Lateral Neck Radiography versus Direct Video Rhinoscopy in Assessing Adenoid Size

Alex Mlynarek, MD, Marc A. Tewfik, MD, Abdulrahman Hagr, MD, John J. Manoukian, MD, FRCSC, FRAC, Melvin D. Schloss, MD, FRCSC, Ted L. Tewfik, MD, FRCSC, and Jeanne Choi-Rosen, MD

Abstract

Objective: To evaluate the usefulness of adynamic lateral neck radiographs and dynamic video rhinoscopy in assessing adenoid size and the relationship of these methods to associated symptoms and thus the severity of the disease.

Methods: Children with suspected adenoid hypertrophy underwent standard lateral neck soft tissue radiographs: the percentage of airway occlusion, adenoid to nasopharynx (AN) ratio, airway to soft palate ratio, and adenoid thickness were assessed by a radiologist. The percentage of airway closure was assessed by direct fibre-optic rhinoscopy in an ear, nose, and throat clinic. Associated clinical symptoms were assessed by parents using a standardized questionnaire, evaluating the severity of symptoms (snoring, sleep apnea, mouth breathing, and otitis media) to give a total symptom score out of 16.

Results: Nonparametric statistical analysis using Spearman’s correlation coefficients was performed on 32 patients. There was a weak correlation, which approaches significance, between the percentage of airway occlusion assessed by fibre-optic rhinoscopy and the total symptom score ($r = .344, p = .054$). However, this correlation becomes significant when the frequency of otitis media is omitted ($r = .367, p = .039$). There was also a significant correlation between airway occlusion assessed by rhinoscopy and the percentage of airway occlusion as determined by lateral neck radiography ($r = .431, p = .014$). There was no correlation between any of the measurements taken by lateral soft tissue neck radiography and total symptom score.

Conclusion: Dynamic video rhinoscopy is more accurate at assessing adenoid hypertrophy, and the percentage of airway occlusion, as estimated by video rhinoscopy, is better correlated to the severity of symptoms than are values obtained by lateral neck radiography.

Key words: adenoid hypertrophy, children, radiography, rhinoscopy, symptom score

Received 06/18/03. Received revised 12/04/03. Accepted for publication 12/08/03.

Address reprint requests to: Dr. John J. Manoukian, Department of Otolaryngology–Head and Neck Surgery, Montreal Children’s Hospital, 2300 Tupper, Suite B-240, Montreal, QC H3H 1P3.
The adenoid, or nasopharyngeal tonsil, is a triangular lymphoepithelial organ situated on the posterior and superior wall of the nasopharynx. Diseases and hypertrophy of this organ are among the most common health problems affecting the pediatric population, and adenoidectomy is one of the most frequently performed procedures. Nasopharyngeal obstruction resulting from adenoidal hypertrophy is associated with sinusitis, speech defects, snoring, sleep apnea, and abnormal facial development.1–3 Furthermore, enlarged adenoids play a role in the pathogenesis of chronic otitis media with effusion.

When adenoidectomy is being considered, the diagnosis and documentation of adenoidal hypertrophy become an important issue. Numerous modalities have been used for this task, including transoral digital palpation and transoral mirror examination; however, these methods are quite impractical with uncooperative younger children. Lateral radiographs of the neck have been a popular alternative owing to their ease of performance. Yet lateral neck films are limited by the two-dimensional representation of a three-dimensional space and by reliability in demonstrating small amounts of obstructing adenoid tissue or stasis of mucous secretions (from functionally significant but not totally obstructing adenoids) blocking the posterior choanae. Improper positioning or poor patient cooperation can affect the results of the radiograph.4,5 Many methods for evaluating lateral soft tissue neck radiographs are described,6–8 but there is no generally accepted standard.

Assessment of the nasopharynx and adenoids by fibre-optic examination bears the advantage of direct visualization of the postnasal space. In addition, previous studies have demonstrated that adenoid size, as determined by rhinoscopy, was well correlated with clinical symptoms such as nasal obstruction and snoring.9–11 The aim of this study was to compare the effectiveness of adynamic lateral neck radiography, as measured by various described methods, and dynamic video rhinoscopy in assessing adenoid size and the relationship of these modalities to associated symptoms and, thus, the severity of the disease. We hypothesize that dynamic video rhinoscopy is the more reliable method of assessing adenoid hypertrophy and that the percentage of airway occlusion as estimated by video rhinoscopy is better correlated to the severity of symptoms than are values obtained by lateral neck radiography.

Materials and Methods

Patients
Children of any age presenting to the Montreal Children’s Hospital (MCH) ear, nose, and throat (ENT) clinic between July and November 2001 and being considered for adenoidectomy were eligible for the study. The majority of the children were between the ages of 1 and 8 years; however, older children were also included in the study (Figure 1). These patients generally complained of symptoms relating to nasal obstruction, including mouth breathing and snoring, as well as recurrent otitis media. Children with acute upper respiratory tract infections associated with fever were excluded. All parents gave consent for participation in this study and were present at the examination of their child.

Radiography
All patients in the study underwent standard lateral soft tissue neck radiography in the Radiology Department of the MCH. The radiographs were obtained with the children in the supine position and their neck slightly extended. Using a Siemens MULTIX machine (Siemens Medical Solutions USA, Inc., 51 Valley Stream Parkway, Malvern, PA 19355, United States), the x-ray field was collimated to the nasopharynx, with a focus film distance of 40 inches, using average exposure factors of 60 kV and 3.2 milliAmpere-seconds (mAs).

The films were then assessed by the same pediatric radiologist, according to previously described methods (Figure 2):

1. Adenoid thickness, described by Johannesson,8 is defined as the distance along a perpendicular line from the pharyngeal tubercle on the base of the skull to the adenoidal convexity.
2. The airway to soft palate ratio, described by Cohen and Konak,6 is a comparison between the width of the airway immediately behind the upper part of the soft palate and the width of the soft palate 1 cm below the hard palate.
3. The adenoid to nasopharynx ratio, proposed by Fujioka and colleagues,7 is defined as the ratio between the adenoid thickness as described by Johannesson8 and the distance along a line from the posterior-superior edge of the hard palate to the sphenopetrosal synchondrosis on the base of the skull.

![Figure 1](image-url) Age distribution of the study cohort.
4. The percentage of airway occlusion as measured on the lateral neck soft tissue radiographs (LNXR), which was measured as the ratio between the adenoid thickness as described by Johanneson8 and the distance from the pharyngeal tubercle on the base of the skull to the superior surface of the soft palate.

Fibre-optic Video Rhinoscopy
The nasopharynx was directly visualized in the ENT clinic by inserting a flexible 3.5 mm Olympus (Olympus America Inc., Melville, NY) ENF-P4 endoscope along the floor of the nose of the unsedated child. Local anesthesia was achieved using a topical solution composed of 4% xylocaine. To determine the degree of airway obstruction, the camera was advanced until a satisfactory view of the adenoid tissue was obtained and positioned in such a manner that all margins of the choanae could be seen within the viewing field (Figure 3). The images were recorded onto VHS, and the percentage of airway obstruction in the postnasal space was later assessed separately by two independent otolaryngologists, with the calculated average used for comparison. There was a 92% agreement between the two otolaryngologists. The remaining 8% were reviewed, and a consensus was reached.

Symptom Score
The degree of associated clinical symptoms was evaluated by the parents in the ENT clinic using a modified standardized questionnaire employed in the sleep apnea

Figure 2 Methods of assessing adenoid enlargement on lateral neck radiography. A, Adenoid to nasopharynx ratio, as described by Fujikawa and colleagues5; B, airway to soft palate ratio, as described by Cohen and Konak6; C, adenoid thickness, as described by Johanneson8; D, percentage of airway occlusion, measured as the ratio of adenoid thickness and the distance from the pharyngeal tubercle to the superior surface of the soft palate.
Each of the four symptoms of snoring, sleep apnea, mouth breathing, and otitis media is given a score out of 4 based on its severity:

1. The symptom of snoring was assigned a value as follows: (1) absent; (2) mild: one or two nights per week, only heard from within the bedroom, during a quarter or less of the night; (3) moderate: three to five nights per week, can be heard from the next room, during up to half of the night; (4) severe: six or seven nights per week, can be heard from two rooms away, during over three-quarters of the night.
2. The symptom of nasal obstruction was assigned a value according to the frequency of observed mouth breathing as follows: (1) absent; (2) one-quarter to half of the day; (3) half to three-quarters of the day; (4) three-quarters to all of the day.
3. The symptom of sleep apnea was assigned a value according to the frequency of observed apneas or restless sleep as follows: (1) absent; (2) during one or two nights per week; (3) during three to five nights per week; (4) during six or seven nights per week.
4. The frequency of episodes of acute otitis media in the past 2 years was assigned a value as follows: (1) none; (2) one to three episodes per year; (3) four to six episodes per year; (4) greater than six episodes per year.

Each of these values was then added together to give a total symptom score out of 16; symptom scores out of 9, for which the frequency of acute otitis media was omitted, were also calculated and used in comparisons.

Statistical Analysis
All statistical tests were carried out two-tailed at the 5% level of significance. Correlations were calculated using Spearman’s rank coefficient rho for nonparametric variables on SPSS for Windows, version 11.0.1 (SPSS Inc., Chicago, IL).

Results
Thirty-nine patients were evaluated by video rhinoscopy in the ENT clinic, and seven of these were excluded for lack of radiographic data. The remaining 32 patients were composed of 24 (75%) boys and 8 (25%) girls, with an age distribution as presented in Figure 1.

Relationship between Fibre-optic Rhinoscopy and Symptom Scores
The results of the endoscopically assessed percentage of airway obstruction caused by adenoids in the postnasal space were compared with symptomatology scores (Table 1). The Spearman’s rank correlation coefficient rho equalled .344 ($p = .054$), which demonstrates a slight correlation approaching significance when looking at the total symptom score as calculated above. However, this coefficient rises to .367 ($p = .039$), demonstrating a significant correlation, when the frequency of acute otitis media is omitted from the symptom score (not shown in the table).

Relationship between Radiography and Symptom Scores
Various previously described methods for the radiologic assessments of airway obstruction caused by adenoids were compared with symptomatology scores, the results of which are summarized in Table 1.

The percentage of airway occlusion as determined from LNXR was the radiologic measurement most highly correlated with clinical symptoms. The Spearman’s rank correlation coefficient rho for this measurement was equal to .241 ($p = .184$). Alternatively, the airway to soft palate ratio, as well as measurement of adenoid thickness, showed no significant correlations. Surprisingly, the adenoid to nasopharynx ratio is the radiologic measurement that was least correlated to the total symptom score (rho = −.073, $p = .69$).

Relationship between Radiography and Fibre-optic Rhinoscopy
Finally, radiologic measurements were compared with the results of endoscopic assessment. By using statisti-
cal methods similar to those above, the percentage of airway occlusion as determined by LNXR was highly correlated with the findings on fibre-optic rhinoscopy, with a Spearman’s rho coefficient equal to .431 \((p = .014)\). Comparison of the adenoid to nasopharynx ratio\(^7\) and endoscopic measurements failed to demonstrate a significant correlation (rho = .312, \(p = .082\)).

**Discussion**

Adenoidectomy continues to be one of the most common surgical procedures performed in the pediatric population. However, there are no universal guidelines for assessing adenoidal enlargement, and there are no clearly accepted indications for adenoidectomy.\(^{13}\) Three modalities continue to be widely used by physicians in the assessment of adenoid hypertrophy: clinical symptoms, lateral neck radiography, and endoscopy. Clinical symptoms of nasal obstruction, mouth breathing, snoring, sleep apnea, and otitis media are considered by many physicians as primary indicators for the severity of adenoidal enlargement and have been a primary focus of many studies.\(^{1–3}\) It is always difficult to compare subjective data, such as clinical symptoms, with objective data, such as radiographic or endoscopic measurements. Therefore, there is usually a poor correlation between the two, as was the case in our study. Nevertheless, in the case of adenoid enlargement, it is essential to make such comparisons to reach the best possible decisions on patient management.

Soft tissue lateral neck radiographs have also been studied in the assessment of adenoid size and airway patency. Many different methods have been described in the evaluation of adenoids on lateral neck radiographs. The most frequently used methods include measuring adenoid thickness,\(^8\) airway to soft palate ratio,\(^6\) and adenoid to nasopharynx ratio\(^7\) (see Figure 2). The measurement of the adenoid to nasopharynx ratio is the method most studied in the literature, and the correlation between the adenoid to nasopharynx ratio, adenoid enlargement, and clinical symptoms is still very controversial. Some studies show a weak correlation between the adenoid to nasopharynx ratio and adenoid enlargement,\(^{14–17}\) whereas others demonstrate a poor correlation between the adenoid to nasopharynx ratio, adenoid enlargement, and clinical symptoms.\(^{18–20}\)

Fibre-optic examination of the nasal cavity and the nasopharynx is also emerging as a useful tool in the estimation of adenoid enlargement. Studies suggest that this method is more accurate and correlates better with the severity of the disease than does lateral neck radiography.\(^9–11\)

The objective of our study was to evaluate these different modes of assessing adenoidal size and assess the relationship between these methods and the associated symptoms. In addition to the three most common methods of examining the lateral neck radiographs (adenoid to nasopharynx ratio, airway to soft palate ratio, and adenoid thickness), we also studied a previously unpublished method that involves measuring the percentage of airway occlusion. The usefulness of these techniques in the evaluation of adenoid size was compared with that of fibre-optic rhinoscopy. Our results show that there is a weak but significant correlation between the percentage of airway occlusion assessed by fibre-optic rhinoscopy and the total symptom score, as well as a weak correlation that approaches significance between airway occlusion assessed by rhinoscopy and the adenoid to nasopharynx ratio determined by lateral neck radiography. We also found no correlation between any of the measurements taken by lateral soft tissue neck radiography and the clinical symptoms.

Our study shows that video rhinoscopy is more accurate than lateral neck radiography at assessing adenoid size and predicting the severity of the disease. The dynamic nature of rhinoscopy, as well as the direct visualization of the postnasal space, gives this method a clear advantage over adynamic radiography. Changes in the patient’s position, as well as the type of breathing at the time of radiography, have a marked effect on the appearance of the nasopharyngeal soft tissues (Figure 4).\(^4\) Therefore, two-dimensional radiographs can be very inaccurate in the assessment of adenoid enlargement and result in poor interobserver agreement.\(^5\) Interestingly, the previously unpublished method of measuring the percentage of airway occlusion on radiographs showed the best correlation with endoscopic findings in our study.

We agree that the fibre-optic examination of a child’s nasopharynx is very physician dependent and,
at times, can be quite challenging.\textsuperscript{21} Using a fibre-optic endoscope requires the cooperation of the child and therefore might not be suitable for all patients. However, in the hands of an experienced otorlaryngologist, this technique is extremely useful in the assessment of adenoid size and should be used as a primary indicator for adenoidectomy. We propose the percentage of airway closure as assessed by direct fibre-optic rhinoscopy to be the method of choice in the evaluation of adenoid enlargement in most patients.

References