Persistent Hypernasality Following Adenoidectomy in Children without Palatal Defects

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ABSTRACT

Background: Many patients who underwent adenoidectomy experience persistent hypernasality and velopharyngeal incompetence (VPI) after adenoidal tissue removal. Velopharyngeal insufficiency is a disorder marked by hypernasal speech, nasal emission and turbulence, and occasionally, the nasal backflow of liquids. This often occurs when the removal of tissue, which previously aided a poorly functioning palate in attaining nasopharyngeal closure, exposes an underlying palatal tissue. However, it is found that hypernasal speech can also occur in children with apparently normal palate and normal palatal functions. **Aim of the work:** The research seeks to examine the cause of persistent hypernasality following adenoidectomy in children lacking obvious palatal defects as a predisposing factor.

Patients and methods: A cross-sectional study was executed on 50 patients experiencing open nasality following adenoidectomy, whether done alone or with tonsillectomy, who presented to Ain Shams University Hospitals from September 2024 to March 2025. Nasopharyngoscopic examination of the velopharyngeal port and the pharynx at the level of the tonsils was done for all cases. A nasometry tool was also used.

Results: A high significant correlation between the presence of adenoid remnants, nasalance score and velopharyngeal closure was found with a P value <0.001. There was a non-significant association among the presence of tonsils and velopharyngeal closure (P value >0.53).

Conclusion: Adenoidal tissue remnants in the nasopharynx may affect good velar closure and following adenoidectomy in children without obvious palatal defects, they may cause persistent hypernasality.

Keywords: Adenoidectomy, Palate, Velopharyngeal incompetence, Hypernasality.

INTRODUCTION

The adenoid tissue, presented in the nasopharynx, is a part of Waldeyer's ring. It plays an important role in nasal airway patency and velopharyngeal competence during speech [(1)]. Adenoidal hypertrophy usually occurs at an early age and can obstruct the nasopharyngeal airway in children. Frequent otitis media, breathing difficulties, nasal airway obstruction, sleep disturbances, and chronic rhinosinusitis due to hypertrophied or occasionally infected adenoids are common indications for adenoidectomy [(2)].

Nowadays, adenoidectomy has become a widely practiced surgical technique in the therapy of nasopharyngeal airway obstruction in children and secretory otitis media. In recent decades, various tools—including adenotomes, cutting forceps, a surgeon's fingernail, a steel nail, and adenoid curettes—have been utilized for the surgical excision of adenoids [(3)]. Traditional adenoid removal through curettage was first introduced in 1985 and has since remained the most widely practiced technique globally [(4)]. Other methods include suction diathermy, a microdebrider, endoscopy-assisted adenoidectomy, and lasers [(5-8)].

Although it is a day case procedure, there are a considerable number of patients who experienced persistent hypernasality and velopharyngeal incompetence (VPI) after adenoidal tissue removal. A condition marked by nasal emission and turbulence, hypernasal speech, and sometimes nasal regurgitation of fluids is known as velopharyngeal insufficiency. Determining its exact occurrence is challenging, but estimates suggest it ranges from approximately 1 in 1,500 to 1 in 10,000 adenoidectomies [(9)]. Frequently, it occurs due to the revelation of an underlying palatal tissue when the tissue that a dysfunctional palate was using to achieve nasopharyngeal closure is removed. However, it is found that hypernasal speech can also occur in children with apparently normal palate and normal palatal functions [(19)].

PATIENTS AND METHODS

Setting

Otorhinolaryngology Department, Faculty of Medicine, Ain Shams University.

METHODS

This cross-sectional study was carried out on 50 patients. The sample size was calculated after proposal of the study protocol to the Community Department in Ain Shams University. Based on the results of **Saunders *et al.*** [(9)], the prevalence of surgery among patients was 45%, postulated surgery was 20%, the power of the study was 80%, and the Alpha error was 5%. The necessary sample size was 50 patients. The program for sample size calculation was STATA 10.

The study was done on patients who were hospitalized or referred to the Department of Otorhinolaryngology of a tertiary care teaching hospital of Ain Shams University (El-Demerdash Hospital) during 6 months from September 2024 to March 2025. All the 50 hypernasal patients were younger than 18 years old. They had no signs of palatal defects that developed the hypernasality

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following adenoidectomy, whether done alone or with tonsillectomy. The inclusion criteria were lacking any signs of submucous cleft palate, short velum, bifid uvula, notching of the hard palate, and oromotor disorders as revealed by clinical, video- fluoroscopic, and nasopharyngoscopic examinations. The patients who had developed hypernasality after adenoidectomy and had signs of palatal defects were excluded from the study.

A 3.4 mm flexible nasolaryngoscopy was used to nasopharyngoscopic examination of the velopharyngeal port and the pharynx at the level of the tonsils to monitor the shape of the posterior pharyngeal wall and the pattern of velopharyngeal closure at rest position and during phonation (Henke-Sass, Wolf Germany). The movement of the velum and the lateral pharyngeal walls was assessed and assigned a score ranging from 0 to 4, which was outlined as: 0=resting (breathing) position or no movement; 2=half the distance to the corresponding wall; 4= greatest movement reaching and touching the opposite wall [10].

A nasometry tool was also used (Nasometer II Model 6450, PENTAX Medical, Lincoln Park, NJ, USA). The Nasometer is a computerized device designed to assess oral-nasal balance throughout speech by assessing the relative intensities of oral and nasal sounds produced during speech. It measures nasal air escape and enables contrast of the results with normative data. Nasalance is determined by computing the numerical ratio of nasal acoustic energy to the total acoustic energy (the combined sum of nasal and oral acoustic energy) and then multiplying the result by 100. It can range from 0% (no sound passing through the nose) to 100% (all sound exiting through the nose) [11-14].

Ethics approval and consent to participate: Prior to initiating the research, ethical clearance was secured from the Faculty of Medicine's Scientific Research Ethics Committee at Ain Shams University (Approval code: R262/2024). All the caregivers of the participants provided written informed consent before taking part in the study after providing them with complete information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

Statistical analysis for all data by using SPSS 22.0 (IBM corporation, Chicago, USA). P value <0.5 is considered significant.

RESULTS

This study engaged 50 patients whose ages ranged from 3.2 to 16.1 and had a mean age of 7.3. Of them, 27 patients were females, while 23 were males.

Twenty-seven patients of the study group underwent adenoidectomy alone, while 23 had adenotonsillectomy. Fiberoptic nasopharyngeal examination revealed a clear nasopharynx with no adenoidal tissue remnants in 16 patients, while 34 patients had adenoidal tissue remnants.

The velopharyngeal closure (VPC) range is illustrated in Table (1).

Table (1): Velopharyngeal closure range.

	Number of patients
Complete closure	4 (8%)
Incomplete closure	43 (86%)
Non closure	3 (6%)

Nasometry examination revealed a minimum score of 64 and a maximum of 116 with mean score ± SD of 83 ± 11. There was a significant positive association among nasalance score and nasofibroscopic examination (P value<0.023) (Table 2).

Table (2): Correlation between nasalance score and nasofibroscopic examination.

Nasalance score mean±SD	**Nasofibroscopic examination mean±SD**		
83 ± 11	Lateral wall motility: 2.4±1.2.	Posterior wall motility: 1.9±0.8	**P value <0.023**

There was a highly significant correlation between the presence of adenoid remnants, nasalance score and velopharyngeal closure (P value<0.001) (Table 3).

Table (3): Correlation among the presence of adenoid remnants, nasalance score and velopharyngeal closure.

Nasalance score mean±SD	**Remaining adenoid tissue**	**Velopharyngeal closure score**		
83 ± 11	68%	Incomplete closure 86%	Non closure 6%	**P<0.001**

A non-significant association was documented between the presence of tonsils and velopharyngeal closure (P value>0.53) (Table 4 and Figure 1).

Table (4): Correlation between the presence of tonsils and velopharyngeal closure.

Cases with remaining tonsils = 27	**velopharyngeal closure score**		
Tonsils affecting closure= 12 24%	Incomplete closure 86%	Non closure 6%	**P>0.53**

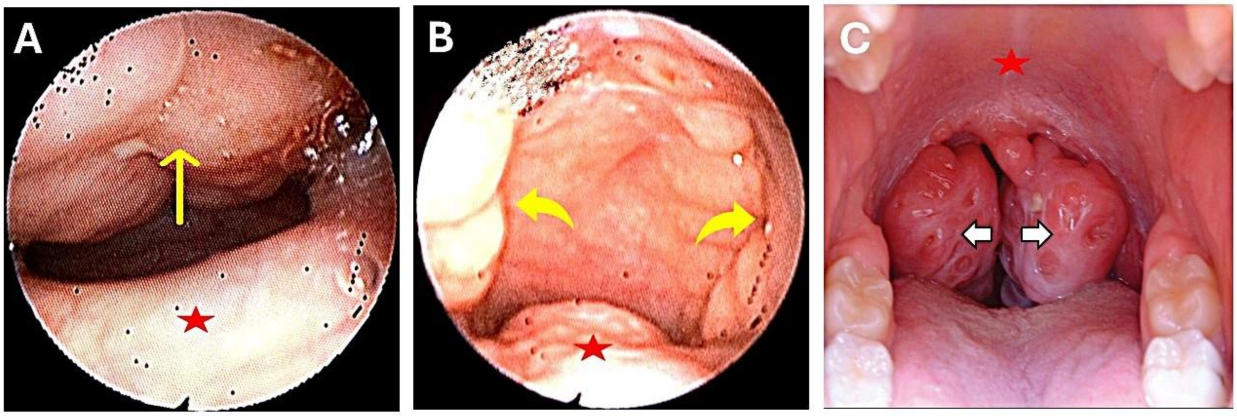

Figure (1): **A** and **B**; Nasopharyngoscopic examination reveals adenoidal tissue remnants in the nasopharyngeal midline and lateral recess respectively **(Yellow arrows)** interfering with complete velar coaptation on the posterior pharyngeal wall. **C**; Oropharyngeal examination reveals kissing tonsils interfering with normal velar movements **(White arrows)**. **Red star**; soft palate.

DISCUSSION

Speech production relies on the velopharyngeal sphincter, which functions through the coordinated action of the palatal muscles and the superior constrictors on both sides [15]. The sphincter borders are the soft palate anteriorly, the lateral pharyngeal walls, and the posterior pharyngeal wall. The active contribution of each wall during speech articulation establishes the type of closure pattern [16].

About 1 in every 1,500 patients have VPI following adenotonsillectomy; however, most cases are temporary and recover over time. Speech therapy can be beneficial for mild cases, but surgical intervention may be necessary for more serious cases or those that do not respond to therapy [17].

In our study we concerned about persistent hypernasality following adenoidectomy in children without palatal defects. Our study involved 50 patients with age ranged from 3.2 to 16.1 with mean age of 7.3, 27 cases of them underwent adenoidectomy alone while 23 cases had adenotonsillectomy.

Nasofibroscopic assessment revealed that lateral wall motility score mean±SD was 2.4±1.2, while posterior wall motility score mean±SD was 1.9±0.8. Only 4 cases of the study group had complete velopharyngeal closure. The remaining cases had either incomplete closure (43 cases) or non-closure (3 cases). Regarding fiberoptic nasopharyngeal examination, we found 16 patients with clear nasopharynx and 34 patients with remnant adenoidal tissue; either midline or laterally in the nasopharynx.

A nasometry tool, a non-invasive computer-based device for measuring nasal acoustic energy in speech, was used. Nasometry examination revealed minimum score of 64 and maximum of 116 with mean score ± SD of 83 ± 11.

According to our results, there was a significant association among nasalance score and pharyngeal wall motility (both lateral and posterior walls, P value <0.023). Also, the correlation between presence of adenoid remnants, nasalance score and velopharyngeal closure revealed high significant correlation with P value <0.001. This suggests that the adenoidal tissue remnants may be an important factor causing incomplete closure of velopharyngeal valve. The presence of adenoidal tissue, especially in the lateral nasopharyngeal recess, may hinder complete apposition of the soft palate against the posterior pharyngeal wall, thus, resulting in some air leakage and open nasality.

Several mechanisms have been suggested to account for hypernasality following adenotonsillectomy, including the increased dimension of the velopharyngeal space, tethering impact on the velum from scarring, and nerve injury. An increase in the dimension of the velopharyngeal valve due to the removal of adenoid tissue may hinder velopharyngeal closure [18].

Adenoids can contribute to compensating for a weak palate by serving as a cushion on the back of the pharyngeal wall, aiding in velopharyngeal closure. For patients experiencing inadequate palatal elevation, adenoidectomy may reveal the adenoid's supportive role, potentially leading to VPI [19].

Increased pharyngeal depth after adenoidectomy requires the velum to assume maximum movement, which cannot occur if hampered by large tonsils. Patients with remaining tonsils in our study were 27 patients, 12 of them had tonsils affecting the velum closure.

Enlarged tonsils may also impact children's speech. They narrow the oropharyngeal space, resulting in a muffled voice and oral breathing. Hypertrophied tonsillar upper pole may reach high up in the nasopharynx with impairment of the velar movement and velopharyngeal closure, which results in hypernasality. Furthermore, due to its mechanical weight, the hypertrophied tonsil may impair palatal elevation, leading to a higher likelihood of VPI [20].

While there is ongoing debate regarding the impact of enlarged tonsils on speech and nasal resonance, certain studies have explored this topic. **Shprintzen *et al.*** [21] examined 20 patients with VPI and tonsillar hypertrophy who had tonsillectomy. Postoperatively, 16 patients experienced full resolution of hypernasal speech without requiring additional surgical intervention. Additionally, **Finkelstein *et al.*** [22] identified a possible influence of the tonsils on the velopharyngeal closure mechanism, particularly in patients with VPI. **MacKenzie-Stepner *et al.*** [23] managed two pediatric cases of hypernasality with an undetermined cause by excising tonsils that were obstructing the space among the palate and the posterior pharyngeal wall. Following the tonsillectomy, both patients experienced a total resolution of speech nasality.

A study conducted by **Abdel-Aziz *et al.*** [24] demonstrated notable enhancement in palatal mobility following the removal of hypertrophied tonsils. The pattern of coronal closure was observed in 43 patients (58%) before surgery and in 51 patients (69%) after surgery. Additionally, they observed the absence of Passavant's ridge in two patients after surgery, which may suggest improved velar elevation compared to before. However, in our study, a non-significant correlation was found between remaining tonsils and velopharyngeal closure with P value >0.53. This may be attributed to the difference between the tonsillar size or the superior extent of the upper tonsillar pole not affecting the velar closure.

CONCLUSION

The presence of remaining adenoidal tissue, either in the midline or laterally, with or without remaining tonsillar tissue may be an important factor in persistent hypernasality following adenoidectomy in children lacking obvious palatal defects. Further studies with more patients may be needed to evaluate the effect of adenoidal tissue remnants removal on the velar movement and hence the speech.

DECLARATIONS

- **Availability of data and material:** The data and results examined throughout this research are fully available within this article and its accompanying supplementary materials.

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- **Competing interests:** The authors declare no competing interests.

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