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Original Article

Outcome of drug-induced sedation endoscopy in adults with obstructive sleep apnoea or snoring

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ABSTRACT

INTRODUCTION. First-line treatment for obstructive sleep apnoea (OSA) is continuous positive airway pressure (CPAP). However, adherence to CPAP is poor. Non-adherent patients may benefit from other treatment modalities. Drug-induced sedation endoscopy (DISE) is a validated tool to suggest individualised treatment options. This study aimed to investigate the outcome of DISE in patients with OSA or severe snoring.

METHODS. Patients with OSA and/or snoring who had poor compliance with CPAP were included in a database from May 2020 to October 2022. The inclusion criteria were BMI < 35 kg/m^2, age 18-65 years and no contraindications to propofol infusion. DISE was performed, and anatomic collapse during DISE was evaluated using the velum-oropharynx-tongue-base-epiglottis classification. Treatment suggestions were registered.

RESULTS. The database included 190 referred patients, and 109 patients underwent DISE. Among these, 34 had mild OSA or snoring (Apnea-Hypopnea Index (AHI) < 15 events/hour)) and 75 had moderate-severe OSA (AHI ≥ 15 events/hour). A total of 51% of patients were recommended sleep surgery, the most frequent being tonsillectomy. Surgery was recommended more among patients with AHI ≥ 15 events/hour.

CONCLUSIONS. DISE suggests a personalised treatment for eligible patients with OSA or severe snoring. When the DISE findings were considered, half of the patients were recommended for sleep surgery. The value of DISE in planning such surgery in this cohort needs to be determined.

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TRIAL REGISTRATION. The study was approved by the Institutional Review Board and the Scientific Ethical Committee of the Central Denmark Region (no: 1-10-72-228-17).

Obstructive sleep apnoea (OSA) is a common condition in Denmark, with a total of 48,168 patients receiving the diagnosis between 1995 and 2015, and a considerable number remaining undiagnosed [1, 2]. Treatment is recommended in case of Apnea-Hypopnea Index (AHI) ≥ 15 events/hour. However, the management and treatment of OSA pose several dilemmas. If left untreated, patients are at risk of several serious comorbidities such as cardiovascular disease, stroke and hypertension [3-5]. OSA patients experience an overall reduced quality of life and are at greater risk of early death. On the other hand, the gold standard treatment, continuous positive airway pressure (CPAP), is associated with alarmingly poor compliance, with studies showing 48% non-adherence levels to CPAP treatment [6]. Thus, several adult OSA patients are left untreated, with a need for other treatment modalities.

Alternatives for CPAP treatment include mandibular advancement devices (MAD), sleep positional trainers (SPT) and sleep surgeries to reduce upper airway collapse or improved use of CPAP. Sleep surgeries range from simple tonsillectomy to multilevel upper airway surgery, depending on the location and the causes and degree of airway obstruction.

In Denmark, CPAP is provided through public healthcare. If MAD treatment is considered, a proper MAD should be purchased by the patient through a dentist [7]. The costs are up to 10,000 DKK (1,300 €) for a custom titratable biblock device [8]. Due to the self-payment, MAD is often rejected by the patients.

Sleep position treatment can be recommended with an SPT if it seems possible to achieve a total AHI < 15 events/hour with a non-supine sleep position in 85-90% of the total sleep time. Some sleep clinics offer SPT treatment through public healthcare.

As of June 2024, recommendations for OSA treatment in Denmark are as follows:

- 5 events/hour ≤ AHI < 15 events/hour: no indication for treatment, but in patients with severe sleepiness, CPAP may be an option

- 15 events/hour ≤ AHI < 30 events/hour, MAD, CPAP or SPT can be used

- AHI ≥ 30 events/hour, CPAP or MAD.

Sleep surgery can be offered if anatomical obstruction sites can be identified [7].

To optimise treatment of OSA patients, drug-induced sedation endoscopy (DISE), originally described in 1991 by Croft & Pringle [9], has been introduced. It has since been validated as an additive tool in the selection of patients for sleep surgery [10, 11].

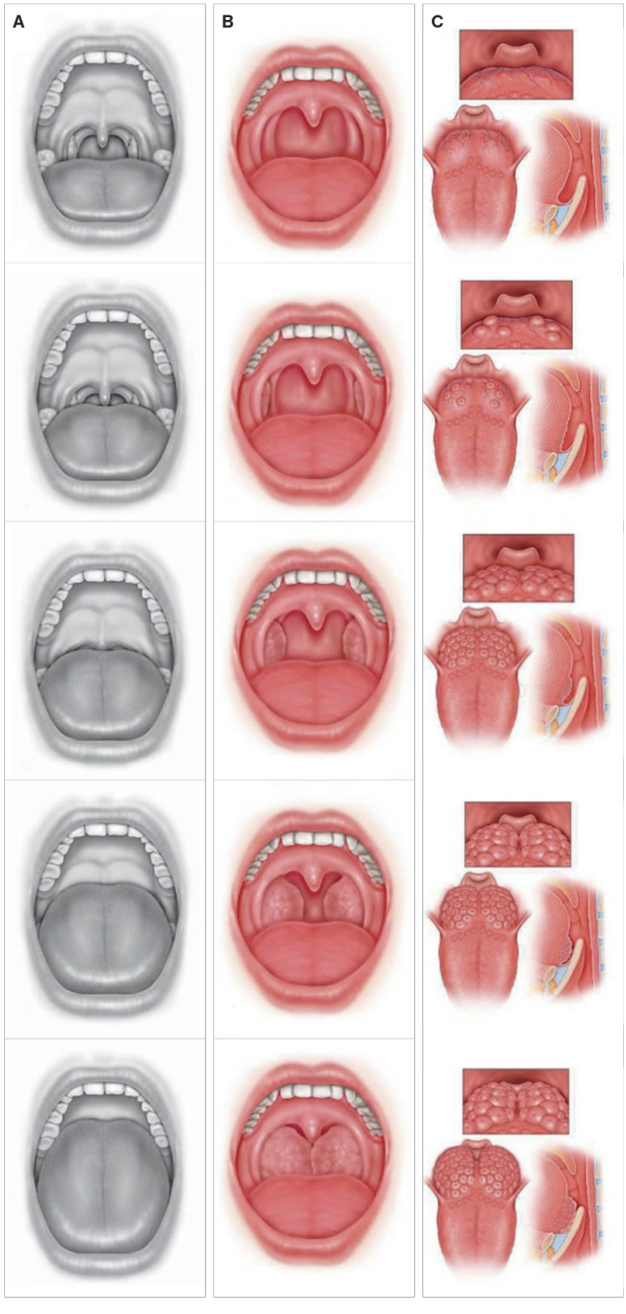
The present study aimed to investigate the outcome of DISE evaluated by the distribution of DISE-assisted choice of treatment in a cohort of patients with OSA and/or snoring and poor CPAP compliance.

Methods

Patients with OSA and/or snoring who are unable to use CPAP or desire to explore other treatment options were referred to the Department of Oto-Rhino-Laryngology Head and Neck Surgery at Gødstrup Hospital, Denmark, (Holstebro Hospital, Hospital Unit Vest until 16th Feb 2022) and were included in a database from May 2020 to November 2022. The inclusion criteria were a BMI < 35 kg/m^2, age 18-65 years, no severe comorbidities and no contraindications to propofol sedation. All patients provided written informed consent.

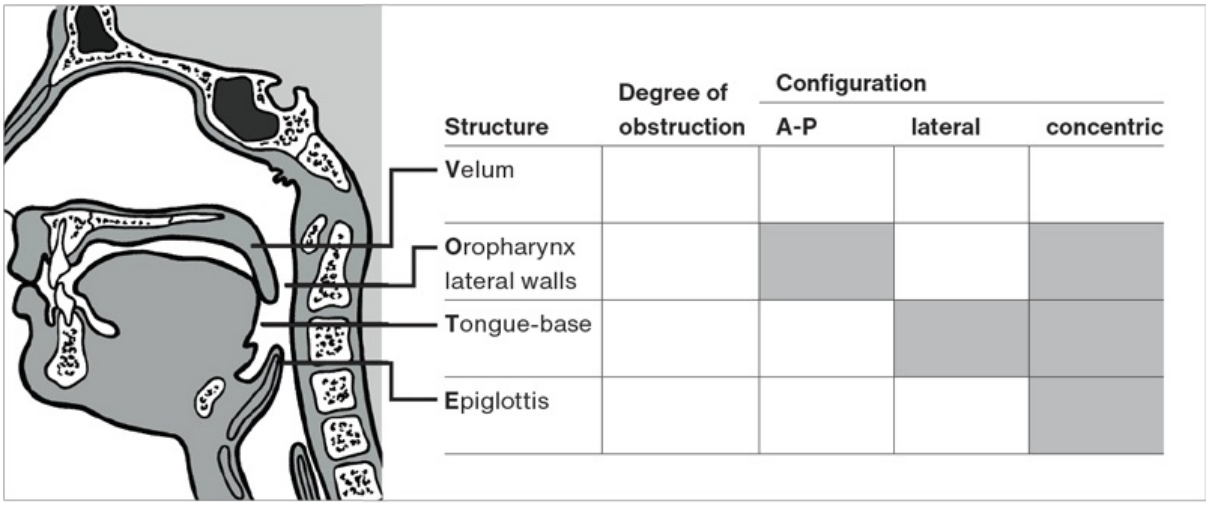
Patients underwent pre-DISE examination by an ENT specialist, and objective measures including BMI, Friedmann tongue position (FTP) [12], tonsil size (Brodsky scale) and lingual tongue hypertrophy (LTH) were noted. **Figure 1** shows the classifications. Patient-reported measures were obtained using the Sino-Nasal Outcome Test 22 (SNOT-22) [13] and the Epworth Sleepiness Scale (ESS) [14], and a sleep apnoea test was performed (either polysomnography or cardio-respiratory measurement (CRM)) to estimate AHI. The vast majority were CRM using the autoscore function.

FIGURE 1 **A**. The Friedman tongue position. **B**. The Brodsky tonsil grading scale (tonsil size). **C**. Lingual tongue hypertrophy [12].



Patients were selected for DISE if they met the inclusion criteria and agreed to the procedure. Anatomical collapse during DISE was evaluated by two oto-rhino-laryngologists using the velum-oropharynx-tongue-base-epiglottis (VOTE) classification (see **Figure 2**) [15], categorising the obstruction as either 0 = none, 1 = partial or 2 = complete and assessing the configuration as either antero-posterior, lateral or concentric. When an obstruction site was complete (class 2), treatment was suggested.

FIGURE 2 The velum-oropharynx-tongue-base-epiglottis (VOTE) classification. The configuration of the velum, oropharynx, base of tongue and epiglottis is assessed as either anterior-posterior (A-P), lateral or concentric. The degree of obstruction is categorised as 0 = no obstruction, 1 = partial or 2 = complete [15].



Structure	Degree of obstruction	Configuration		
		A-P	lateral	concentric
Velum				
Oropharynx lateral walls				
Tongue-base				
Epiglottis				

The patients were divided into two groups based on snoring or mild OSA with AHI < 15 events/hour or moderate to severe OSA with AHI ≥ 15 events/hour. Individual treatment recommendations were made based on DISE evaluation by two ENT specialists and registered in the database. Surgeries included tonsillotomy, tonsillectomy, surgery of the velum, base of tongue, epiglottoplasty or multilevel surgery and septoplasty and/or turbinoplasty or conchotomy and maxillofacial surgery with mandibular or maxillo-mandibular adjustment (MMA). MAD or MMA was recommended when jaw thrust prevented collapse during DISE. The patients were invited for follow-up, including a review of the DISE video, and personalised treatment recommendations were provided based on shared decision-making.

Ethical considerations

Requirements on privacy and informed consent from patients were met, and the study was approved by the Institutional Review Board and the Scientific Ethical Committee of the Central Region Denmark (no: 1-10-72-228-17).

The study was registered with the Danish Data Protection Agency and was performed in accordance with the Declaration of Helsinki.

Trial registration: The study was approved by the Institutional Review Board and the Scientific Ethical Committee of the Central Denmark Region (no: 1-10-72-228-17).

Results

A total of 190 patients referred from primary healthcare went through pre-DISE examinations and were included in the database between May 2020 and November 2022. Among these patients, 109 underwent DISE. In the remaining 81 patients, DISE was not performed due to a lack of desire among patients in exploring treatment alternatives to CPAP or due to contraindications to DISE. No inadvertent events with anaesthesia or upper airway management occurred during the procedure.

Of the 109 patients undergoing DISE, 75 had an AHI ≥ 15 events/hour, and 34 had an AHI < 15 events/hour and/or

reported socially invalidating snoring.

Approximately 80% were males, and the mean age was 44.5 years (standard deviation: ± 14.7 years). The self-reported symptoms from ESS and SNOT-22 were comparable regardless of AHI. Baseline data are presented in **Table 1.**

TABLE 1 Baseline data on the 109 patients undergoing drug-induced sedation endoscopy.

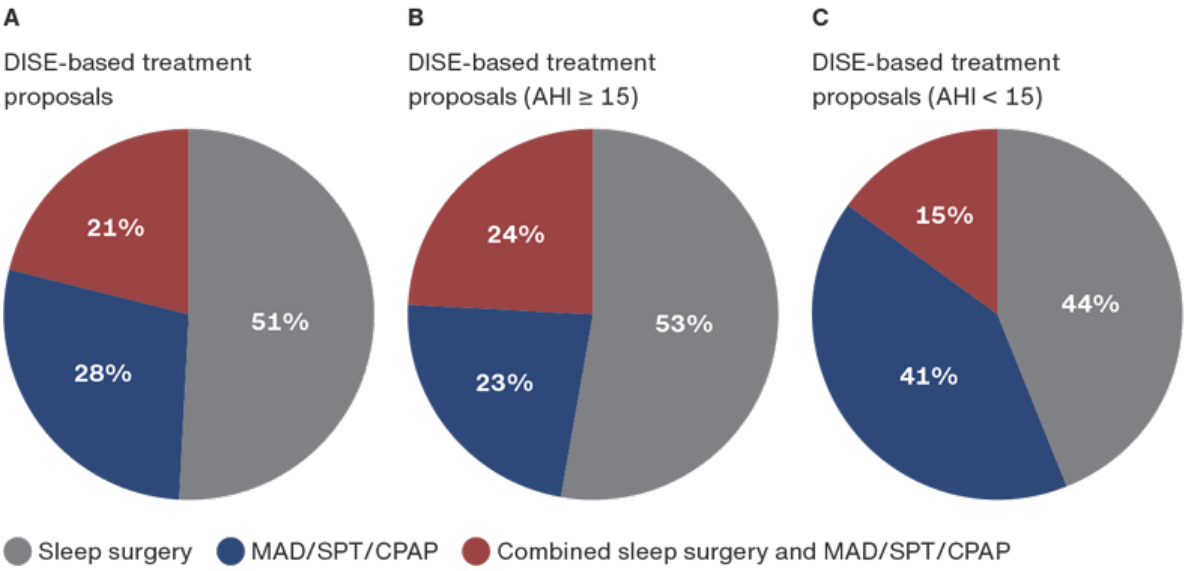
	Patients with AHI	
Kolonneheader	**≥ 15 events/h ($N_{\geq 15}$ = 75)**	**< 15 events/h ($N_{< 15}$ = 34)**
Age, yrs		
Mean ± SD	45.9 ± 11.2	41.9 ± 11.3
Median	48	42.5
Range: min.-max	40.5-53.5	33.3-49.8
Females, n (%)	12 (16)	9 (26.5)
BMI, kg/m²		
Mean ± SD	29.4 ± 3.5	28 ± 3.7
Median	29.0	27.8
IQR	26.9-31.9	25.8-29.7
Smoking status: yes/no/ex, n	14/40/21	5/18/11
CPAP users, n		
"Do you own a CPAP machine?": "Yes"	50	9
Answers	74	22
ESS baseline, score		
Mean ± SD	9.2 ± 5.3	8.7 ± 5.3
Median	10	9
IQR	5-13	4-13
SNOT-22 baseline, score		
Mean ± SD	38.3 ± 20.7	30.2 ± 14.7
Median	38	29.5
IQR	24.5-52	19.3-36
Tonsil size grading, n		
0/1/2/3/4	11/32/24/7/0	8/12/8/2/1
Answers	74	31
Friedman tongue position class, n		
I/IIa/IIb/III/IV	5/17/21/30/1	9/6/9/7/0
Answers	74	31
Lingual tongue hypertrophy degree, n		
0/1/2/3/4	6/12/24/26/5	5/7/8/10/0
Answers	73	30

AHI = Apnea-Hypopnea Index; CPAP = continuous positive airway pressure; ESS = Epworth Sleepiness Scale, score 0-24; IQR = interquartile range; SD = standard deviation; SNOT-22 = Sino-Nasal Outcome Test 22, score 0-110.

Recommendations after DISE are shown in **Figure 3.** The most recommended surgical procedure was tonsillectomy, with 19 patients in total being recommended tonsillectomy as sole treatment and 27 patients being recommended a combination of tonsillectomy and other treatment, the most common being surgery of the velum. The most recommended non-surgical treatment was MAD, with 34 patients; of these, 16 patients had

MAD combined with other treatments. Fifteen patients were recommended to use CPAP, hereof four patients as the only treatment.

FIGURE 3 **A**. Treatment suggestions for 109 patients after undergoing drug-induced sedation endoscopy (DISE). **B**. Treatment suggestions based on DISE for 75 patients with Apnea-Hypopnea Index (AHI) ≥ 15 events/hour. **C**. Treatment suggestions based on DISE for 34 patients with AHI < 15 events/hour.



CPAP = continuous positive airway pressure; MAD = mandibular advancement devices; SPT = sleep positional trainer.

Discussion

In our study, we included 109 patients undergoing DISE due to OSA or socially invalidating scoring.

Based on DISE findings, surgery was proposed for 51% of the patients. Tonsillectomy was the most common surgical recommendation, often in conjunction with velum surgery. Surgery was more commonly recommended in patients with an AHI ≥ 15 events/hour than among those with an AHI < 15 events/hour.

For patients with an AHI < 15 events/hour, MAD was the most frequently advised non-surgical treatment.

Non-surgical treatments such as MAD, CPAP and SPT were primarily recommended for patients with an AHI < 15 events/hour, of which MAD was the most frequently suggested option.

In Denmark, MAD is classified as a dental device and is not covered by the public health service, unlike surgery and CPAP devices. This could potentially reduce the number of patients opting for this treatment, as the cost of acquiring a MAD can be substantial. However, ongoing work is in process to introduce reimbursement for MAD, as studies have shown promising results with the use of MAD in mild and moderate OSA [16].

Even though the patients in this study had previously attempted to use CPAP, some were still recommended this treatment based on the findings from the DISE. This could include different mask types or other remedies to increase CPAP compliance.

A Swedish study by Sundman et al. [17] found that patients who underwent modified uvulopalatopharyngoplasty

surgery, which included tonsillectomy, experienced a significant long-term decrease in AHI. However, a later study by Sundman et al. [18] provided evidence that patients with moderate to severe OSA and tonsillar hypertrophy (sizes 2-4 according to Friedman staging) did not benefit more from a combination of modified uvulopalatopharyngoplasty (UPPP) and tonsillectomy than from tonsillectomy alone. This should be considered when choosing a treatment for patients in this study who were recommended a combination of velum surgery and tonsillectomy. A systematic review showed that lateral-expansion pharyngoplasty and barbed reposition pharyngoplasty improved AHI and patient-reported outcomes [10]. Such surgical interventions are proposed when DISE show anterior-posterior collapse of the velum and lateral collapse at the oropharyngeal level.

Estimating the degree of obstruction is subjective and depends on the DISE operator. A study by Zainali-Gill et al. [19] concluded that multiple DISE evaluations are needed before one becomes familiar with DISE interpretation. In this study, the procedure was recorded, and the obstruction was evaluated by two oto-rhino-laryngologists to enhance reproducibility.

During DISE, the patient's jaw was protruded to mimic the effect of a MAD or MMA and assess whether the patient experienced any effects. This method of determining whether the patient would benefit from using a MAD is less precise than trying an oral device during DISE and may have led to more patients being recommended this treatment than necessary.

Due to the high cost to the patient of obtaining a MAD, this study includes patients who choose to undergo DISE but might have otherwise benefited from a MAD had they obtained one. As the DISE procedure is also costly, it might be considered to provide a MAD through public healthcare to patients who may potentially benefit from it and only carry out the DISE procedure if the treatment proves to be ineffective.

An interesting observation from our study was the willingness of patients, primarily identified as snorers, to undergo surgical procedures. This inclination towards surgery, despite not having a formal OSA diagnosis, highlights the profound effect that persistent snoring can have on an individual’s daily life.

Persistent snoring can lead to disrupted sleep, resulting in daytime tiredness, mood swings and reduced cognitive performance. It may also cause considerable discomfort to sleeping partners, affecting personal relationships and overall mental health. Consequently, many snorers opt for surgery to mitigate these issues and enhance their quality of life. Additionally, snoring can be an early sign of OSA, and some patients may opt for surgery as a preventative measure to halt the progression of their condition. Surgical procedures like tonsillectomy or UPPP can potentially rectify the anatomical irregularities that cause snoring and lower the risk of developing OSA.

However, it is important to note that surgery is not a universal solution and may not be the best treatment option for all snorers. Systematic documentation on the effect of non-surgical treatment modalities is needed to personalise treatment for each patient. A thorough evaluation, including DISE, is crucial to determine the most appropriate treatment based on the individual’s specific condition and requirements.

Conclusions

Alternative treatments to CPAP for OSA are needed because of low adherence. DISE is an additive procedure to identify patients who are eligible for upper airway surgery or non-surgical treatment when CPAP is not tolerated or is otherwise deselected. Sleep surgery was suggested to 51% of patients included in this study, the most frequent surgery being tonsillectomy, either with or without surgery of the velum. Sleep surgery was advised more often among patients with AHI ≥ 15 events/hour. The most recommended non-surgical treatment was MAD; however, MAD was often neglected due to the acquisition costs. Data on the effect of different upper

airway surgeries and the acquisition of MAD are needed and will be provided.

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