Drug Induced Sleep Endoscopy (DISE)

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What is DISE?

Evaluate upper airway collapses dynamically under induced sleep

| Bronchoscopy | DISE |
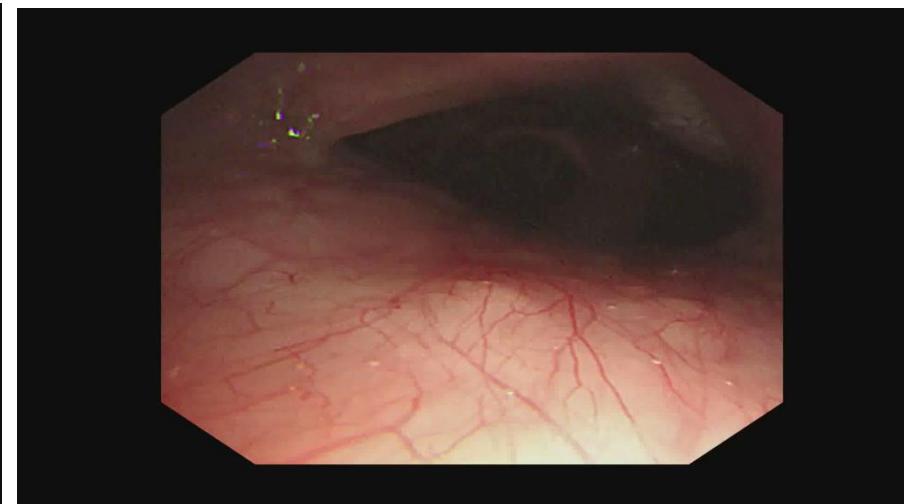
Purpose of DISE

- Help to determine treatments for obstructive sleep apnea patients
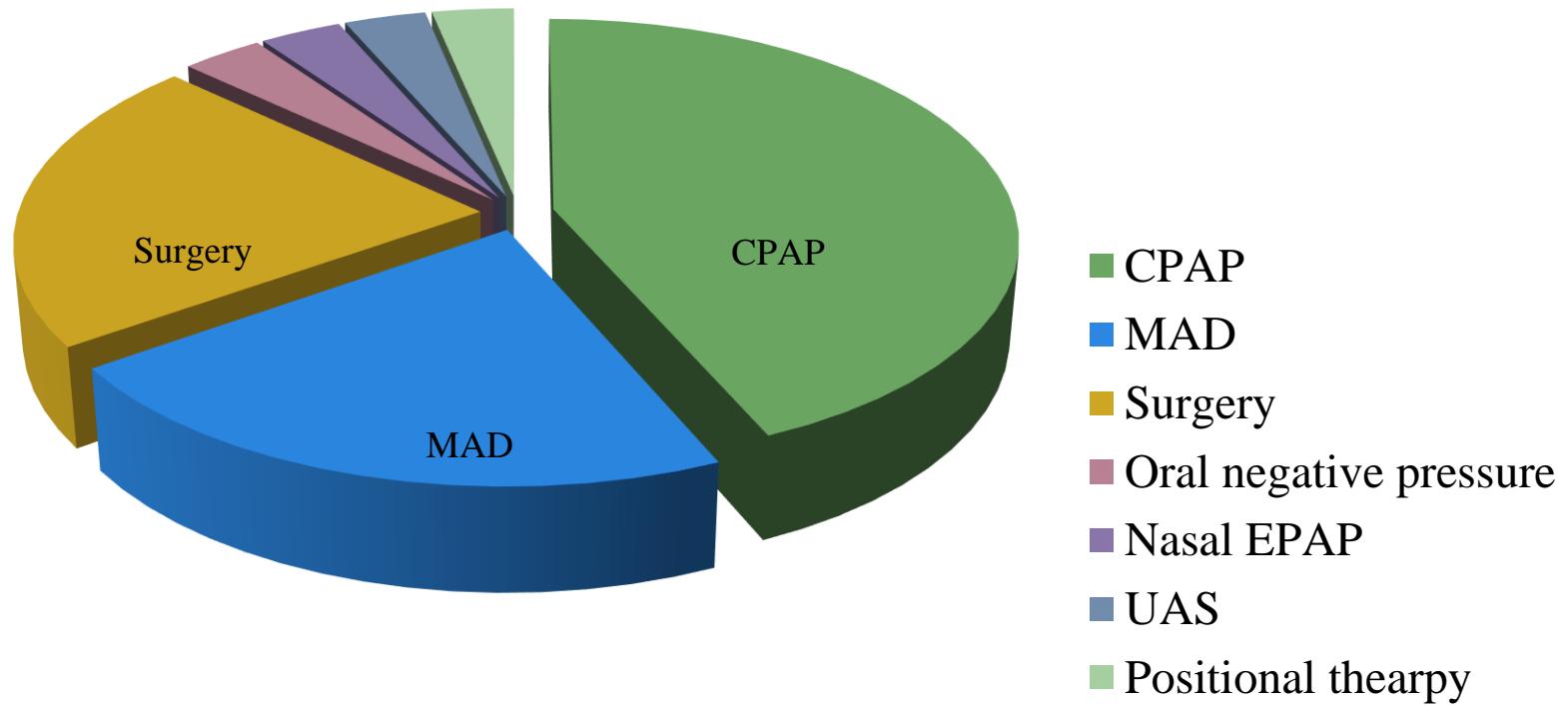
# Traditional assess methods

- Physical examinations
  - Modified Mallampati's score
  - Tonsil enlargements
  - Friedman classification
  - Overbite or retrognathia

- Cephalometry

- Nasal endoscopy with Muller's Maneuver

Purpose of DISE

- Guide surgical plans for OSA patients

Palatal surgery
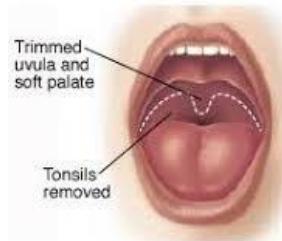
Pillar procedure

Tongue base surgery
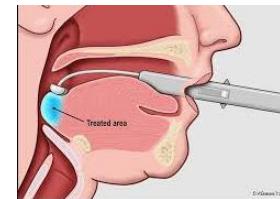
Hyoid suspension
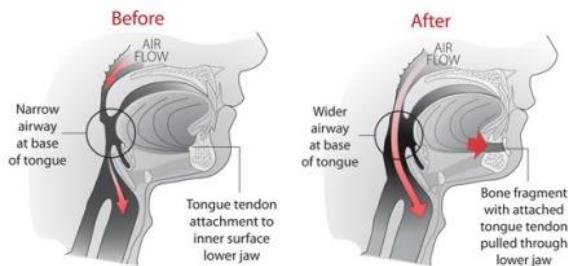
Maxillomandible advancement surgery
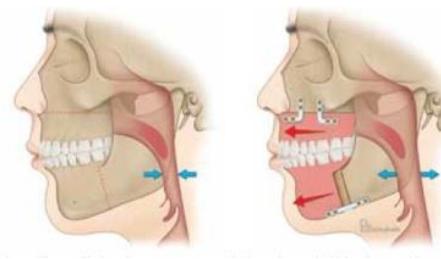
Evolution of sleep endoscopy

- 1978 Borowiecki : nature sleep endoscopy

- 1982 Rojewski: PSG, nature sleep endoscopy

- 1991 Croft and Pringle: drug induced sleep endoscopy
  - Midazolam sedation
  - Grading : palatal, multilevel, or tongue-based

Number of publications on DISE per year (1990-2016)
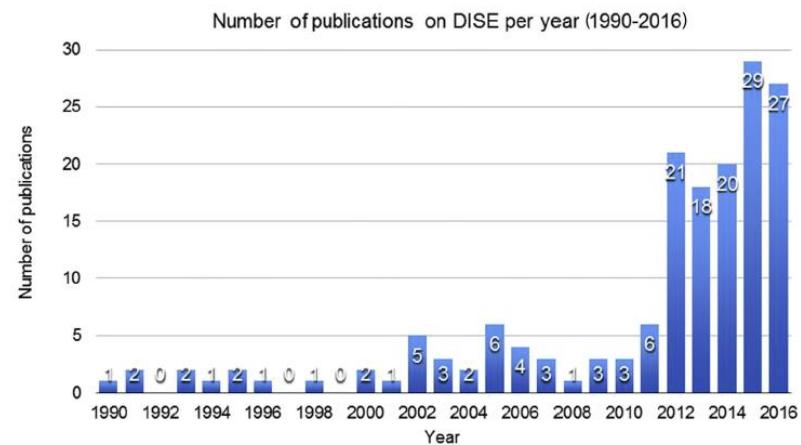
Factors affect DISE interpretation

- Sedatives and sedation depth
- Grading systems

Sedatives - Midazolam

Bolus technique
Starting dose: 0.03-0.05 mg/kg
Increase doses: 0.015 – 0.03 mg/kg q2-5 min

Respiratory drive ↓
Pcrit ↔

BP ↔
HR ↔

Light sleep
(N1,N2)

Induction and
recovery time ↑

Half life: 1.5 hrs

Clin Otolaryngol. 2018 Dec;43(6):1541-1552

Sedatives - Propofol

Target Control Infusion: (effect site concentration):
Starting dose: 2.0-2.5 µg/mL, increase dose of 0.2-0.5 µg/mL every 2 min
Manually controlled infusion: Delivering dose: 50-100 mL/h
Bolus: starting dose: 30-50 mg, increasing rate of 10 mg every 2 min

Respiratory drive ⬇
Pcrit ⬆
(dose dependent)

BP ⬇
HR ⬇

NREM

Induction and recovery time ⬇

Triphasic HL
 1.8-9.5mins
20-60 mins
1.5-31 hrs

Sedatives - Dexmedetomidine

Induction: 1.5 µg/kg over 10 minutes,
Maintain: 1.5 µg/kg/h

Respiratory drive ⟷
Pcrit ⟷

BP ⟷
HR ↓

Light sleep
(N1,N2)

Induction and
recovery time ↑

distribution HL: 6 mins
elimination HL: 2hrs

Sedatives depth during DISE

- Loss of conscious
  - Ramsay score
  - OAA/S

Level	Characteristics
1	Patient awake, anxious, agitated, or restless
2	Patient awake, cooperative, orientated, and tranquil
3	Patient drowsy, with response to commands
4	Patient asleep, brisk response to glabella tap or loud auditory stimulus
5	Patient asleep, sluggish response to stimulus
6	Patient has no response to firm nail-bed pressure or other noxious stimuli

- Snoring start and stable sedation level and consistent breathing patterns

Snoring → Obstructive hyponea/apnea → Desaturation → Breathing

2 cycles or 1 mins
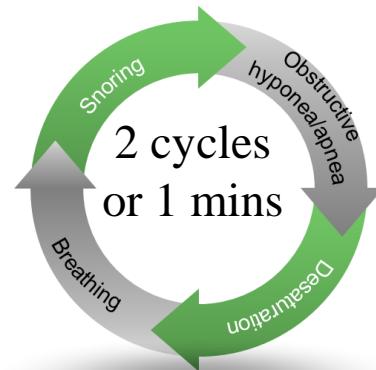
BIS for sedative depth monitor

- EEG-derived indices: Bispectral index (BIS), cerebral state index (CSI), sleep recording,
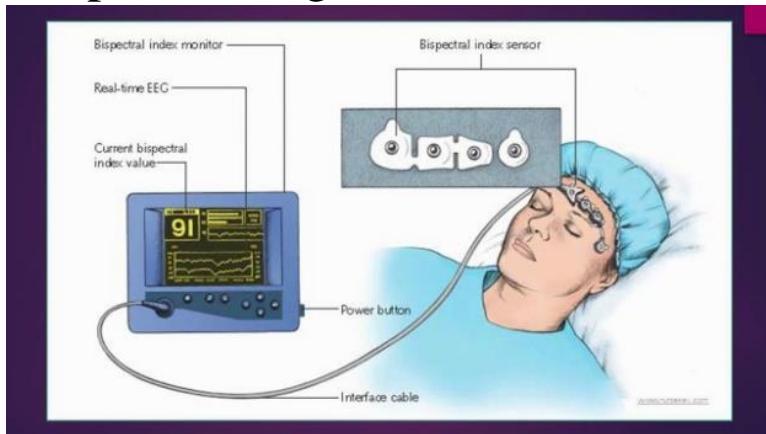
- BIS range : 60-80 (moderate sedative level)

DISE grading systems

Authors, reference number	Year	Name of grading system
Pringle [16]	1991	Croft&Pringle
Camillieri [54]	1995	
Quinn [36]	1995	
Sadaoka [55]	1996	
Higami [56]	2002	
Iwanaga [57]	2003	
Kezirian [48]	2011	VOTE
Vicini [49]	2012	NOHL
Bachar [58]	2012	
Victores [59]	2012	
Gillespie [60]	2013	DISE index
Koo [61]	2013	modified VOTE (1)
Lee [62]	2015	
Herzog [63]	2015	
Carrasco-Llatas [64]	2016	Modified VOTE (2)
Dijemeni [51]	2017	uDISE
Kotecha-Lechner [52]	2018	Modified Croft&Pringle

Checklist (x indicates that grading system tak...

Anatomy levels	Severities	Patterns
Velophaynx	None	Anteroposterior (AP)
Tonsil	Partial	Lateral
Lateral pharyngeal wall (oro or hypopharynx)	Complete	Concentric (circular)
Tongue base		
Epiglottis		
Larynx		
Multi segmental		
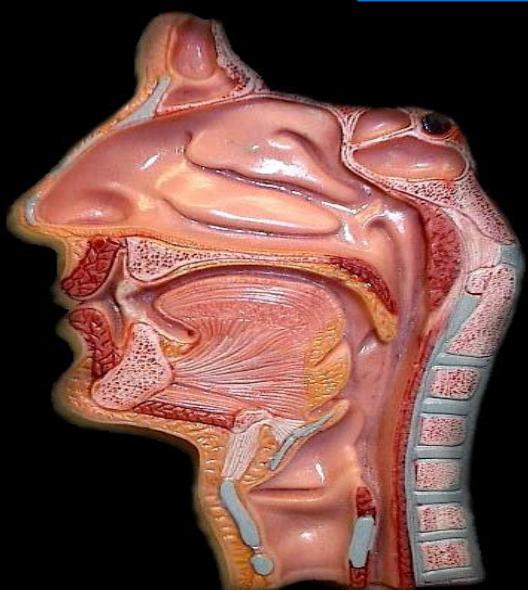
collapse

Configuration divided up into AP, lateral and contributing structures and related to the level at which these different configurations ca... occur

AP, lateral, concentric

AP, lateral, concentric

...grade 3) AP, lateral, concentric

Velum

- Severities: None/Partial/Complete
- Patterns: AP/Lateral/Concentric

Concentric obstruction
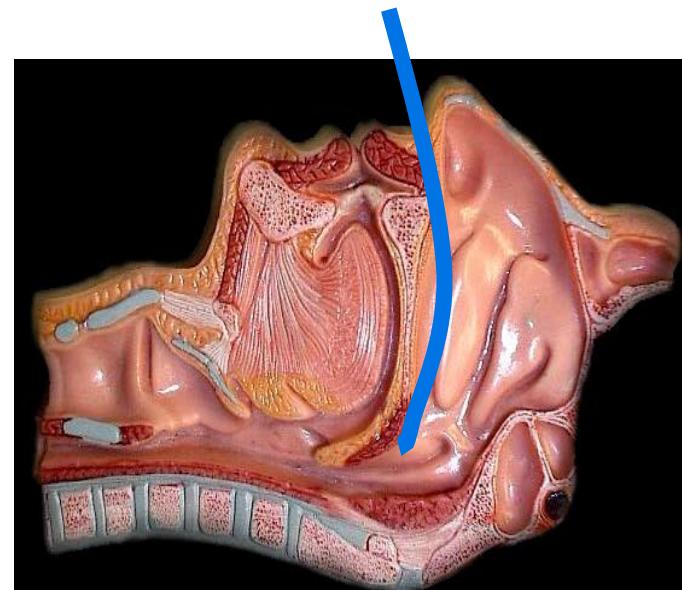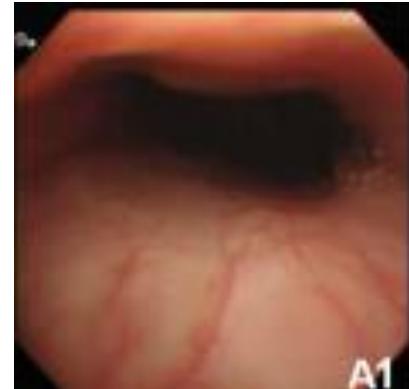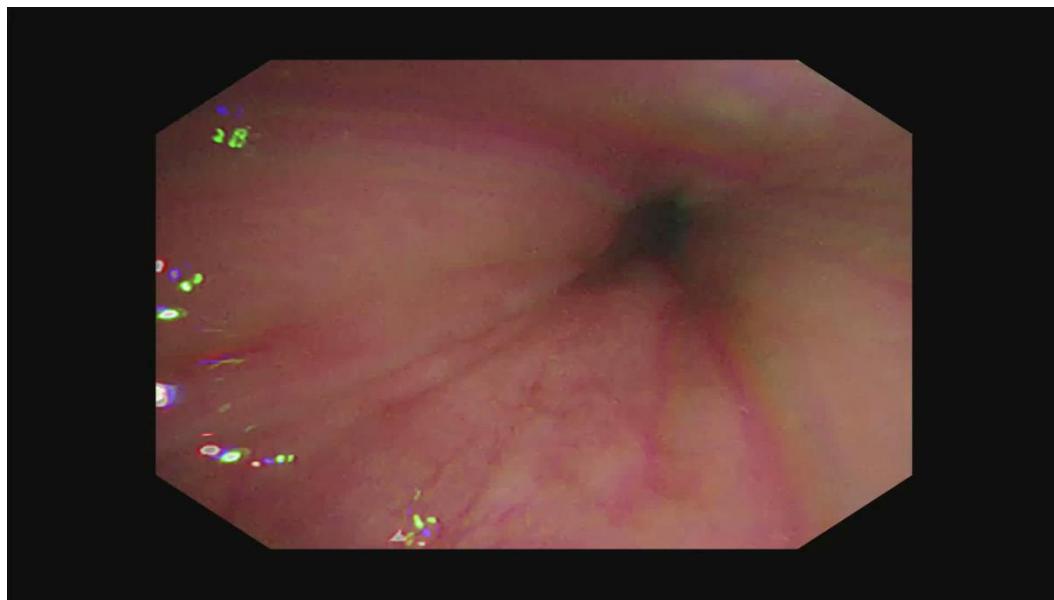
Velum

- Severities: None/Partial/Complete
- Patterns: AP/Lateral/Concentric

AP obstruction
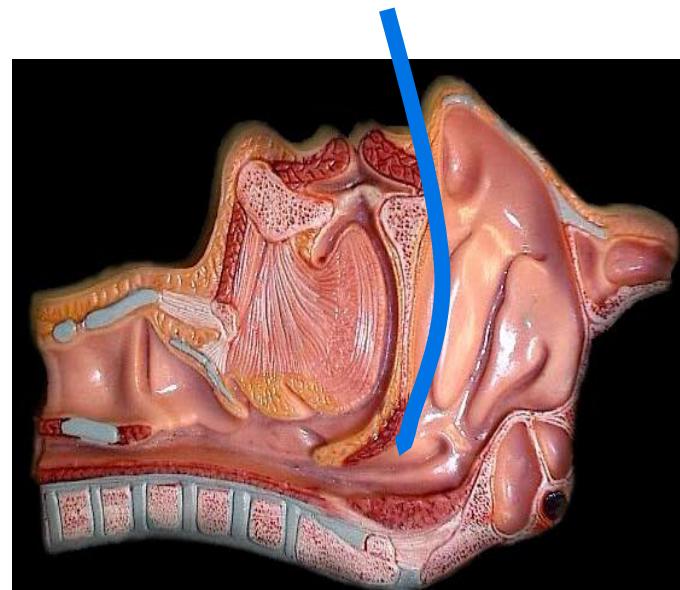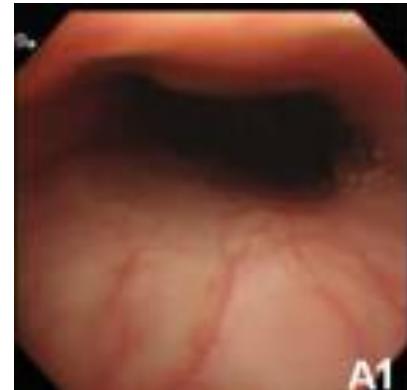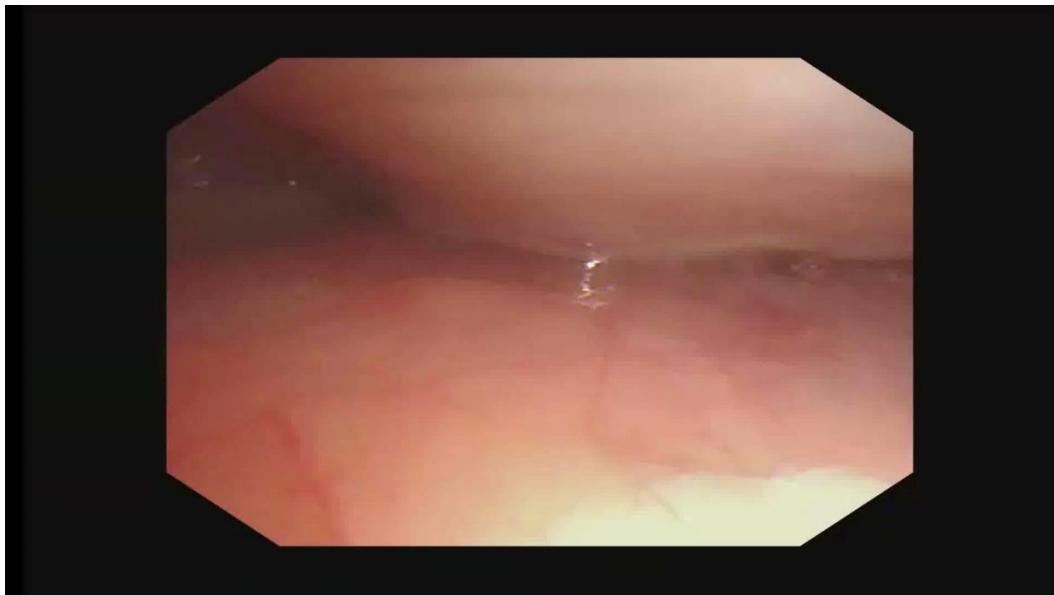
Tonsil
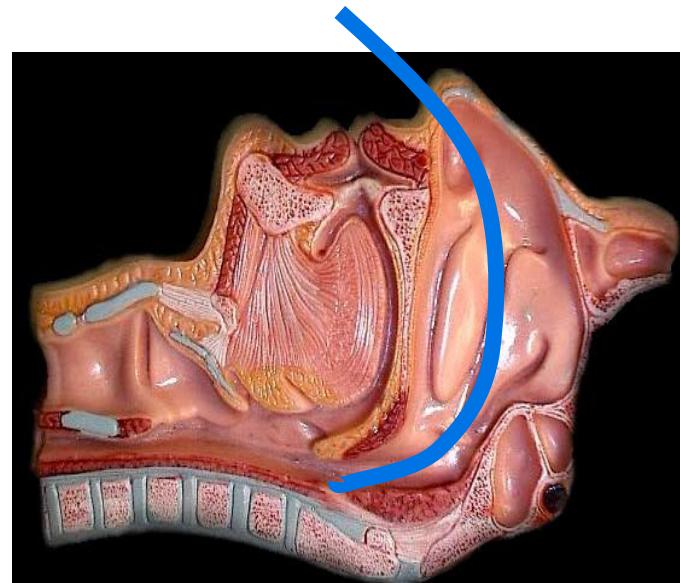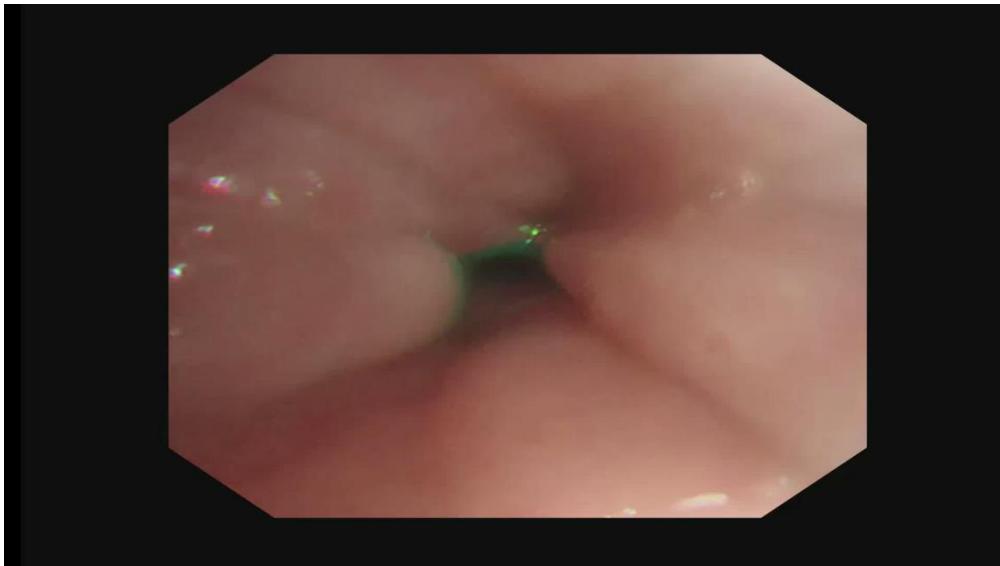
Lateral pharyngeal wall

- Oropharynx or hypopharynx
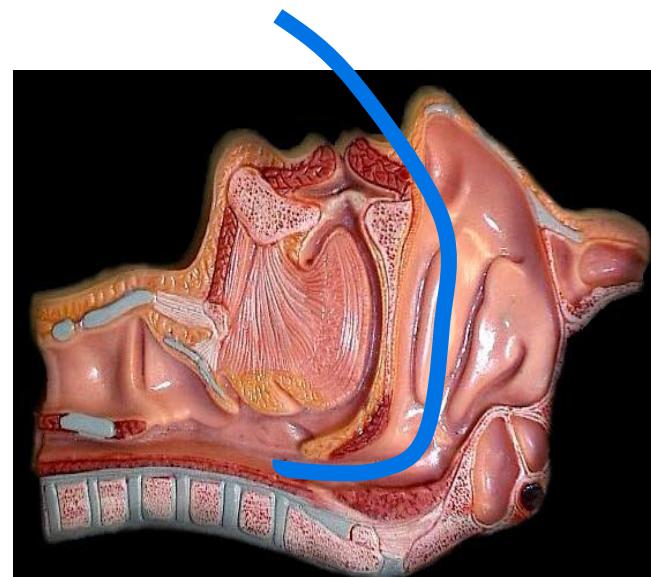
Tongue base

- Severities: None/Partial/Complete
- Type: AP

Tongue base obstruction
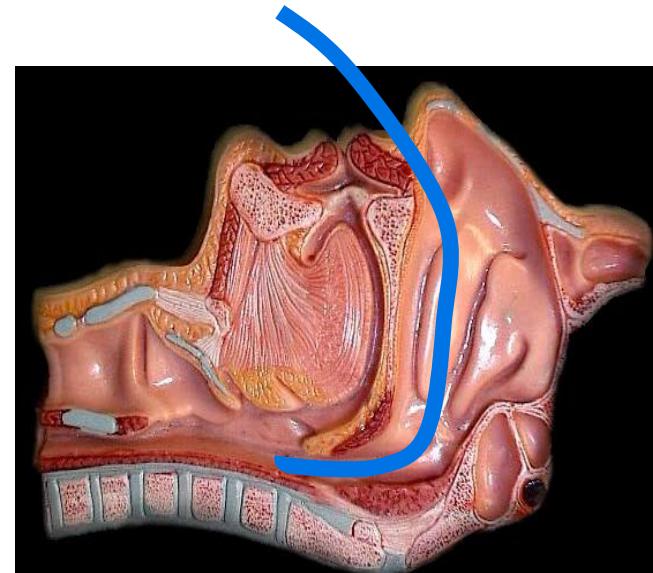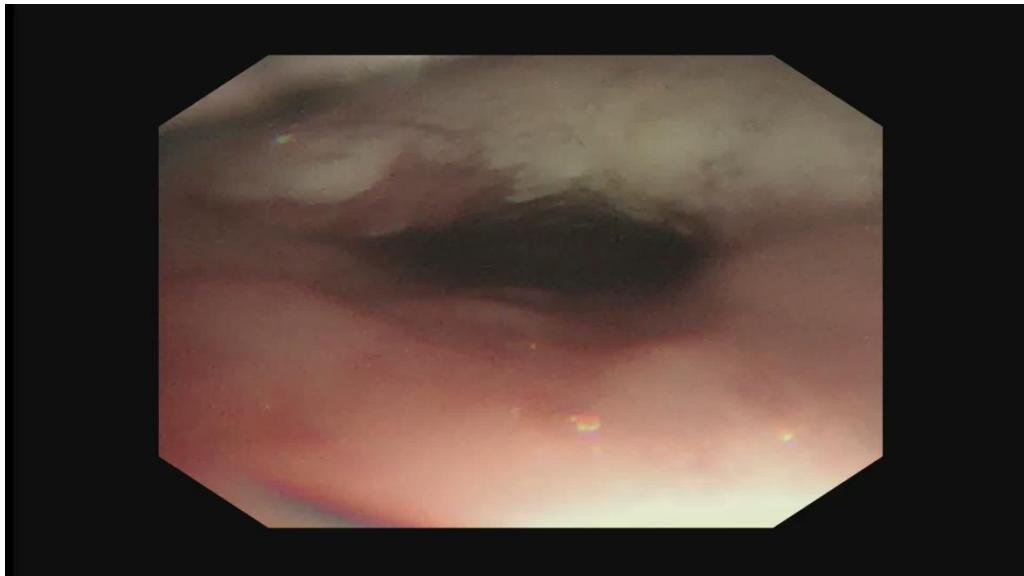
Tongue base

- Severities: None/Partial/Complete
- Type: AP

Lingual tonsil obstruction
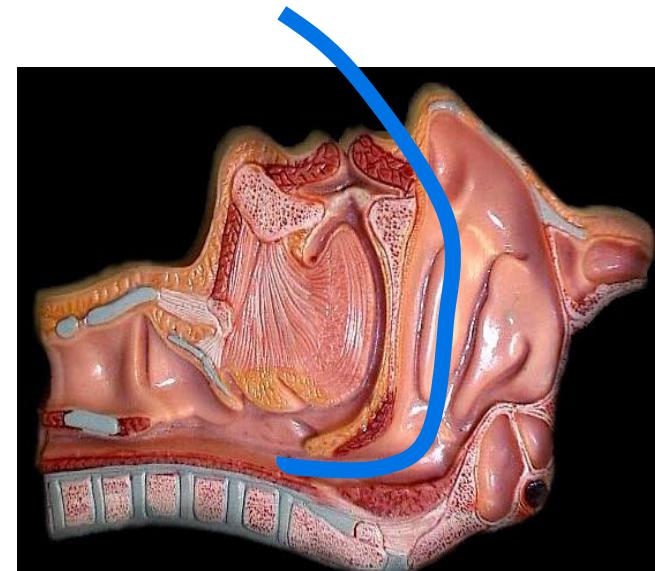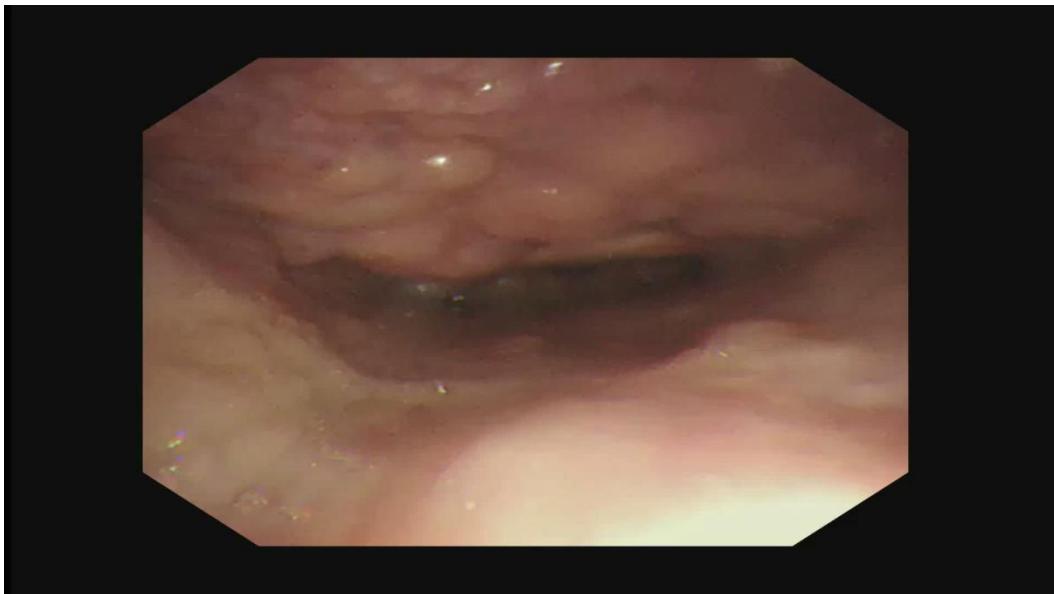
Larynx – epiglottis prolapse (trapdoor phenomenon)
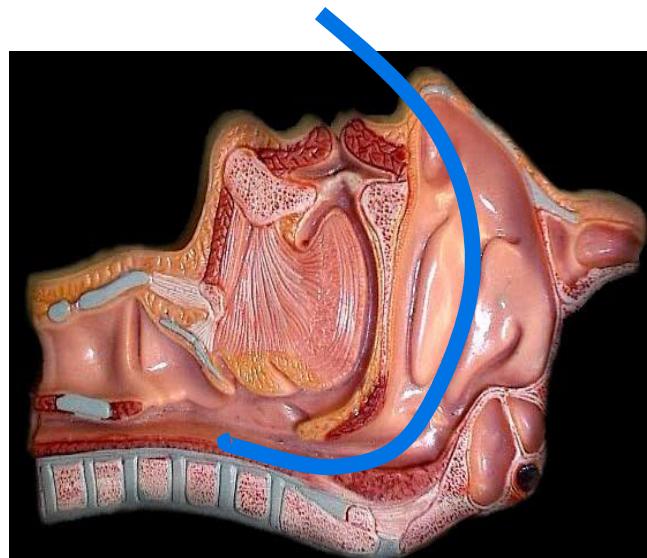
Larynx – epiglottis folding
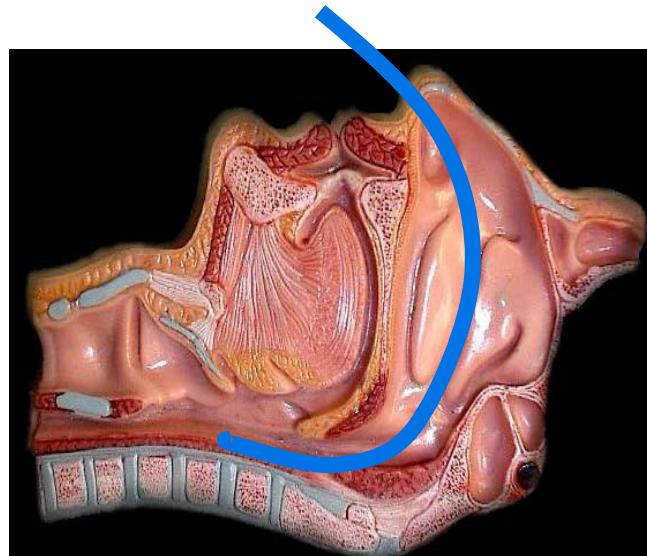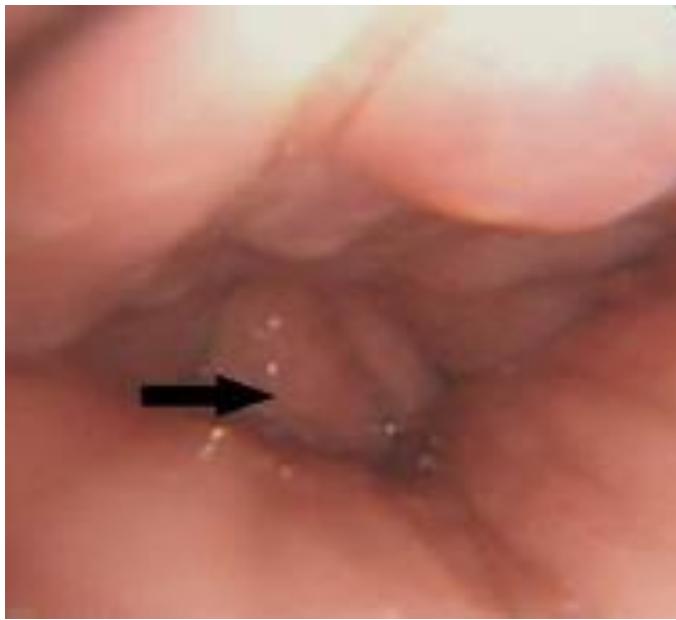
Larynx – arytenoids prolapse
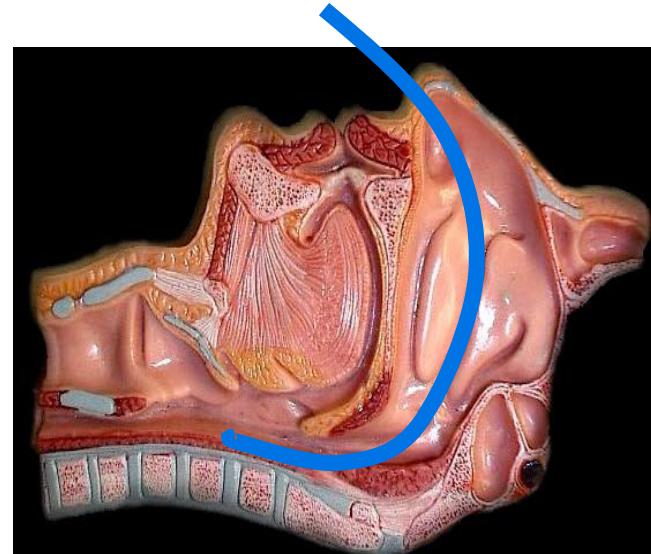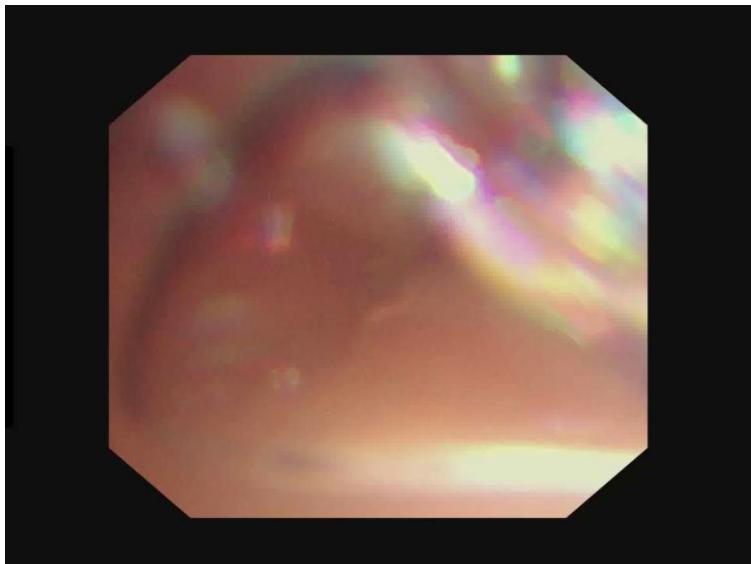
Pringle and Croft classification

- 1991 -2010

Grade 1—Simple snoring

Grade 2—Palatal obstruction

Grade 3—Multisegment intermittent obstruction

Grade 4—Sustained multisegment collapse

Grade 5—Tongue base obstruction

VOTE classification

- V velum
- O oropharynx
- T tongue base
- E epiglottis

STRUCTURE	DEGREE OF OBSTRUCTION[a]	CONFIGURATION[c]		
		A-P	LATERAL	CONCENTRIC
Velum				
Oropharynx[b]				
Tongue Base				
Epiglottis				

NOHL classification

N   nose
O   oropharynx
H   hypopharynx
L   larynx

Site	Nose static obstruction	Oropharynx	Hypopharynx	Larynx a. Supraglottic b. glottic
Static nasal obstruction/ pharynx collapse % grade value	1: 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	1: 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	1: 0-25% 2. 25-50% 3. 50-75% 4. 75-100%	Positive or negative

Preparation of DISE

- Location

OP room

endoscopy suite

- Monitors
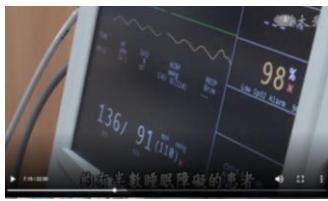
BIS 60-80

Preparation of DISE

avoid local
anesthesia

as thin as
possible

DISE

Sedation

Supine + another posture

Sedatives depth would affect DISE findings

Table 3—Effects of sedation and obstructive sleep apnea disease severity on different drug-induced sleep endoscopy obstruction patterns.

| | Sedation Depth | | OSA Severity | | | | | |
| | | | Mild | | Moderate | | Severe | |
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Velopharynx obstruction severity	4.5[c]	3.0, 6.8	2.6	0.9, 7.5	6.0[c]	2.3, 15.9	14.3[c]	4.7, 43.4[d]
Velopharynx obstruction pattern	0.9	0.6, 1.4	0.9	0.2, 4.0	1.0	0.2, 4.0	0.7	0.2, 2.6
Oropharynx obstructions severity	6.3[c]	4.0, 10.0	2.5	0.8, 7.6	3.5[a]	1.3, 9.1	11.7[c]	4.2, 32.9[d,e]
Oropharynx obstruction pattern	1.8[a]	0.3, 0.9	1.7	0.2, 10.1	0.7	0.1, 4.4	0.2	0.0, 1.8
Tongue base obstruction	4.9[c]	3.0, 8.0	2.1	0.9, 4.9	2.2[a]	1.1, 4.5	3.3[b]	1.6, 6.9
Larynx obstruction								
Epiglottis anteroposterior prolapse	4.0[c]	2.7, 6.1	1.2	0.5, 3.1	0.7	0.3, 1.7	1.5	0.6, 3.7
Epiglottis folding	2.2[b]	1.2, 4.0	1.9	0.2, 18.9	0.9	0.1, 11.0	3.8	0.4, 35.1
Arytenoid prolapse	5.0[c]	2.9, 8.5	2.1	0.5, 9.5	3.4	0.8, 15.2	13.2[c]	2.8, 62.3[d,e]
Hypopharynx obstruction	1.3	1.0, 1.6	1.288	0.3, 4.9	1.4	0.4, 4.6[a]	5.5[a]	1.4, 20.9[d,e]

General estimation equations for the evaluation of different DISE results. Variables included sedation depth and OSA severity. Age, body mass index, and neck circumference were adjusted as covariates. Light sedation and normal subjects were taken as reference categories, respectively. [a]$p < 0.05$. [b]$p < 0.005$. [c]$p < 0.001$. [d]Postestimation analysis showed significant differences ($p < 0.05$) between patients with severe and mild OSA. [e]Postestimation analysis showed significant differences ($p < 0.05$) between patients with severe and moderate OSA. CI, confidence interval; DISE, drug-induced sleep endoscopy; OR, odds ratio; OSA, obstructive sleep apnea.

J Clin Sleep Med. 2015 Sep 15;11(9):1011-20

Sedatives agents would affect DISE findings

- Midazolam vs. propofol vs. dexmedetomidine

TABLE III.
Agreement Between Drugs for Different DISE Findings

Site	Combination	K^*	Lower CI[†]	Upper CI[†]
Velum degree	Midazolam × propofol × dexmedetomidine	0.84	0.70	0.98
	Midazolam × propofol	0.87	0.64	1.00
	Midazolam × dexmedetomidine	0.76	0.48	1.00
	Propofol × dexmedetomidine	0.88	0.65	1.00
Velum pattern	Midazolam × propofol × dexmedetomidine	0.73	0.61	0.84
	Midazolam × propofol	0.74	0.58	0.90
	Midazolam × dexmedetomidine	0.74	0.58	0.89
	Propofol × dexmedetomidine	0.71	0.54	0.87
Oropharynx degree	Midazolam × propofol × dexmedetomidine	0.74	0.62	0.85
	Midazolam × propofol	0.78	0.64	0.93
	Midazolam × dexmedetomidine	0.67	0.50	0.83
	Propofol × dexmedetomidine	0.76	0.61	0.91
Tongue base degree	Midazolam × propofol × dexmedetomidine	0.29	0.17	0.40
	Midazolam × propofol	0.34	0.17	0.52
	Midazolam × dexmedetomidine	0.16	0.04	0.29
	Propofol × dexmedetomidine	0.48	0.29	0.66
Epiglottis degree	Midazolam × propofol × dexmedetomidine	0.76	0.61	0.90
	Midazolam × propofol	0.76	0.60	0.93
	Midazolam × dexmedetomidine	0.71	0.52	0.90
	Propofol × dexmedetomidine	0.80	0.64	0.96
Epiglottis pattern	Midazolam × propofol × dexmedetomidine	1.00	1.00	1.00
	Midazolam × propofol	1.00	1.00	1.00
	Midazolam × dexmedetomidine	1.00	1.00	1.00
	Propofol × dexmedetomidine	1.00	1.00	1.00

- Number of obstruction sites did not show difference among 3 drugs

- Midazolam and propofol presented higher incidence of tongue base collapse
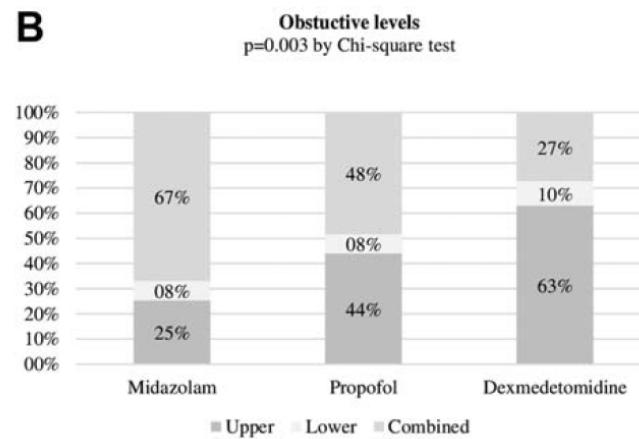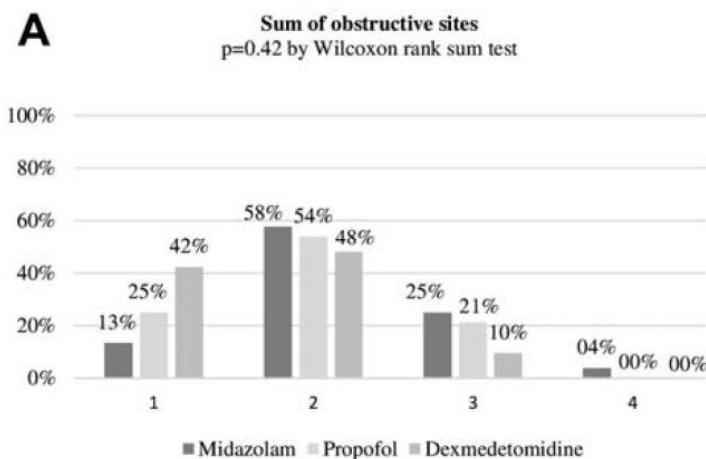

VO → upper
TE → lower

Impact of DISE in patient selection for non-surgical and surgical treatments

Predict MAD success
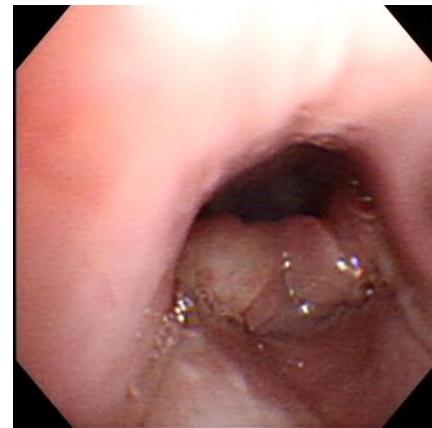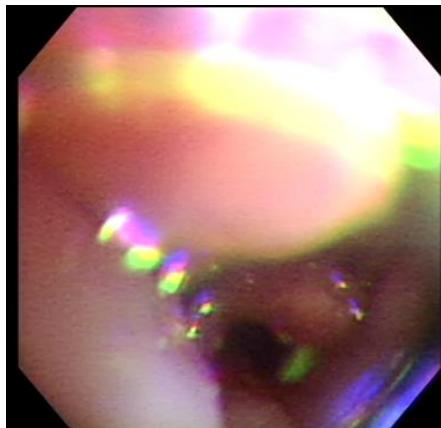
69 y/o female,
AHI 39.4,
BMI 24.5

Suggest: advance 5mm

Mandible advancement
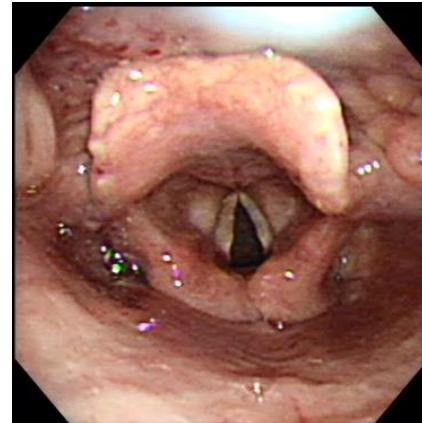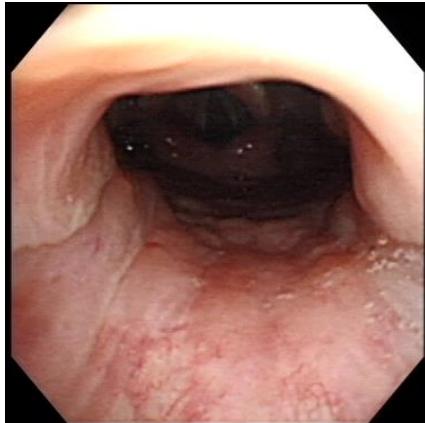
Select candidates for single-level palatal surgery or multi level surgery

- Single palatal obstruction by DISE
 - ➤ Higher portion had long term benefit from LAUP

- DISE to guide surgeries including palatal surgery, tongue base surgery and hyoid bone suspection
  - ➤ velopharynx circumferential complete obstruction
  - ➤ complete antero-posterior collapse at tongue base
 - ➤ arytenoid prolapse
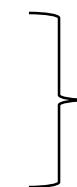
Surgical failure
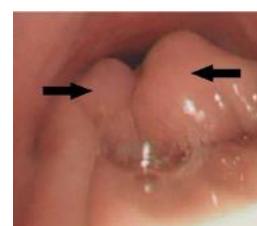
Laryngol Otol 2006;120:932-8.
Laryngoscope. 2012 Nov;122(11):2587-91
Clinical Otolaryngology. 2018;43:1541–1552.

Evaluate etiology of CPAP failure

- Epiglottis prolapse (trapedoor phenomenum)

Trans-oral robotic surgery for partial epiglottis resection

$\longrightarrow$
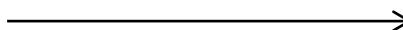
- Oropharyngeal collapse ex, tonsillar hypertrophy with lateral wall obstruction

Predict UAS failure

- No concentric complete obstruction at velum predict UAS success
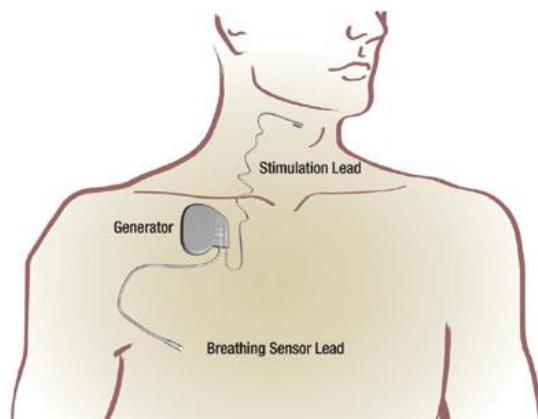
Summary

- DISE allows meticulous endoscopic evaluation of the airway and identifies areas of collapse.

- Sedative agents, monitors, and DISE grading systems could be selected based on experience. BIS monitor should be applied if available.

- DISE is helpful on the selection of surgical techniques and on the usefulness of conservative measures, such as mandibular advancement splints.