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ASSESSMENT OF THE SIZE OF ADENOIDS USING DIGITAL X-RAY LATERAL VIEW OF NASOPHARYNX AND CORRELATE THE ADENOIDAL NASOPHARYNGEAL RATIO WITH MIDDLE EAR FUNCTION MEASURED USING TYMPANOMETRY

Otolaryngology

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ABSTRACT

Background: The impact of infection and obstruction from tonsil and adenoid on the related anatomical structure like nose and paranasal sinus, Eustachian tube , and middle ear cleft are well established. Aim: To assess the size of adenoids in relation to nasopharyngeal space using digital X-ray lateral view of nasopharynx and correlate the Adenoidal Nasopharyngeal Ratio with middle ear function measured using tympanometry. **Materials And Methods:** This prospective study involves children reporting to the Department of ENT at CSSH, SVSU, Meerut. A total of 50 cases of clinically and radiologically diagnosed adenoid hypertrophy were studied and subjected to Tympanometry to assess middle ear function. **Results:** Our study shows that, as the Adenoidal Nasopharyngeal Ratio increases, the number of B-type and C-type Tympanogram were also increasing, correlating that the increase in adenoid size will have some pathological affect on middle ear. Conclusion: The digital X-ray Nasopharynx lateral view provides a reliable method for determining whether the adenoid hyperplasia is clinically significant or not. The children with significant pathological enlargement should be subjected to Tympanometry at the earliest to diagnose effects of adenoid hypertrophy over the Eustachian tube and in turn over the middle ear function.

KEYWORDS

Adenoid Hypertrophy, Adenoidal Nasopharyngeal Ratio, Tympanometry, Middle Ear Function.

INTRODUCTION:

Diseases of the adenoids and tonsils are among the most common problems seen by the Pediatricians and Otorhinolaryngologists in children. Recurrent Upper respiratory tract infection (URTI) affect the adenoids resulting in hyperplasia causing nasal obstruction, snoring, mouth breathing and hypo-nasal speech.[2]

The role of adenoid hypertrophy in Eustachian tube dysfunction has been much debated, the most commonly suggested mechanism being displacement of the Eustachian tube orifice rather than its mechanical obstruction. In children, the adenoids are invariably enlarged and there is little evidence to suggest that large adenoids are more frequently associated with otitis media with effusion than with normal ears.[3–6]

MATERIALS AND METHODS:

The study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery and Department of Radiology at Netaji Subhash Chandra Bose Subharti Medical College, Swami Vivekanand Subharti University, Meerut. The study was conducted between January 2017 to June 2018 (18 months).

Inclusion Criteria

1. Subjects with symptoms and signs of enlarged adenoids.
2. In age group of 5 years to 15years.

Exclusion Criteria

1. Subjects with perforation of tympanic membrane.
2. Patients with external auditory canal anomalies and disease.
3. Patients with cleft palate.
4. Patients with previous ear or palatal surgeries.

An informed consent was taken from all patients fulfilling the inclusion criteria. A detailed history with special emphasis on symptoms of enlarged adenoids including nasal obstruction which may be partial or complete leading to mouth breathing or snoring and nasal discharge (posterior or anterior) and symptoms of Eustachian tube obstruction like blocked feeling ears, impaired hearing, ear ache, tinnitus and associated throat complaints like swallowing difficulty and duration of said complaints.

A complete general physical and systemic and ENT examination was done.

Investigation for assessment of adenoidal size:

Soft tissue lateral digital radiograph of nasopharynx : It is a non-invasive procedure well tolerated by children, economical and easily performed. It helps to measure the volume of adenoid mass and extent to which nasopharyngeal air space is compromised. Picture is taken with child in erect position and head fixed in a wall- mounted cephalo stand and oriented in Frankfort horizontal plane. The exposure is made with 100 KV and 50 mA. The exposure time varies between 0.4 to 0.6 secs and the tube cassette distance is 180 cms. Two digital radiographical measurements are done. The adenoidal measurement represents the distance from the point of maximal convexity of the adenoid shadow anteroinferiorly to the anterior margin of the basiocciput. The nasopharyngeal measurement represents the distance between the posterior border of the hard palate and sphenobasiocciputsynchondrosis.

Investigation for Assessment of middle ear function: Impedance audiometry has been one of the major advancement in the field of otology and neuro-otology in recent times which provides a wide range of otological and neurological information about the nature and anatomical site of lesion.7 We used Impedance Audiometer AZ 26.

RESULTS:

A total of 50 cases of clinically and radiologically diagnosed adenoid hypertrophy were studied and subjected to tympanometry to asess in middle ear function. Following observations were made:

Table 1 shows that most of the patients belonged to the age group 5-7 yrs and 8-10 yrs i.e 16 patients (32%) each as compared to 8 (16%) and 10 (20%) patients in the age group11-13 yrs and 14-15 yrs respectively.

Table-1: Age Wise Distribution Of Cases

Age Group (Years)	No. Of Cases	Percentage(%)
5-7	16	32
8-10	16	32
11-13	8	16
14-15	10	20
Total	50	100

A total of 40 cases i.e. 80% were males and 10 cases i.e. 20% were

female (Table 2). The male:female ratio was found to be 4:1. Overall sex distribution showed male preponderance.

Table-2: Sex Wise Distribution Of Cases

Sex	No. Of Cases	Percentage(%)
Male	40	80
Female	10	20
Total	50	100

Table 3 shows that most of the cases presented with nasal obstruction 49 cases i.e, 98%, nasal discharge 35 cases i.e., 70%, and mouth breathing 46 cases i.e., 92%. Followed by snoring 43 cases i.e., 86%, hard of hearing 28 cases i.e., 56%, ear pain 2 cases i.e., 4%. Maximum number of patients presented with nasal complaints as compared to ear and throat complaints.

Table-3: Symptom Wise Distribution Of Cases

Chief Complaints	No. Of Patients	Percentage Of Patients (%)	Mean Duration Of Complaints (In Months)
Nasal Obstruction	49	98	14.4
Anterior Nasal Discharge	35	70	10.1
Post Nasal Discharge	22	44	6.95
Mouth Breathing	46	92	6.91
Snoring	43	86	6.51
Sleep Apnoea	2	4	6
Nocturnal Cough	0	0	0
Sore Throat	28	56	4.82
Swallowing Difficulty	27	54	4.19
Blocked Feeling Ears	27	54	4.56
Impaired Hearing	28	56	4.71
Tinnitus	1	2	6
Ear Ache	2	4	4
Headache	2	4	12

Most of the children (74%) were uncooperative for postnasal examination (Table 4). Adenoids were visualized in only 13 (26%) cases. The average age of cooperative children was 12.46 years.

Table-4: Post Nasal Examination

Post nasal examination	No. Of Cases	Percentage(%)
Adenoids Seen	13	26
Patient Uncooperative	37	74
Total	50	100

24 children i.e., 48% of the cases included in the study had adenoid facies (Table 5).

Table-5 Adenoid Facies

Adenoid Facies	No. Of Cases	Percentage (%)
Present	24	48
Absent	26	32
Total	50	100

Concomitant hypertrophied tonsils were seen in 40 cases (80%) in addition with 9 cases (18%) which were hypertrophied and congested (Table 6).

Table-6: Condition Of Tonsils

Tonsils	No. Of Cases	Percentage (%)
Hypertrophied	40	80
Hypertrophied And Congested	9	18
Normal	1	2
Total	50	100

Table 7 shows that 19% ears showed normal appearing tympanic membranes, 77% were showing characteristics of retracted eardrum and 4% ears showed air fluid level behind TM.

Table 7 : Tympanic Membrane Characteristics

Tympanic Membrane	Right Ear	Left Ear	Total
Normal	8	11	19
Retracted	39	38	77
Air Fluid Level Behind TM	3	1	4
Total	50	50	100

TUNING FORK TESTS

- 26 ears showed positive rinnie's test for frequencies 256, 512 and 1024 hz; 44 ears showed negative rinnie's for 256 hz but positive for 512 and 1024hz; 28 ears showed negative rinnie's test for frequencies 256 and 512 hz and positive for 1024 hz; and 2 ears showed negative rinnie for all three frequencies.
- 12 patients showed weber's to left, 25 to right and 13 central.
- All ears showed Absolute Bone Conduction not reduced except in 1 patient.

Table 8 shows that Adenoid-Nasopharyngeal Ratio (ANR) decreased from 0.734 to 0.633 with increase in age from 5 years to 15 years. The mean average ANR of 50 cases was calculated to be 0.696.

Table 8: Correlation Between Age And Adenoid-Nasopharyngeal Ratio (ANR)

Age (Years)	No. Of Cases	Average ANR
5 To 7	16	0.734
8 To 10	16	0.708
11 To 13	8	0.678
14 To 15	10	0.633
Total	50	0.696

Table 9 shows that 55% ears showed Type B tympanogram, 33% were Type C and 8% were Type A. Two patients showed bilateral As Type tympanogram.

Table 9 : Type Of Tympanogram

Type Of Tympanogram	No. Of Ears
Type A	8
Type As	4
Type B	55
Type C	33
Total	100

Table 10 shows Correlation of Adenoid-Nasopharyngeal Ratio with Type of Tympanogram. With AN Ratio between 0.701-0.800 maximum number of Type B (33) and Type C (15) Tympanogram were seen. With AN Ratio between 0.801-0.900 the Tympanogram was found to be of Type B bilaterally.

Table 10 : Correlation Of Adenoid-Nasopharyngeal Ratio (ANR) With Type Of Tympanogram

AN Ratio	No. Of Cases	No. Of Ears	Type A	Type As	Type B	Type C
0.501-0.600	5	10	4	0	1	5
0.601-0.700	19	38	4	2	19	13
0.701-0.800	25	50	0	2	33	15
0.801-0.900	1	2	0	0	2	0
Total	50	100	8	4	55	33

Average compliance in all ears was found to be 0.48 ml.(Table 11) and Average pressure in all ears was -205 daPa. (Table 11)

Table 11 : Mean Compliance & Mean Pressure

Number Of Ears	Mean Compliance (ml)	Mean Pressure
Right Ears (50)	0.41	-191 daPa
Left Ears (50)	0.55	-219 daPa
All Ears (100)	0.48	-205 daPa

DISCUSSION:

Age: Children aged 5 years to 15 years were considered in the study. But majority of the children were in the age group 5-7 years (32%) and 8-10 years (32%) in our study which is comparable to a recent study done by Febin James et al[8] where most prevalent age group was 5-7 years (34.78%) followed by 7-9 years (30.43%). Our study also correlates with the study done by Ajayan PV et al[9] where majority of children belonged to the age group 4-6 years (37.2%) which was followed by the 7-9 year group (31.4%).

Sex: In our study 40 cases were male children and 10 cases were female, with a ratio of **4 : 1** (M:F). Male children have more incidence due to male preponderance of childhood infection secondary to more exposure to infectious and allergic agents compared to female children. Our study is in accordance with a recent study done by Rajashekhar RP and Shinde VV[10] wherein out of 20 patients, 12 (60%) were male and 8 (40%) were female who had adenoid hypertrophy.

Our study is also comparable to the study carried out by Khayat F et al[11] for adenotonsillectomy which, with regard to gender distribution, revealed that 61.5% of patients with abnormal tympanometry were male and 38.5% were female. Our finding was also similar to the previous studies that showed male predominance for abnormal tympanometry over females. Both Yassan and Agidir showed that 60% of cases with abnormal tympanometry were males and the rest were females.[12,13]

Symptoms: In our study of 50 cases, most of the cases presented with nasal obstruction (n=49) 98%, nasal discharge (n=35) 70%, mouth breathing (n=46) 92% and snoring (n=43) 86%, a classical presentation of adenoid hypertrophy. Majority of the children presented with the nasal symptoms than aural symptoms indicating that the parents identify nasal symptoms easily compared to aural symptoms secondary to adenoids. Our study is in accordance with the study done by Ajayan PV et al[9] wherein these symptoms i.e., mouth breathing (97.1%), nasal obstruction (91.4%), nasal discharge (82.9%) and snoring (82.9%) were the predominant symptoms. Comparable to our study is a study of 50 patients (children) by James F et al[8], where most children presented with more than one symptom; 91.30% presented with mouth breathing and 86.95% presented with nasal obstruction, which were the commonest symptoms. Other symptoms were recurrent cold, snoring, ear block, suspected hard of hearing and recurrent sore throat. Larsen, P.L et al[14] in a study assessed the clinical symptoms of adenoid hypertrophy and found that nasal obstruction, mouth breathing and hyponasal speech were seen in 84-90 % of patients. Jeans W.D et al[15] in their study have confirmed the relationship of the adenoid size, nasopharyngeal size and symptoms of nasal obstruction. It has been confirmed that enlarged adenoid led to mouth breathing and associated with particular type of facial skeletal malformation.

Postnasal examination: In our study most of the children (74%) were uncooperative for postnasal examination as children are anxious, so it is clinically difficult in approaching the child for postnasal examination. All the children who were cooperative were usually above 8 years. Average age of co-operative children was 12.46 yrs. Young children are uncooperative that leads to difficult clinical evaluation of adenoid size by postnasal examination. Adenoid facies : 48% of the children in our study had features of adenoid facies which correlates well with the symptoms of adenoid hypertrophy. Tonsils : Concomitant involvement of tonsil was seen in 98% of cases indicating a common etiological factors acting on both adenoids and tonsils. Tympanic membrane : On Otoscopic examination Tympanic membrane (TM) appearance varied from 19% normal to 77% retracted and in 4% air fluid level behind TM. Our findings are in accordance with the study conducted on 35 children by Ajayan PV et al[9] in which adenoid facies were present in 91% of cases , tonsil was seen in 100% of cases and Otoscopic findings showed 78.5% having dull & retracted tympanic membrane. Change in colour of the tympanic membrane and air fluid level, each showed around 10% incidence.

Symptoms and signs depend not merely on the absolute size of the adenoid mass but are relative to the available space in the nasopharynx. The absolute size of the adenoids and the size and shape of the nasopharyngeal space are major factors that determines nasopharyngeal obstruction. The ratio of these two sizes, ADENOIDAL - NASOPHARYNGEAL RATIO (ANR) provides arithmetic measure of nasopharyngeal obstruction. The Adenoidal nasopharyngeal ratio reliably expresses the adenoidal size and the patency of the nasopharyngeal airway. In our study, Adenoidal nasopharyngeal ratio greater than 0.696 is subjectively judged to have enlarged adenoids.

In our study the Adenoidal nasopharyngeal ratio (ANR) is maximum at an average of 0.734 in age group of 5-7 years and 0.708 in 8-10 years, in whom the signs and symptoms of adenoid hypertrophy are more common. Adenoidal nasopharyngeal ratio gradually decreases to 0.678 in children of 11- 13 years of age and 0.633 in age group 14-15 years. The mean Adenoidal nasopharyngeal ratio (ANR) of our study is 0.696. Our present study correlates with the recent study of Kappadi et al[16] conducted on 75 children wherein adenoidal nasopharyngeal was found to be maximum at an average of 0.73091 in age group of 4-6 years and 0.70598 in 7-9 years, in whom the signs and symptoms of adenoid hypertrophy were more common and Adenoidal nasopharyngeal ratio gradually decreased to 0.60564 in children of 10-12 years of age. The mean Adenoidal nasopharyngeal ratio of the study was 0.70037. Our study is in concurrence with a case controlled study by Kurien M et al[17] which concluded that Adenoidal nasopharyngeal ratio measured on simple lateral skull radiography, correlated well with the clinical assessment and that for all practical purposes ANR greater than 0.73 may be considered indicative of pathological enlargement of the adenoids . According to the studies conducted by Elwany S[18] and Chien CY[19] the signs and symptoms of adenoid hypertrophy were found to be more severe in children with Adenoidal-nasopharyngeal ratio of more than 0.666 and should be considered as pathological enlargement of adenoid for all practical purposes. Our present study gives support to the concept that the ANR is a conventional and convenient radiological parameter for determining whether adenoid hypertrophy is clinically significant or not, rather than the size of adenoid or the size of the nasopharynx alone.

In our study we observed that most of the Tympanograms were type B (55%) indicating fluid in the middle ear, Type C Tympanogram was seen in 33% of cases indicating negative middle ear pressure secondary to Eustachian tube dysfunction, 8% Type A Tympanogram indicates normal middle ear and 4% Type As Tympanogram were seen. A recent study by Rajashekhar RP and Shinde VV[10] in which out of all 20 patients with adenoid hypertrophy who underwent adenoidectomy, Type B Tympanogram was seen in 30% ears, Type C Tympanogram was seen in 20% ears and Type A Tympanogram was seen in 30% ears. Prevalence of Type B tympanogram was found to be more in our study.

Correlating Adenoidal-Nasopharyngeal Ratio (ANR) with type of Tympanogram:

In our present study of 50 patients (100 ears), maximum number of type B Tympanogram (33) were seen in the ANR of 0.701-0.800 followed by 19 type B Tympanogram in ANR 0.601-0.700. Maximum number of type C Tympanogram (35) were seen in the ANR of 0.701-0.800 followed by 13 type B Tympanogram in ANR 0.601-0.700. Our study shows that the maximum number of pathological Tympanograms were seen in the ANR between 0.601-0.700 and 0.701-0.800 and shows a positive correlation between ANR and type of Tympanogram. In our study, Tympanograms showed reduced compliance (average compliance was 0.48 ml) and increased negative pressure in the middle ear (average middle ear pressure was -205 daPa). Our study also shows that, as the ANR increases, the number of B type and C type Tympanogram were also increasing, correlating that the increase in adenoid size will have some pathological affect on middle ear.

Our study correlates with the study of Egeli E et al[7] which shows maximum number of Type B and Type C Tympanogram in the Adenoidal nasopharyngeal ratio (ANR) between 0.701-0.800, indicating middle ear effusion and negative middle ear pressure. In their study they showed that negative middle ear pressure was related to Eustachian tube dysfunction resulting from enlargement of adenoids with ANR greater than 0.710 and that middle ear pressures were found lower in children with ANR greater than 0.71 than in children with ANR less than 0.71.

CONCLUSION:

The inferences drawn from our present study were:

- The digital X-ray Nasopharynx lateral view provides a reliable method for determining whether the adenoid hyperplasia is clinically significant or not.
- The effects of adenoid hypertrophy on the surrounding depends not merely on the absolute size of the adenoid mass but are relative to the available space in the nasopharynx - Adenoidal-Nasopharyngeal Ratio (ANR).
- Since the clinical examination with post nasal mirror in children is difficult and unreliable, the imaging technique like digital X-ray Nasopharynx lateral view gives a measure of the absolute size of the adenoids and nasopharynx and thereby Adenoidal-Nasopharyngeal Ratio (ANR) which gives a significant relationship.
- The adenoid with Adenoidal-Nasopharyngeal Ratio (ANR) more than 0.696 is considered as significant pathological enlargement for all practical purposes.
- Tympanometry is a basic, easily available, affordable, very sensitive OPD investigative procedure to find out the compliance and pressure changes in middle ear and conductive hearing loss.
- The children with adenoid hypertrophy revealed by digital X- ray Nasopharynx should be subjected to Tympanometry at the earliest to diagnose effects of adenoid hypertrophy over the Eustachian

tube and in turn over the middle ear function.

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