

Correlation Between Radiological and Endoscopic Grading of Adenoid Hypertrophy in Children: A Prospective Observational Study

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Abstract

Background: Adenoid hypertrophy is a common cause of nasal obstruction in children. While clinical evaluation of palatine tonsils is straightforward, assessment of adenoid size is challenging due to its location in the nasopharynx^{15,16}. Both radiological and endoscopic methods are commonly used, but their correlation remains debated. The objective is to evaluate the relationship between radiological grading (Adenoid–Nasopharyngeal Ratio) and endoscopic grading of adenoid hypertrophy in children. **Material and Methods:** This prospective observational study was conducted in the Department of ENT at Pushpagiri Institute of Medical Sciences, Thiruvalla, over a period of 1.5 years. A total of 66 children aged 4–14 years with symptoms of adenoid hypertrophy were included. All patients underwent lateral nasopharyngeal X-ray (graded using Fujioka method)²⁵ and diagnostic nasal endoscopy (graded using Clemens classification)²⁷. Correlation and agreement between the two methods were analyzed statistically. **Results:** The mean age was 7.14 ± 2.46 years, with male predominance (66.7%). The most common symptoms were snoring and mouth breathing (100%). The mean Adenoid–Nasopharyngeal Ratio (ANR) was 0.76 ± 0.10 . Grade IV adenoids were most common in both radiological (57.6%) and endoscopic (57.6%) assessments. A strong positive correlation ($r = 0.98$, $p < 0.01$) was observed between ANR and endoscopic grading. Kappa agreement between the two methods was 85%. **Conclusion:** There is a strong correlation between radiological and endoscopic grading of adenoid hypertrophy. Lateral nasopharyngeal X-ray, being non-invasive and cost-effective, can serve as a reliable alternative in settings where endoscopy is not feasible.

Keywords: Adenoid hypertrophy, nasopharyngeal X-ray, nasal endoscopy, ANR, pediatric ENT.

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INTRODUCTION

Adenoid hypertrophy is one of the most common causes of upper airway obstruction in the pediatric population. It is frequently associated with symptoms such as nasal obstruction, mouth breathing, snoring, and hearing impairment.^[1-5]

Unlike palatine tonsils, which can be easily examined clinically, adenoids are located in the nasopharynx and are not directly visible. This makes their assessment challenging. Various diagnostic modalities have been developed, including lateral nasopharyngeal radiography and nasal endoscopy.^[6-13]

Radiographic evaluation using the Adenoid–Nasopharyngeal Ratio (ANR) is widely used due to its simplicity and non-invasive nature. On the other hand, nasal endoscopy provides a direct, three-dimensional view of the adenoids and surrounding structures, making it more accurate but invasive.^[14-20]

Despite widespread use of both techniques, there is variability in their correlation across studies. This study aims to evaluate the relationship between radiological and endoscopic grading of adenoid hypertrophy in children.^[21-27]

Objectives

- To assess adenoid size using lateral nasopharyngeal X-ray.

- To assess adenoid size using diagnostic nasal endoscopy.
- To determine the correlation between radiological and endoscopic grading.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational study conducted in the Department of ENT at Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla. Study was conducted for a period of one and half years after institutional ethics committee approval. A total of 66 children aged 4–14 years diagnosed with adenoid hypertrophy and scheduled for adenoidectomy was selected as the study population

Inclusion Criteria

- Children aged 4–14 years
- Both genders

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- Symptoms suggestive of adenoid hypertrophy

Exclusion Criteria

- Previous nasal surgery
- Structural nasal anomalies (e.g., choanal atresia, septal deviation)
- Cleft palate
- Chronic rhinosinusitis with nasal polyps

Data Collection Methods

- Informed consent obtained from parents
- Lateral nasopharyngeal X-ray (Fujioka grading).^[25]
- Diagnostic nasal endoscopy under sedation (Clemens grading).^[227]

Sample Size: In a study conducted by Pathak et al comparing radiological and endoscopic assessment of adenoid tissue in patients of chronic adenoiditis, there was agreement between both the methods of assessment in 78% of cases¹.

Using this data, minimum sample size required for the current study is calculated using the formula

$$N = \frac{Z_a^2 PQ}{d^2}$$

Z_a = Z value of α error at 5% = 1.96

P = Prevalence of agreement = 78% = 0.78

Q = 1 - P = 1 - 0.78 = 0.22

d = absolute precision = 10%

$$n = \frac{(1.96)^2 \times 0.78 \times 0.22}{(0.10)^2} = 66$$

Hence this study will be conducted in a minimum of 66 cases with adenoid hypertrophy

Statistical Analysis

Study procedure

- The adenoid to nasopharyngeal ratio (ANR) calculated from all images by dividing AD with ND. Value was documented in percentage by multiplying with 100. Based on ANR categorized to 4 groups.
 - a) Group X0 0-25%
 - b) Group X1 25-50%
 - c) Group X2 50-75%
 - d) Group X3 75-100%
- Endoscopic evaluation done per operative in children with rigid endoscope. Images are analysed using photo editing tools and categorized into 4 grades [Clemens]
 - a) Grade I - None less than 25% of scarce tissue at the choanal opening.
 - b) Grade II -Mild more than 25% but less than 50% of obstruction confined to the upper half of nasopharynx cavity with a patent choanae.
 - c) Grade III- Moderate more than 50 % but less than 75% obstruction with free airway only in inferior area
 - d) Grade IV- Severe more than 75% or practically complete obstruction
- The two grading systems are then compared.

Plan of Analysis: Data will be properly coded and entered in Microsoft excel and will be analyzed using statistical software SPSS Version 25. Qualitative variables will be summarized as percentages and for quantitative variables mean with standard deviation will be calculated. Proportion of cases with agreement between the two methods of assessment will be calculated. The agreement between

Radiological and Endoscopic assessments will be further evaluated using Kappa statistics. Significance level will be set a p value less than 0.05.

RESULTS

A total of 66 children were included in the study. The age ranged from 2 to 14 years, with a mean age of 7.14 ± 2.46 years. The majority of patients (54.5%) belonged to the 5.1–8 years age group, followed by 22.7% in the <5 years group, 16.7% in the 8.1–11 years group, and 6.1% in the 11.1–14 years group. There was a male predominance, with 44 (66.7%) males and 22 (33.3%) females.

Among the study population, 27 children (40.9%) exhibited adenoid facies, while 39 (59.1%) did not. Nasal obstruction was present in 59 children (89.4%), making it one of the most common presenting complaints. Ear-related symptoms included earache in 15 children (22.7%) and hearing deficit in 23 children (34.8%). On otoscopic examination, the tympanic membrane was normal in 51 children (77.3%), dull and retracted in 11 (16.7%), and dull and bulging in 4 (6.1%).

The mean adenoid depth measured on lateral nasopharyngeal X-ray was 18.47 ± 3.89 mm (range: 11.7–27.5 mm). The mean nasopharyngeal depth was 24.21 ± 3.95 mm (range: 16.4–33.2 mm). The mean Adenoid–Nasopharyngeal Ratio (ANR) was 0.76 ± 0.10 (range: 0.5–1.0). Based on ANR grading Grade IV: 38 patients (57.6%), Grade III: 27 patients (40.9%), Grade II: 1 patient (1.5%)

Endoscopic evaluation showed a mean adenoid size score of 78.48 ± 11.09 (range: 50–95). The distribution based on endoscopic grading was as follows Grade IV: 38 patients (57.6%), Grade III: 26 patients (39.4%), Grade II: 2 patients (3.0%)

Agreement Between Radiological and Endoscopic Grading

There was a high level of agreement between radiological grading (ANR) and endoscopic findings. Among patients classified as Grade IV by ANR (n = 38), 36 (94.7%) were also classified as Grade IV on endoscopy. Similarly, among Grade III patients (n = 27), 24 (88.9%) corresponded to Grade III on endoscopy.

The single patient classified as Grade II by ANR was also graded as Grade II on endoscopy.

Kappa statistics demonstrated 85% agreement between the two modalities, indicating strong concordance ($p < 0.01$).

Correlation Analysis

A very strong positive correlation was observed between ANR and endoscopic grading, with a correlation coefficient of $r = 0.98$, which was statistically significant ($p < 0.01$).

Association Between ANR and Endoscopic Grading

The association between ANR grading and endoscopic grading was statistically significant (Fisher's Exact test = 63.07, $p < 0.01$), indicating a strong relationship between the two diagnostic methods.

Key Findings

- Majority of patients were aged 5–8 years with male predominance
- Nasal obstruction was present in 89.4% of cases
- Grade IV adenoid hypertrophy was most common in both methods

- Strong agreement between X-ray and endoscopy (kappa = 0.85)
- Very strong correlation between ANR and endoscopy (r = 0.98).

Table 1: Age distribution of the study population (n = 66)

Age group (years)	Frequency (n)	Percentage (%)
<5	15	22.7
5.1–8	36	54.5
8.1–11	11	16.7
11.1–14	4	6.1
Total	66	100

Mean age $\pm$ SD: 7.14 $\pm$ 2.46 years (range: 2–14 years)

Table 2: Gender distribution of the study population (n = 66)

Gender	Frequency (n)	Percentage (%)
Male	44	66.7
Female	22	33.3
Total	66	100

Table 3: Distribution based on adenoid facies (n = 66)

Adenoid facies	Frequency (n)	Percentage (%)
Present	27	40.9
Absent	39	59.1
Total	66	100

Table 4: Distribution based on nasal obstruction (n = 66)

Nasal obstruction	Frequency (n)	Percentage (%)
Present	59	89.4
Absent	7	10.6
Total	66	100

Table 5: Distribution based on earache (n = 66)

Earache	Frequency (n)	Percentage (%)
Present	15	22.7
Absent	51	77.3
Total	66	100

Table 6: Distribution based on hearing deficit (n = 66)

Hearing deficit	Frequency (n)	Percentage (%)
Present	23	34.8
Absent	43	65.2
Total	66	100

Table 7: Tympanic membrane findings (n = 66)

Tympanic membrane appearance	Frequency (n)	Percentage (%)
Normal	51	77.3
Dull and retracted	11	16.7
Dull and bulging	4	6.1
Total	66	100

Table 8: Adenoid depth measured by X-ray (mm)

Parameter	Value
Minimum	11.7
Maximum	27.5
Mean $\pm$ SD	18.47 $\pm$ 3.89

Table 9: Nasopharyngeal depth measured by X-ray (mm)

Parameter	Value
Minimum	16.4
Maximum	33.2
Mean $\pm$ SD	24.21 $\pm$ 3.95

Table 10: Adenoid–Nasopharyngeal Ratio (ANR) grading (n = 66)

ANR Grade	Frequency (n)	Percentage (%)
Grade II	1	1.5

Grade III	27	40.9
Grade IV	38	57.6
Total	66	100

Mean ANR $\pm$ SD: 0.76 $\pm$ 0.10 (range: 0.5–1.0)

Table 11: Endoscopic grading of adenoid hypertrophy (n = 66)

Endoscopic Grade	Frequency (n)	Percentage (%)
Grade II	2	3.0
Grade III	26	39.4
Grade IV	38	57.6
Total	66	100

Mean score $\pm$ SD: 78.48 $\pm$ 11.09 (range: 50–95)

Table 12: Agreement between ANR grading and endoscopic grading (n = 66)

ANR Grade	Endoscopy Grade II	Endoscopy Grade III	Endoscopy Grade IV	Total
Grade II	1 (100%)	0 (0%)	0 (0%)	1
Grade III	1 (3.7%)	24 (88.9%)	2 (7.4%)	27
Grade IV	0 (0%)	2 (5.3%)	36 (94.7%)	38
Total	2	26	38	66

Kappa value: 0.85. p-value: <0.01

Table 13: Correlation between ANR and endoscopic grading (n = 66)

Parameter	Value
Correlation coefficient (r)	0.98
p-value	<0.01

Table 14: Association between ANR and endoscopic grading (Fisher's Exact Test)

Test	Value
Fisher's Exact value	63.07
p-value	<0.01

DISCUSSION

The present study demonstrates a strong correlation between radiological and endoscopic grading of adenoid hypertrophy. The majority of patients were in the younger age group, consistent with previous studies.^[1-13]

Male predominance observed in this study aligns with findings by multiple authors. The most common symptoms—snoring and mouth breathing—were universally present, reinforcing their diagnostic importance.^[2,5,7]

Radiological and endoscopic grading showed similar distribution patterns, particularly in higher grades.^[4,10] The strong correlation ($r = 0.98$) observed in this study is higher than that reported in some previous studies, suggesting good reliability of radiographic assessment.

However, some studies have reported discrepancies, particularly in mid-range grades, where radiographs may overestimate or underestimate severity. Despite this, the high kappa agreement (85%) in the present study indicates substantial agreement between the two methods.

CONCLUSION

Diagnostic nasal endoscopy remains the gold standard for assessing adenoid size due to its direct visualization and accuracy.^[1] However, it is invasive and may not always be feasible.²⁷

Lateral nasopharyngeal X-ray is a simple, non-invasive, and cost-effective alternative.^[25] Given the strong correlation and high agreement observed, it can be reliably used in clinical practice, especially in resource-limited settings.

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Conflicts of interest

There are no conflicts of interest.

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