)

Preoperative Tympanometry Findings among Subjects (Right and Left Ear)

Among 206 ears (right and left) of the 103 subjects examined, a majority of 55.3% (57) of the right ear had Type A tympanometry while Type C tympanometry was the least frequent at 9.7% (10) in the right ear, figure 1. On the other hand, 54.4% (56) had Type A tympanometry of the left ear, while Type C tympanometry was also the least at 7.8% (8), figure 2. Type B tympanometry accounts for 35.0% (36) in the right ear and 37.9% (39) in the left ear.

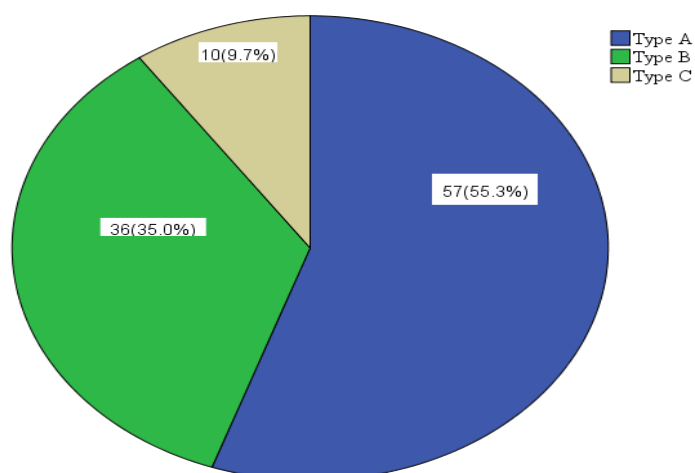


Fig I: Pre-operative Tympanometry findings among Adenoid patients in the right ear

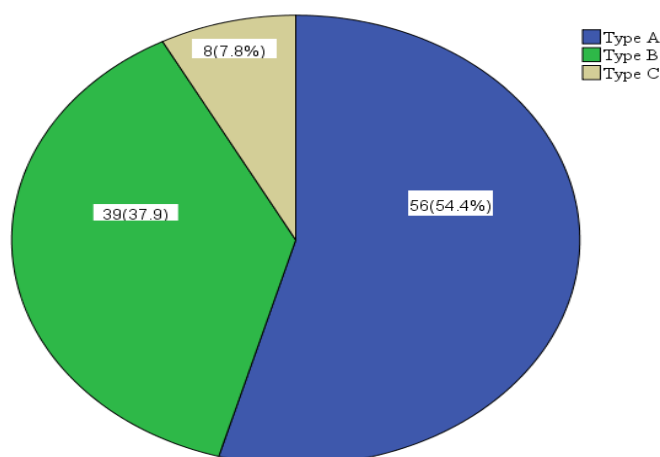


Fig II: Pre-operative Tympanometry findings among Adenoid patients in the left ear.

TABLE 1: Prevalence of Symptoms of Adenoidal Hypertrophy among Subjects

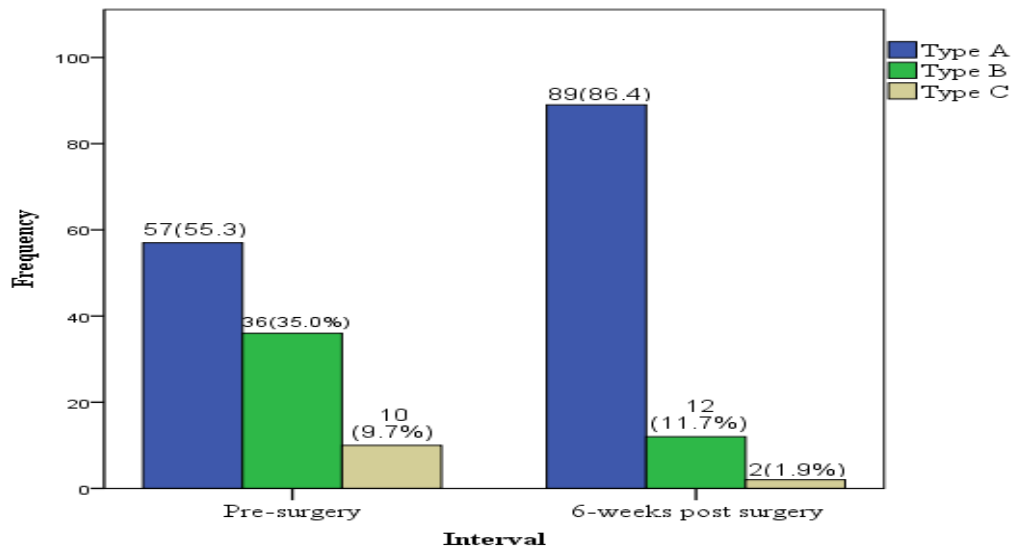
	Interval		p-value
	Pre-surgery (%)	Post-surgery (%)	
Snoring			p<0.001*
Yes	97(94.2)	28(27.2)	
No	6(5.8)	75(72.8)	
Mouth Breathing			p<0.001*
Yes	93(90.3)	36(35.0)	
No	10(9.7)	67(65.0)	
Frequent Catarrh			p<0.001*
Yes	86(83.5)	26(25.2)	
No	17(16.5)	77(74.8)	
Sleep Apnoea			p<0.001*
Yes	78(75.7)	27(26.2)	
No	25(24.3)	76(73.8)	
Daytime Somnolence			p<0.001*
Yes	32(31.1)	5(4.9)	
No	71(68.9)	98(95.1)	
Number of Symptoms			P<0.001*
Mean±SD	3.75±1.14	1.18±1.66	
Median	4	0	
Probability of having ≥1 symptoms	0.75	0.2	

TABLE 2: Comparison of Otoscope Findings Preoperatively and Postoperatively in the Right Ear

		Interval		p-value
		Pre surgery (%)	Post surgery (%)	
Tympanic membrane appearance	Normal	56(54.4)	83(80.6)	0.000*
	Abnormal	47(45.6)	20(19.4)	
	Dull and Retracted	53(51.5)	28(27.2)	0.000*
Common abnormal appearance in right ear (Multiple response)	Yellow/ Blue colour	6(5.8)	2(1.9)	0.149*
	Bulging	1(1.0)	3(2.9)	0.313
	Air-fluids level	0(0.0)	0(0.0)	NA
	Air bubbles	3(2.9)	0(0.0)	0.081

TABLE 3: Comparison of Otoscopic Findings Preoperatively and Postoperatively in the Left Ear

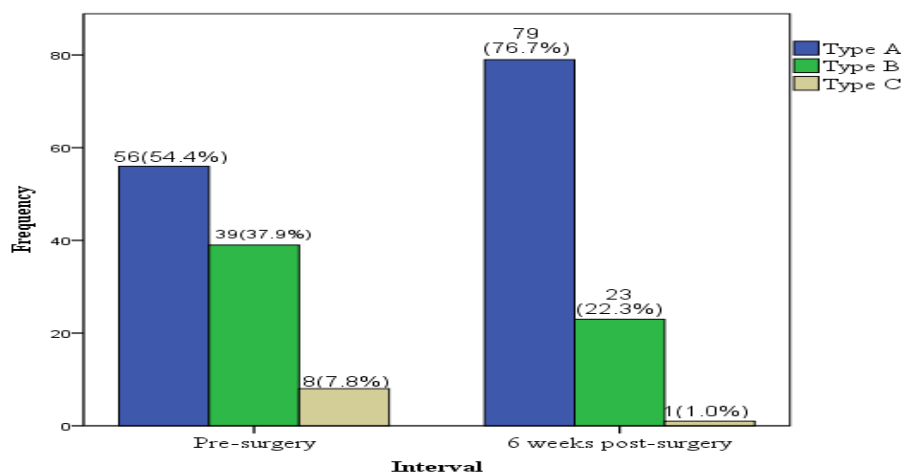
		Interval (%)		p-value
		Pre surgery	Post surgery	
Tympanic membrane appearance	Normal	64(62.1)	78(75.7)	0.035*
	Abnormal	39(37.9)	25(24.3)	
#Common abnormal appearance in left ear (Multiple response)	Dull and Retracted	36(35.0)	21(20.4)	0.019*
	Yellow/ Blue colour	6(5.8)	1(1.0)	0.055
	Bulging	3(2.9)	2(1.9)	0.651
	Air-fluids level	0(0.0)	0(0.0)	NA
	Air bubbles	0(0.0)	0(0.0)	NA



p = 0.002

FIGURE 4: Component Bar Chart Showing Comparison of Tympanometry Findings Preoperatively and Postoperatively in the Right Ear**Right Ear**

Out of 103 right ears examined, a majority, 55.3% (57) of the right ear had Type A tympanometry while Type C tympanometry was the least frequent at 9.7% (10), preoperatively. On the other hand, 86.4% (89) had Type A tympanogram, and 1.9% (2) tympanogram (the least seen) 6 weeks



p = 0.004

Component Bar Chart Showing Comparison of Tympanometry Findings Preoperatively and Postoperatively in the Left Ear

Comparison of Tympanometry Findings Preoperatively and Postoperatively in the Left Ear

Out of 103 left ears of the 103 subjects examined, a majority had Type A tympanometry at 54.4% (56) and the least frequent was Type C tympanometry was at 7.8% (8) preoperatively. Postoperatively, 76.7% (79) had Type A tympanogram, and the least seen was Type C tympanogram at 1.0% (1).

4. Discussion

The role of adenoid hypertrophy in the development of otitis media with effusion (OME) in young children has been reported in several studies^{6, 9, 10}. This study shows the prevalence of otitis media with effusion in patients diagnosed with adenoid hypertrophy when screened with tympanometry, ($p = 0.314$) with significant difference between preoperative and postoperative tympanometric findings.

There were 61 males (59.2%) and 42 females (40.8%) with male to female ratio 1:0.7, which is similar to a study done in 11 Bangladesh by Alam et al with a ratio of 1.6:1. A study by 10 Satish et al also reported a slight male preponderance when compared to females. 12 A similar study by Onotai et al had a higher male to female ratio of 1.9:1. This may be attributed to the duration of their study (2003- 2012). On the contrary, a study done by Eziyiet al²³ at Ile Ife among primary school children, reported a higher female ratio, which is at variance with this study. Manas et al in their own study reported a higher male to female preponderance, which is in agreement with this study.

The age prevalence was between ages 3 to 6, with mean age 4.40 ± 2.33 . The age of subject in my study is at variance with the studies done by 12 Onotai et al who reported the highest incidence in ages 3-5 and Aydin et al who noted higher prevalence in ages 5-7. Also, 13 Satish et al recorded a majority in age group 5-10, with a mean age of 7.48 years which is similar to the study by 14 Vogler et al. Both studies are at variance with this study.

Aydin et al reported a higher prevalence of 49.4% in primary school pupils aged 6-13 years in Brazil, whereas Santos reported a much higher prevalence of 66.4% in primary school children in Turkey. Both studies are at variance with the findings in this study.

In this study, the small family size and the middle socioeconomic class formed the largest group based on Oyedeji's classification. This is at variance with the study which revealed a higher prevalence in the lower socioeconomic class (4.5%), while the middle and upper socioeconomic classes were 2.0% and 1.2% respectively⁹. This variation might probably be because their own study was carried out in the suburbs of South Western Nigeria, while this study was done in Lagos, a cosmopolitan city. Several other studies reported a higher prevalence in the low socioeconomic class which is at variance with this study^{14, 15}.

11Symptoms like mouth breathing (80%), snoring (58.6%), nasal discharge (56.67%) and hearing impairment (53.33%). This is in agreement with the findings in this study.

Long term adenoidal enlargement can lead to ear diseases and chronic mouth breathing which may subsequently result in high arched palate^{16, 17} which is in tandem with the findings of this study.

The Otoscopy findings in both ears (pre and post-surgery) in this study is similar to the findings in the study by 13Satish et al. Otoscopy findings in support of OME in this study are lower than the study by Satish et al which may be due to the fact that not all ears affected with OME affected the tympanic membrane and the sensitivity and specificity of ordinary otoscopy (without pneumatic inflator) is on the lower side. The Agency for Healthcare Policy and Research in 1994, (now the Agency for Healthcare Research and Quality) corroborated this finding when it stated that only pneumatic otoscopy compares favorably with tympanometry in the diagnosis of OME^{18, 19}Kaleidal et al also suggested, based on their comparative studies, that adequate training on otoscopic skills is required before considering otoscopy as an independent entity in the diagnosis of OME.

In this study the overall prevalence of OME among the 103 subjects studied was 35.0% (36) in the right ear preoperatively with a significant improvement 6 weeks postoperatively to 11.7% (12), while 37.9% (39) and 22.3% (23) was recorded preoperatively and 6 weeks postoperatively in the left ear respectively. These differences in both ears were statistically significant. This may be due to improvement in the eustachian tube dysfunction. This study demonstrates that adenoid hypertrophy plays an important role in the aetiology or risk factor of OME occurrence. In a similar study done in Africa by 5Orji et al, it was found that of the 92 ears (46 patients) of children with adenoid obstruction, 35% (32 ears) presented with OME using type B tympanogram, whereas 7% (36 ears) of the 540 ears (270 children) in the control group were diagnosed with OME. Prevalence. These results varied because of the age ranges, risk factors, and sample sizes studied. Also affecting the results were the methods of diagnosis of OME (tympanometry, otoscopy, audiometry, or a combination of two or all) and the season when the study was conducted (winter or summer).

20Okolugbo et al found a prevalence of 8% in Nigerian urban population for children aged 5 and 6 years. Environmental factors such as urban versus rural setting, and population characteristics such as age, may determine the prevalence.

In this study, there was a significant difference in the tympanometry findings between preoperative and postoperative periods.

21Khayat et al only found two types of tympanogram, i.e type B 70% and type C 30%, which is at variance with this study. 5Orji et al in their study found type A in 43.47%, type B in 34.78% and type C in 21.73% in the study group, and type A 84%, type B 6.66% and type C 9.25% in the control group, which is similar to the findings of this study.

Reference

- 1) Brown G. Otitis media with effusion. In: Scott-Brown's Otolaryngology, Head and Neck Surg, 7th Ed, Edited by Micheal Gleeson, George G Browning, Martin J Burton, Ray Clarke, John Hibbert, Nicholas S Jones, Valerie J Lund, Linda M Luxon and John C Watkinson. Edward Arnold Publishers Ltd, London. 2008; 1(72):877-882
- 2) Al- Robbani AM, Karim AR. Effect of enlarged Adenoid on Middle Ear Function. *Dinajpur Med Col J*. 2013; 6(2):141-147
- 3) Aydin S, Sanli A, Celebi O, Tasdemir O, Paksoy M, Eken M, Hardal U, Emil A. Prevalence of adenoid hypertrophy and nocturnal enuresis in primary school children in Istanbul, Turkey. *Int J Pediatr Otorhinolaryngol*. 2008; 72(5):665-668
- 4) Santos RS, Cipolotti R, Gurgel RQ. School children submitted for nasal fiber optic examination at school: Finding and tolerance. *J Pediatr*. 2005; 81(6):443-444
- 5) Orji FT, Okolugbo NE, Ezeanolue BC. The role of obstruction in the pathogenesis of otitis media with effusion in Nigerian children. *Nig J Med*. 2010; 19:62-68
- 6) Gunel C, Ermisler, Basak HS. The effect of adenoid hypertrophy on tympanometric findings in children without hearing loss. *Journal of Ear, Nose and Throat*. 2013; 24.(6):334-338
- 7) Ren DD, Wang WQ. Assessment of middle ear effusion and audiological characteristics in young children with Adenoid hypertrophy. *Chinese medical journal*. 2012; 125(7):1276-1281
- 8) Cummings CW, Flint PW. Cummings otolaryngology head & neck, Fourth Edition, Mosby/ Elsevier. Philadelphia 2010
- 9) Eziyi JA, Amusa YB, Nwawolo C. The prevalence of nasal diseases in Nigerian school children. *Journal of Medicine and Medical Sci*. 2014; 5(4).71-77
- 10) Akinlade O, Nwawolo CC, Okeowo PA. Tympanometric screening for otitis media with effusion in Nigerian children aged 2-7 years. *Nig Quart Hosp Med*. 1998; 8(1):44-46
- 11) Alam MM, Ali MI, Habib MA, Siddique MA, Sanyal NP, Joarder AH. Otitis media with effusion in children admitted for adenoidectomy. *Mymensingh Med J*. 2015; 24(2):284-289
- 12) Onotai L, Lilly-Tariah OD. Adenoid and tonsil surgeries in children: How relevant is pre-operative blood grouping and cross matching? *Afr J Paediatr Surg* 2013; 10:231-234
- 13) Satish HS, Sarojamma, Anjan Kumar AN. A Study on role of Adenoidectomy in otitis media with effusion. *IOSR Journal of dental and medical sciences*. 2013; 4(6):20-24

- 14) Tomonaga K, Kurono Y, Chaen T, Mogi G. Adenoids and otitis media with effusion: nasopharyngeal flora. *Ann J Otolaryngol.* 1989;10(3):204-207
- 15) Coyte PC, Croxford R, Mclsaac W, Friedberg J. The role of adjuvant adenoidectomy and tonsillectomy in the outcome of the insertion of tympanostomy tubes. *N Engl J Med* 2001; 344:1188-1195
- 16) Engel J, Anteunis L, Chenault M, Marres E. Otoscopic findings in relation to tympanometry during infancy. *Eur Arch Otorhinolaryngol.* 2000; 257:366-371.
- 17) Yildirim N, Sahan M, Karsliglu Y. Adenoid hypertrophy in adult: clinical and morphological characteristics. *J Int Med Res.* 2008;36:157-162
- 18) Urshitz MS, Guerther A, Eggebrecht E, Wolff J, Urshitz-Duprat PM, Schlaud M, Poets CF. Snoring, intermittent hypoxia and academic performance in primary school children, *Am J Respir Crit Care Med.* 2003;168(4): 464-468
- 19) Kaleida PH, Ploof DL, Kur-Lasky M, Shaikh N, Colborn DK, Haralam MA, Ray S, Kearney D, Paradise JL, Hoberman A. Mastering diagnostic skills: Enhancing Proficiency in Otitis Media; a model for diagnostic skills training. *Pediatrics.* 2009;124(4):714-720
- 20) Okolugbo NE, Ugwu M. Prevalence of Secretory Otitis Media amongst Primary School Children in Benin City Nigeria. *Continental J. Medical Research.* 2009;3:12-15
- 21) Khayat FJ, Dabbagh LS. Incidence of otitis media with effusion in children with adenoid hypertrophy. *Zanco J. Med.Sci.* 2011;15:(2)