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ORIGINAL RESEARCH

Validation of a new grading system for endoscopic examination of adenoid hypertrophy

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OBJECTIVE: To propose and validate a new subjective grading system of adenoid size with flexible fiberoptic evaluation.
STUDY DESIGN AND SETTING: Digital video clips of 24 flexible fiberoptic nasopharyngeal exams were presented to 24 examiners (otolaryngology resident and consultant physicians) at a tertiary care institution. Examiners were asked to use the proposed grading system to rate adenoid hypertrophy. Kappa statistical analysis was used to evaluate the degree of intergrader agreement or disagreement.
RESULTS: Statistical analysis of intergrader agreement demonstrated an overall Kappa score of 0.71 suggesting a "substantial" strength of agreement. The Kappa strength of agreement was found to be 0.83 (almost perfect) among consultant physicians and 0.62 (substantial) among resident physicians.
CONCLUSIONS: The proposed adenoid staging system is a reliable and consistent method of staging adenoid tissue size.
SIGNIFICANCE: This new validated grading system may be a useful standard for reporting adenoid size in future clinical outcome studies.

Adenoid hypertrophy is a common cause of nasal obstruction in the pediatric population. This can lead to such issues as obstructive sleep apnea, recurrent otitis media, and Eustachian tube dysfunction. Evaluation of the adenoids in the child can be a difficult endeavor that historically has been performed via lateral skull radiographs. With the introduction of flexible fiberoptic endoscopes, a greater number of children are being evaluated without radiation. The fiberoptic endoscope can be passed along the floor of the nose to provide an excellent view of the adenoids and its relation to adjacent structures.

There have been very few studies published on the evaluation of adenoid hypertrophy. One study[1] used lateral skull radiographs to categorize adenoid size as normal or large. Some research groups[2,3] have tried to use acoustic rhinometry to evaluate adenoid size. One other study[4] attempted to classify adenoid hypertrophy at the time of adenoidectomy through the use of concurrent intraoperative flexible fiberoptic examination. Only 1 study has attempted to grade adenoid hypertrophy endoscopically in the outpatient setting. Wang et al[5] examined 180 patients and graded adenoids from 1 to 3 based on the distance between the vomer and the adenoid tissue during nasal endoscopic examination. In that study, a significant relationship between the size of the adenoids and upper respiratory symptoms such as nasal obstruction and snoring were demonstrated, but validation of their grading system was not performed.

The objective of this study is to construct and validate a subjective grading system for endoscopic adenoid examination that could be used as a possible standard for reporting adenoid size in future clinical outcome studies.

MATERIALS AND METHODS

A grading system for adenoid hypertrophy was created based on the anatomical relationships between the adenoid tissue and the following structures: vomer, soft palate, and torus tubaris (Table 1). The grading is based on the relationship of the adenoids to adjacent structures when the patient is at rest (ie, when the soft palate is not elevated). A prospective protocol for validation of this grading system was proposed and then Institutional Review Board approval for the study was obtained.

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Table 1
Proposed adenoid staging system: anatomic relationship between the adenoid tissue and vomer, soft palate, and torus tubaris (Eustachian tube orifice)

Grade	Anatomic structures in contact with adenoid tissue
Grade 1	None
Grade 2	Torus tubaris
Grade 3	Torus tubaris Vomer
Grade 4	Torus tubaris Vomer Soft palate (at rest)

Patients were prospectively recruited and consented from 2 outpatient hospital-based otolaryngology clinics and included any patients who required nasal endoscopy as part of their office visit. The majority of patients were recruited in a pediatric setting. No patient was recruited for the sole purpose of undergoing endoscopy.

After application of topical 0.5% tetracaine, a fiberoptic examination was carried out with either a 2.4 mm (Pentax FNL-7RP3) or a 3.5 mm (Vision Sciences ENT-2000) flexible endoscope. Video imaging was than captured with a camera (Storz telecam 2021230) and transferred to a laptop computer using a video bus (Belkin USB Videobus II). Digital video clips were then edited with software (MGI Videowave III) for presentation to examiners. Video clips were excluded if they were deemed inadequate for visualization of adenoid tissue or adjacent anatomic structures.

Otolaryngology consultant physicians and resident physicians were given a handout with the proposed adenoid grading system, both in illustrated and written form. Each examiner was then asked to grade the adenoid tissue of 24 fiberoptic nasal endoscopies by viewing approximately 15 to 30 second digital video clips of each endoscopic examination. Examiners were allowed to review each clip as often as they required to provide a grade of adenoid hypertrophy.

Statistical Analysis

Kappa statistical analysis was used to evaluate the degree of intergrader agreement or disagreement.[6,7] The Kappa value measures the amount of agreement that occurs beyond what would occur by chance alone. The range of the Kappa value is between 1 (complete agreement) and 0 (complete disagreement) and is calculated by the following formula:

$$\text{Kappa coefficient} = \frac{\text{observed agreement} - \text{chance agreement}}{\text{total possible agreement} - \text{chance agreement}}$$

The strength of agreement based on the Kappa value ranges from "poor" to "almost perfect" (Table 2).

RESULTS

Twenty-nine patients were prospectively recruited after Institutional Review Board approval in an outpatient otolaryngology office based in a tertiary hospital setting. All patients were already undergoing nasal endoscopy as part of their office visit. Informed consent was obtained from all patients for this study. Five of the 29 digital clips had to be removed from the study because they were inadequate as a result of bleeding, blurred image, or an absence of the vomer or soft palate in the field of view.

The mean age of the 24 patients reviewed was 10.9 years with a range of 4 months to 48 years and a median of 11 years. Of the 24 otolaryngology examiners, 14 were residents in training and 10 were consultants in practice. The average postmedical school graduate year of training for the resident examiners was 3.6 years. The average number of years of practice for the consultant examiners was 10.2 years with a range of 2 to 30 years and a median of 8 years.

Overall, 460 of a possible 576 agreements in adenoid grading were obtained from the 24 examiners who scored the 24 nasal endoscopy digital video clips. With the Kappa measurement of agreement, an overall score of 0.71 was obtained that falls into the 0.61 to 0.80 range and suggests a "substantial" strength of agreement. A score of 0.81 or better is considered "almost perfect." Separating residents in training from consultants demonstrated a Kappa measurement score of 0.62 (substantial) for resident physicians and 0.83 (almost perfect) for consultant physicians.

DISCUSSION

Traditionally, lateral skull radiographs have been the standard for evaluation of adenoid size. There are several limitations to the use of lateral skull films. A radiographic plain film is only a 2-dimensional study that evaluates the relationship of the adenoid to the palate in a single plane. This can result in misinterpretation of adenoid obstruction in cases where there is only bulky lateral adenoid growth and open choanae medially. Furthermore, the relationship of the adenoid to the palate in a lateral skull film can be erroneous as a result of skull rotation or inappropriate palate position from inspiration, expiration, or phonation. Finally, lateral skull films inherently expose the patient to radiation.

Table 2
Kappa value and strength of agreement[7]

Kappa	Strength of agreement
0.01	Poor
0.01-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost perfect

Office nasal endoscopy offers several advantages over the lateral skull radiograph in the evaluation of adenoid hypertrophy. There is no patient exposure to radiation and the relationship of the adenoid to important adjacent anatomic structures can be evaluated dynamically in 3 dimensions. Although the image of an endoscope is 2-dimensional, the ability to move the camera in and out of the nose allows the examiner to have a 3-dimensional sense of adenoid size. The relationship of the adenoid to the adjacent torus tubaris, vomer, and soft palate can be easily evaluated in a dynamic fashion that allows for complete evaluation of the nasopharynx. Eustachian tube and airway obstruction can be readily identified through nasal endoscopy in all 3 planes.

In this prospective study, a new grading system has been devised based on the principle that the relationship of the adenoid tissue to adjacent structures is as important as the adenoid size itself. Impingement on the Eustachian tube or on the nasopharyngeal airway can both have negative sequelae for the patient. The grading system presented here incorporates the relationship of the adenoid to the torus tubaris (Eustachian tube orifice), vomer (posterior nasal septum), and soft palate (Table 1). Specifically grade 1 adenoids are nonobstructive and do not contact any of the previously mentioned anatomic subsites (Fig 1). Subsequently, grade 2, 3, and 4 adenoids contact the torus tubaris, vomer, and soft palate (at rest) respectively (Figs 2, 3, and 4).

Several factors may have had an impact on the final Kappa score and strength of this study. In particular, examiners may not have had as clear a view of the adenoid tissue as they would have if they were performing the endoscopy themselves. The quality of digital video is inferior to direct visualization through a flexible nasal endoscope. Furthermore, the learning curve for the grading system was not taken into account. All endoscopic video clips examined were included in the study, and examiners were not given practice video clips (the discrepancy between residents and consultants may potentially reflect how familiarity with the endoscopic view of the nasopharynx affects grading). Nevertheless, the Kappa score in this study suggests that the proposed endoscopic adenoid grading system has a substantial strength of agreement among residents in training and an almost perfect strength of agreement among consultants in practice.

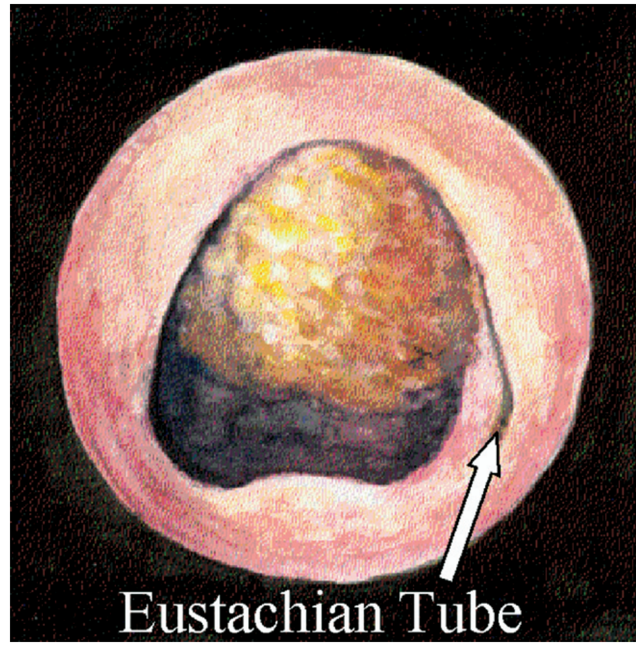

Figure 2 Grade 2, adenoid tissue in contact with torus tubaris.

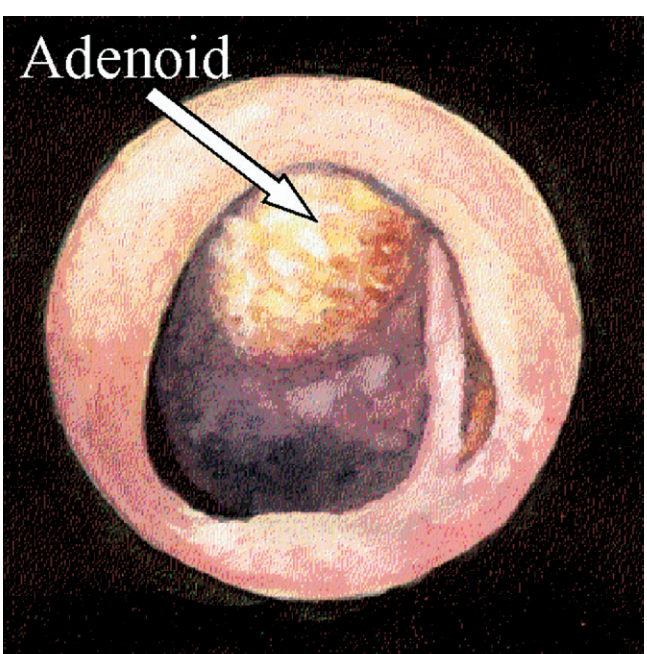

Figure 1 Grade 1, adenoid tissue not in contact with adjacent structures.

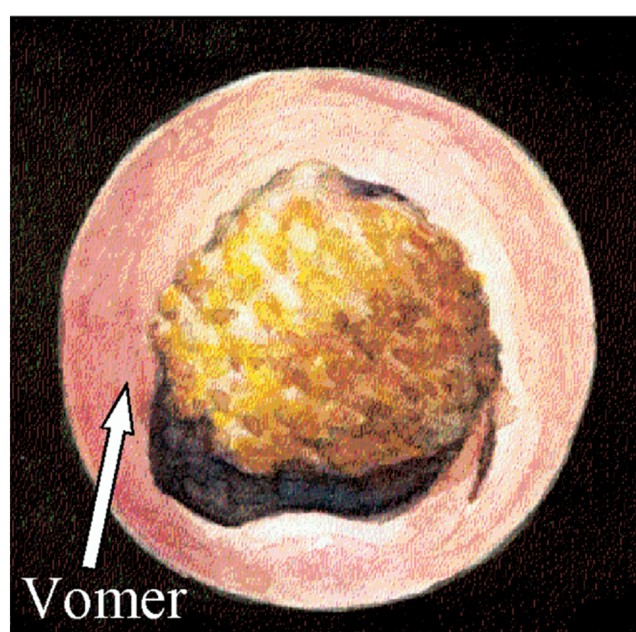

Figure 3 Grade 3, adenoid tissue in contact with Vomer.

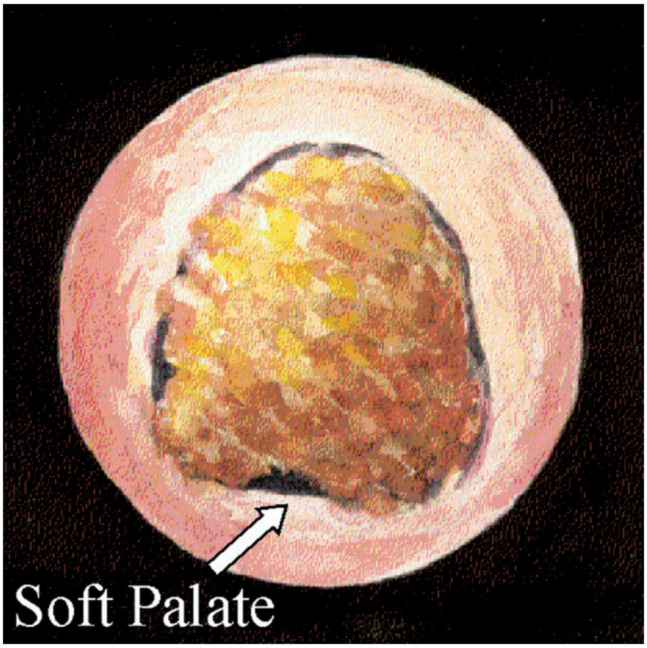

Figure 4 Grade 4, adenoid tissue in contact with palate (at rest).

CONCLUSIONS

Although lateral skull radiographs have been used by otolaryngologists in the evaluation of adenoid hypertrophy, nasal endoscopy is evolving as a valuable alternative diagnostic modality. At present, there is no validated grading system for adenoid hypertrophy with endoscopic examination. The proposed adenoid grading system reported here is a reliable and consistent method of evaluating adenoid tissue size and may be useful as a standard for reporting adenoid size in future clinical outcome studies.

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