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A Combined Anatomical Scoring System for Upper-Airway Obstruction in OSA (ACUOS)

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ABSTRACT

Introduction: Obstructive sleep apnoea (OSA) arises from the collapse of the upper-airway during sleep and is influenced by multiple anatomical factors, including tonsillar hypertrophy, septal deviation, turbinate enlargement, tongue-base crowding, and elevated body mass index (BMI). Current clinical staging systems (e.g., Friedman) emphasize oropharyngeal compartments but often overlook nasal anatomical burden. We propose a unified anatomical scoring framework, Arefin's Combined Upper-Airway Obstruction Score (ACUOS), which integrates nasal, palatal, and tongue-related contributors in a numeric system to guide treatment decisions in OSA. **Methods:** Five anatomical contributors were selected based on their documented association with OSA severity and surgical outcomes. Each was assigned a 0–3 or 0–4-point range, totaling 0–16, with an optional adenoid modifier for pediatric cases. ACUOS staging (A–D) suggests first-line medical, surgical, or CPAP therapy. **Results:** For example, a patient with tonsil grade 3 (3 points), septal obstruction grade 2 (2), inferior turbinate hypertrophy grade 2 (2), Mallampati II (1), and BMI 31 (2) scores 10 = Stage C → multilevel surgery or CPAP. ACUOS enables OPD-based anatomical guidance for OSA treatment. **Conclusion:** ACUOS provides a practical, bedside scoring approach to evaluate anatomical burden in OSA and assist ENT surgeons in surgical counseling and decision-making. Validation studies are required.

Keywords: Obstructive Sleep Apnoea, Airway Anatomy, Nasal Obstruction, Septal Deviation, Turbinate Hypertrophy

INTRODUCTION

Obstructive sleep apnoea (OSA) is characterized by repeated upper-airway collapse during sleep, leading to sleep fragmentation and increased cardiovascular risks. Anatomical contributors such as tonsillar hypertrophy, nasal obstruction, turbinate hypertrophy, and tongue-base encroachment play key roles in OSA pathogenesis [1]. Nasal obstruction increases inspiratory resistance, predisposing to downstream pharyngeal collapse via the Starling resistor mechanism [2].

Despite this, commonly used OSA staging systems, such as Friedman's, focus on tonsils, tongue position, and BMI but do not explicitly include

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nasal obstruction [3]. Yet nasal pathology can significantly affect sleep breathing and reduce CPAP tolerance [4,5]. There is a need for a unified anatomical scoring system to guide decision-making in ENT sleep clinics. We propose ACUOS: a 0–16 score incorporating five anatomical variables and optional modification for pediatric adenoid hypertrophy.

METHODS

Five components were selected based on published anatomical predictors of OSA:

- **Tonsil size (Brodsky scale):** 0–4
- **Septal deviation (% airway obstruction):** 0–3
- **Inferior turbinate hypertrophy:** 0–3
- **Tongue position (Modified Mallampati):** 0–3
- **Body Mass Index (kg/m^2):** 0–3

The total score (0–16) stratifies patients into four stages with guidance on likely management options. In pediatric cases, adenoid obstruction (0–3) may be added as a modifier [6,7].

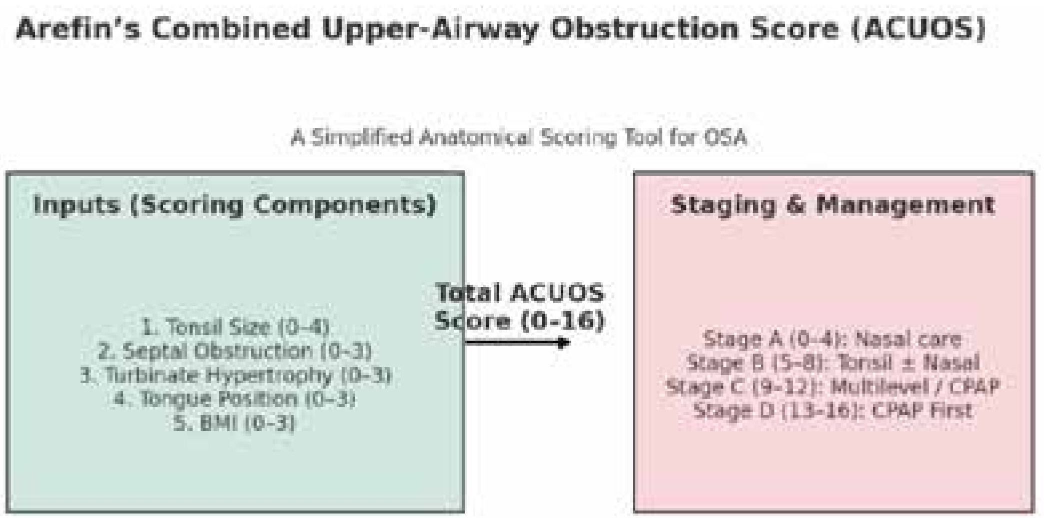
ACUOS is designed for outpatient evaluation using anterior rhinoscopy or nasal endoscopy, BMI measurement, and modified Mallampati scoring.

Table 1. ACUOS Scoring Components and Point Values

Component	Description	Points
Tonsil size (Brodsky)	0: absent → 4: >75% or kissing tonsils	0–4
Septal obstruction	<25% → >75% (endoscopy/CT)	0–3
Inferior turbinate hypertrophy	<25% → >75% airway filling	0–3
Tongue position (Mallampati)	Class I → IV	0–3
BMI (kg/m^2)	<25 → ≥35	0–3

Figure 1. ACUOS Staging and Suggested Management Pathway

- **Stage A (0–4):** Medical therapy, nasal steroid/irrigation, allergy control
- **Stage B (5–8):** Tonsillectomy if tonsils ≥3; correct nasal obstruction
- **Stage C (9–12):** DISE to assess multilevel obstruction → combined surgery or CPAP
- **Stage D (13–16):** CPAP first; consider staged surgical correction, especially if BMI ≥35



RESULTS

Example scoring using ACUOS:

Component	Score
Tonsil grade 3	3
Septal deviation (50–75% obstruction)	2
Inferior turbinate hypertrophy (50–70%)	2
Mallampati II	1
BMI 31 kg/m^2	2
Total Score	**10 → Stage C**

Interpretation: Stage C (9–12): Multilevel airway obstruction → DISE advised; consider combined palate, tonsil, nasal, ± tongue base surgery or trial of CPAP.

Rationale and Literature Basis

1. **Tonsil size:** Bigger tonsils are recognized as a key surgical target in adult and paediatric OSA, and are included in the Friedman staging system [3].
2. **Nasal septal deviation & turbinate hypertrophy:** Anatomical nasal obstruction is linked with OSA severity and may worsen CPAP tolerance. A recent Korean study of septal deviation and turbinate hypertrophy found a higher rate of OSA in patients with deviation [8]. In addition, a retrospective imaging study found that septal deviation location and turbinate size correlated with NOSE scores of nasal obstruction [4].
3. **Multilevel obstruction:** Literature on multilevel OSA surgery emphasises nasal, palatal and hypopharyngeal levels. For example, tailor-made multilevel surgery including the nasal cavity achieved a ~43% strict success (AHI <5) in one series [7].
4. **Phenotyping and anatomy-tailored surgery:** A 2019 paper on OSA surgical options emphasised the need for anatomic phenotyping (tonsil, palate, tongue base, nose) to choose appropriate surgery [6].
5. **Physical exam correlation:** A 2025 systematic review of OSA physical exam found that anatomical findings (tonsils, nasal obstruction) still play a role in risk stratification. Hence, each component of ACUOS has a sound evidence base for inclusion.

DISCUSSION

ACUOS incorporates both nasal and oropharyngeal factors overlooked in standalone staging systems and can facilitate:

- Quick outpatient surgical counseling
- Consistent anatomical reporting in clinical trials
- Stratification of patients for targeted nasal/tonsillar or multilevel OSA surgery [8]

However, this proposal remains theoretical and requires cross-sectional validation and inter-observer reliability evaluation [9]. Additionally, ACUOS does not attempt to predict physiological contributors like loop gain or arousal threshold [10] and should therefore complement PSG rather than replace it.

Future work should include prospective cohort studies applying ACUOS at baseline, correlating it with surgical and non-surgical treatment outcomes, and refining cut-offs and weightings. Validation in different populations and in children (with adenoid modifier) is also needed. In the Bangladeshi/Indian context, where resource constraints may limit full DISE or imaging, ACUOS offers a practical, bedside tool using endoscopic and clinical assessment.

CONCLUSION

Arefin's Combined Upper Airway Obstruction Score (ACUOS) provides a single, clinically simple tool to measure anatomical burden in OSA and guide ENT-led treatment pathways. Early adoption may help standardize reporting and decision-making, with validation studies needed to support wider use.

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CONFLICT OF INTEREST

The author has no conflict of interest.

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