

OBSTRUCTIVE SLEEP APNOEA
ASSESSMENT, MANAGEMENT
AND NICE GUIDANCE

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For the Midlands Institute of Otorhinolaryngology

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LEARNING OBJECTIVES

1. To identify what OSA is and how it is graded.
2. To understand the pathophysiology of OSA
3. To appreciate the consequences of untreated OSA.
4. To understand the contributors to OSA.
5. To assess a patient with Sleep Disturbed Breathing.
6. To gain an overview of the treatment options
7. To consider NICE guidance on treatment for OSA

OBSTRUCTIVE SLEEP APNOEA

Periodic collapse / partial collapse of the pharyngeal airway during sleep resulting in apnoea or hypopnoea due to obstruction despite persistent ventilatory effort.

Decrease in pharyngeal muscle tone during sleep.

Abnormal anatomy anywhere between the nasal aperture and the laryngeal inlet.

2% of women and 4% of men worldwide.

2.7% in England population.

Age and obesity are major predictors of its likelihood.

Increasing incidence.

OBSTRUCTIVE SLEEP APNOEA

- Measured by Apnoea / Hypopnoea Index (AHI)
- Apnoea - cessation of airflow for more than 10s.
- Hypopnoea - > 50% decrease in airflow > than 10s.
- Grades of OSA by (AHI)
 - 5 to 15 events/hour – mild OSA
 - 15 to 30 events/hour – moderate OSA
 - > 30 events/hour – severe OSA

PATHOPHYSIOLOGY OF OSA : THE PHARYNX IS A TUBE

Bernoulli principle*:

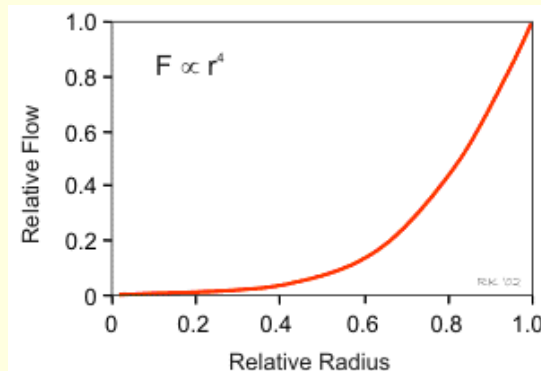
“as the velocity of a fluid increases, the pressure exerted by that fluid decreases.”

= inspiratory effort will lead to a higher negative pressure at the narrowest point, predisposing to collapse

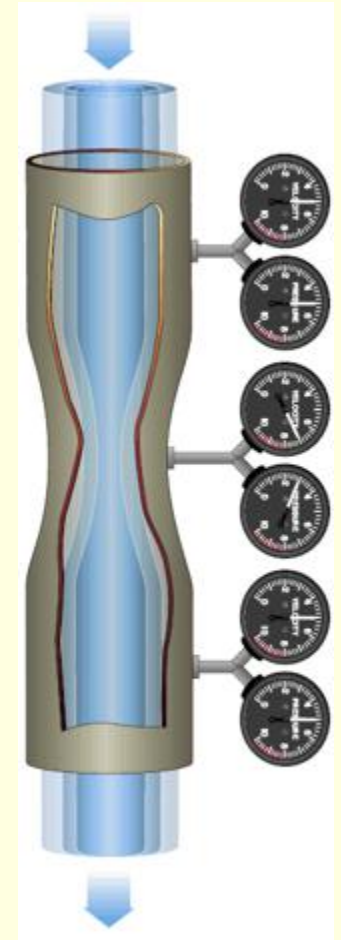
Poiseuille's Equation*:

“resistance to airflow increases proportional to tube length and is inversely proportional to the radius to the fourth power.”

= a long narrow tube poses a considerable resistance to flow.
= more effort (suction pressure) to ventilate the lungs effectively.



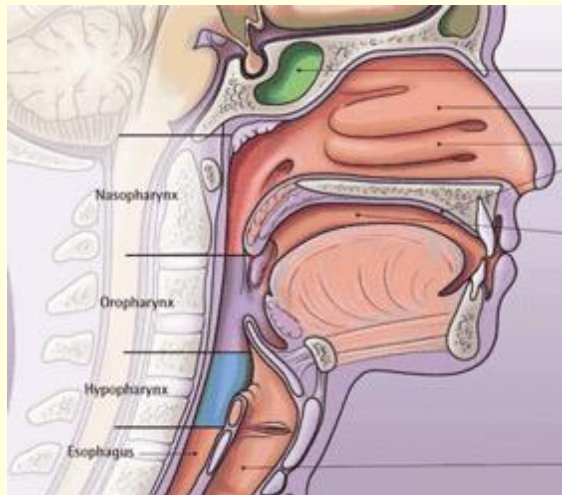
$$R \propto \frac{\eta \cdot L}{r^4}$$



* assuming laminar flow

SNORING

- Turbulent airflow from Nose to Laryngeal inlet
- Prevalence of 40-50%
- Spectrum Snoring ->>> OSA



Resistance
Anatomical obstruction
Reduced muscle tone
Redundant mucosa
Bulky anatomy
Mouth breathing

CONSEQUENCES OF OSA

- On the **person**:
 - Disordered sleep patterns
 - Unrefreshing sleep
 - Daytime somnolence
 - Behavioral problems
 - Depression
 - Poor school/ work performance
 - Relationship disharmony!

All I Want Is a Good Night's Sleep



CONSEQUENCES OF OSA

- On the **body**:
 - Hypertension proportional to OSA severity
 - Myocardial infarction
 - Congestive Heart Failure
 - Cardiac Arrhythmias
 - Cerebral Vascular Accident
 - Diabetes Type II and Obesity

CONSEQUENCES OF OSA

- On the **roads**:
 - 6-15x more likely to have RTA.
 - 20% of motorway accidents due to sleeping at wheel.
 - DVLA - must stop driving until treated
 - Must not drive if Excessive Daytime Tiredness
 - Car drivers must have review every 3 yrs minimum
 - Bus and Lorry drivers review every 1 year minimum

CONDITIONS ASSOCIATED WITH OSA SYNDROME

NOSE

Deviated septum
Polyposis
Inferior turbinate hypertrophy
Septal dislocation

NASOPHARYNX

Carcinoma
Adenoid hypertrophy
Lymphoma
Stenosis
Papillomatosis

MOUTH AND OROPHARYNX

Hypertrophic tonsils
Lymphoma of tonsils
Lingual cyst
Lingual tonsillar hypertrophy
Macroglossia
Micrognathia
Lipoma of neck
Hunter syndrome
Head & neck burns
Papillomatosis

LARYNX

Edema of supraglottic structures
Vocal cord paralysis

NEUROMUSCULAR

Cerebral palsy
Myotonic dystrophy
Muscular dystrophy
Myasthenia gravis
Multiple sclerosis
Hypothyroidism
Chiari malformation
Spinal cord injury
Bulbar Stroke
Etc.

CLINICAL PRESENTATION OR WHEN TO SUSPECT OSA - NICE (NG202) 2021

Night time symptoms	Daytime symptoms	Co-morbidities
Snoring	Unrefreshing sleep	High BMI
Witnessed Apnoeas	Daytime somnolence	Hypertension
Sleep Fragmentation	(through ESS)	Type 2 DM
Insomnia	Headache	Cardiac arrhythmias
Night sweats	Poor concentration	Stroke / TIA's
Nocturia	Cognitive Impairment	Heart Failure
Nocturnal choking		Asthma
		PCOS
		Trisomy 21
		Hypothyroidism
		Acromegaly

DIAGNOSIS OF OSA

■ Clinical Examination

- Head, neck and upper airway
- Flexible nasendoscopy

■ Sleep Questionnaire

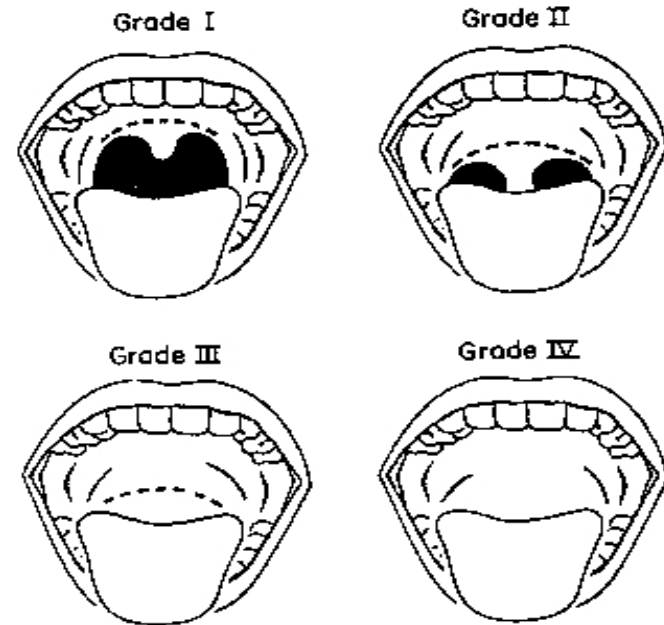
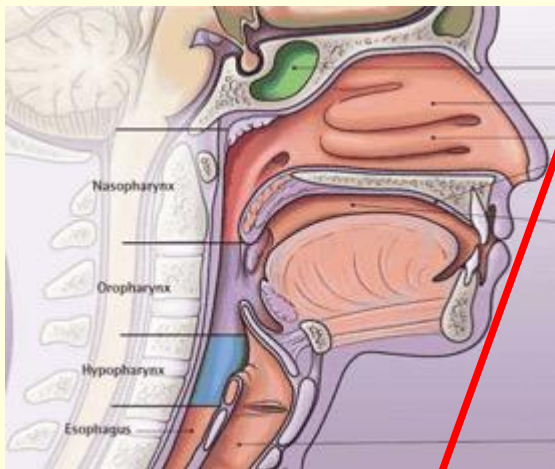
- Subjective history (patient), including occupation
- Objective history (spouse) – if you can get it!
- ESS, STOP-BANG, RSI, NOSE, Insomnia, HADS
- Past medical history

■ Investigations

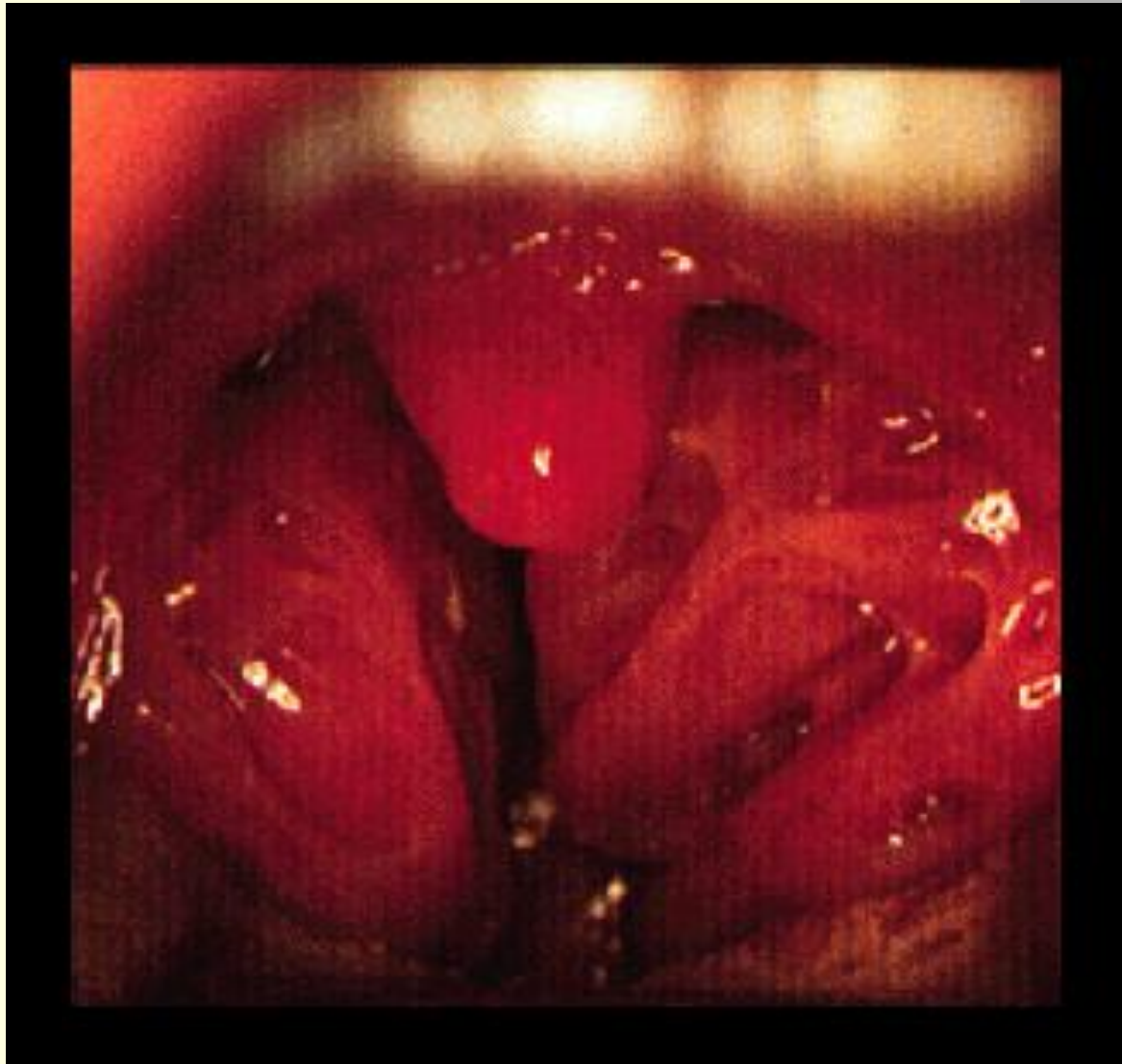
- Polysomnography or sleep study
- Sedation nasendoscopy (DISE)

CLINICAL EXAMINATION

- BMI and collar size
- Retrognathic mandible / Hypoplastic maxilla
- Relative tongue position and size (Mallampatti)
- Low hanging soft palate +/- redundant mucosa / Long uvula
- Oropharyngeal overcrowding
- Tonsillar hypertrophy
- State of dentition (?MAS)



TONSILLAR HYPERTROPHY



PHARYNGEAL OVERCROWDING



FLEXIBLE NASENDOSCOPY

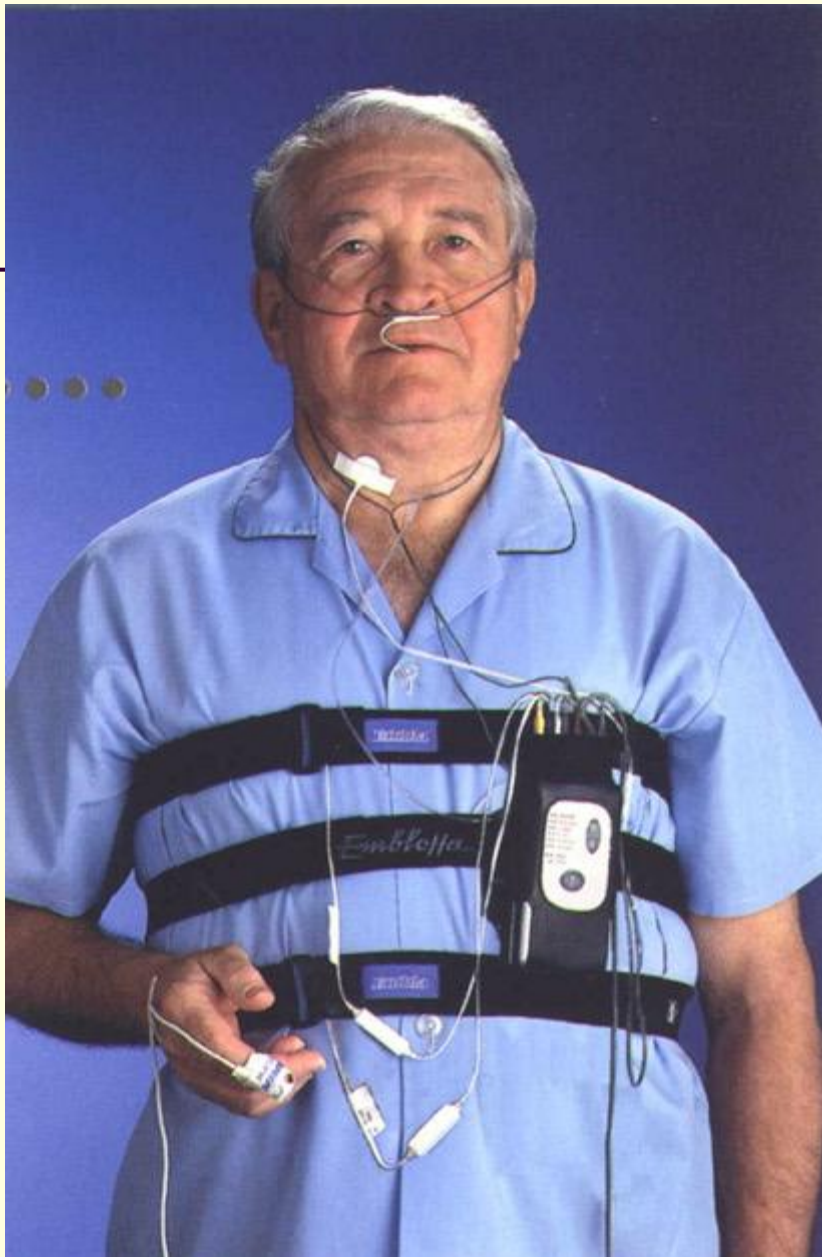
- Provides anatomical and mucosal information on:
 - Nasal cavity
 - Nasopharynx
 - Oropharynx
 - Hypopharynx

- Muller manoeuvre:
 - Forced inspiratory effort with closed mouth and nose. Helps evaluate the upper airway by mimicking the negative pressure that may be encountered during an obstructive episode whilst sleeping. Suggests level of pharyngeal collapse.

INVESTIGATIONS: HOME SLEEP STUDY (NICE)



POLYSOMNOGRAPHY



- Apnoea / hypopnoea events
- Sleeping position
- Snoring events / sound levels
- Blood pressure and pulse
- Oxygen saturation levels
- Respiratory effort
- ECG, EEG
- Thoracic movements
- Abdominal movements
- Limb movements

Simpler models are available!

SLEEP STUDY DATA

Sleep Study Report

Body Position Statistics

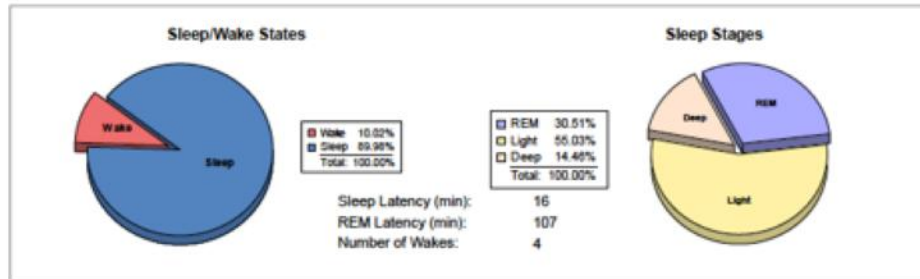
Position	Supine	Prone	Right	Left	Non-Supine
Sleep (min)	61.2	0.0	82.7	233.1	315.8
Sleep %	16.2	0.0	21.9	61.8	83.8
pRDI	15.0	N/A	1.5	3.9	3.3
pAHI	11.0	N/A	1.5	2.1	1.9
ODI	11.0	N/A	3.7	2.1	2.5



Snoring Statistics

Snoring Level (dB)	>40	>50	>60	>70	>80	>Threshold (45)	Mean: 41 dB
Sleep (min)	47.3	5.7	2.3	0.4	0.0	9.6	
Sleep %	12.5	1.5	0.6	0.1	0.0	2.5	

Sleep Stages Chart



* Reference values are according to AASM guidelines

Sleep Study Report

Sleep Summary

Start Study Time:	23:20:27
End Study Time:	06:19:29
Total Recording Time:	6 hrs, 59 min
Total Sleep Time	6 hrs, 17 min
% REM of Sleep Time:	30.5

Respiratory Indices

	Total Events	REM	NREM	All Night
pRDI:	32	7.5	4.2	5.2
pAHI:	21	5.9	2.3	3.4
ODI:	24	7.0	2.5	3.9

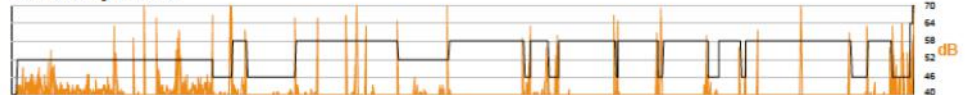
Indices are calculated using technically valid sleep time of 6 hrs, 11 min.

pRDI/pAHI are calculated using $\text{oxi desaturations} \geq 4\%$

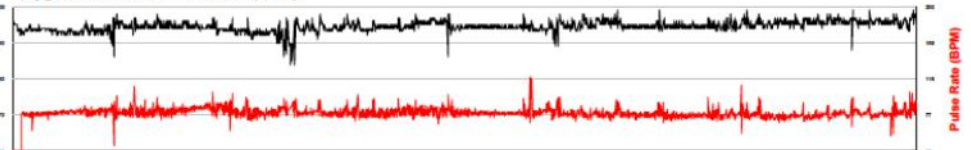
PAT Respiratory Events



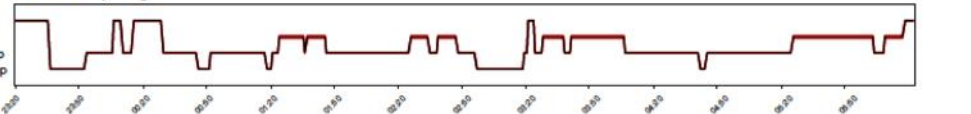
Snore / Body Position



Oxygen Saturation / Pulse Rate (BPM)



Wake / Sleep stages



Oxygen Saturation Statistics

Mean:	94	Minimum:	84	Maximum:	99
Mean of Desaturations Nadirs (%):	91				

Oxygen Desatur. %:	4-9	10-20	>20	Total
Events Number	22	2	0	24
Total	91.7	8.3	0.0	100.0

Oxygen Saturation	<90	<=88	<85	<80	<70
Duration (minutes):	2.8	1.9	0.2	0.0	0.0
Sleep %	0.7	0.5	0.0	0.0	0.0

Pulse Rate Statistics during Sleep (BPM)

Mean:	80	Minimum:	54	Maximum:	111
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SLEEP NASENDOSCOPY: SNE/DISE

- Theatre procedure
- Titrated Propofol +/- midazolam
- Normal sleeping position (supine +/- lateral)
- Assessed in conjunction with sleep study
- To evaluate site of obstruction
- To guide surgical / non-surgical management
- Standardised

SLEEP NASENDOSCOPY: SNE/DISE

- Patient selection:
 - In moderate to severe OSA with CPAP
 - In poor CPAP compliance
 - In CPAP failures
 - In MAS failures
 - In disruptive / simple snoring
 - In mild OSA

Consultant:	Mr Hassaan (6046345)					
Procedure:	SEDATION NASENDOSCOPY (DISE)					
Date:						
ASA:						
Background	AHI:	sAHI	nsAHI:	ODI:	Snore time:	Flow:
NOSE:	Mean O2:	sats<90:		sats<80:	lowest O2 on SS:	
RSI:	BMI:	ESS:	STOP BANG:	NIPF:	SS date:	
HADS:	RAST:	Vit D:	smoker:	Alc (u):	CPAP compliance:	
Insom:	Further OSA Hx:					
Clinical Findings:	Friedman:	Tonsils:	Uvula:	Dental:	Arch:	
	Redundant mucosa soft palate:		Oropharyngeal crowding:	inflamed:		
	Rhinitis:	Inf Turb Hyp:	DNS:	PNS:		
	Reflux:	Retrognathic:	Macroglossia:			
DISE Findings:	Propofol	mg	Midazolam	mg	BIS score:	Glycopyrolate: Y/N Decongested: Y/N
	Soft palate flutter:		Sneezing:	Secretions:		
	Velopharyngeal Collapse: Circ / AP / Lateral			%	of area at rest	
	Oropharyngeal Collapse: Circ / AP / Lateral			%	"	
	Base of Tongue collapse : Circ / AP / Lateral			%	"	
	Epiglottis: U-shaped / normal					
		Snoring (noise)	Airway size	Trapdoor epiglottis		
	At rest:					
	Lips sealed:					
	Mouth closed:					
	Chin lift:					
	Jaw thrust:					
	VV classif:	P:	T:	L:	Tb:	E:
Post Op:	Eat & Drink + Home later					
Follow up:	OPD Mr Hassaan only in 2 / 6/ 12 weeks			AMH F / AMHTC		
Treatment Plan:	[Weight Loss]	[Rhinitis Rx]	[PPI Trial]	[Sleep Hygiene]	[Myofunct. Therapy]	
(Staged)	[Chinstrap]	[MAD]	[Sleep Position Modifier]	[Allergy Testing]	[+rpt sleep study]	
	[Tonsillectomy]	[RF Palate]	[Procut Palatoplasty]	[Expansion Sphincteroplasty]		
	[RF BOT]	[Lingual Tonsil Reduction]	[RF turbinates]	[Septoplasty]	[Barbed Suture]	[Adenoidectomy]
	[Orthognathic Surgery]	[TORS]	[Hypoglossal N. Stimulator]	[Restart / continue CPAP]		

DISE DATA SHEET:

SLEEP STUDY + CLINICAL DATA

Background	AHI:	sAHI	nsAHI:	ODI:	Snore time:	Flow:
NOSE:	Mean O2:	sats<90:	sats<80:	lowest O2 on SS:		
RSI:	BMI:	ESS:	STOP BANG:	NIPF:	SS date:	
HADS:	RAST:	Vit D:	smoker:	Alc (u):	CPAP compliance:	
Insom:	Further OSA Hx:					
Clinical Findings:	Friedman:	Tonsils:	Uvula:	Dental:	Arch:	
	Redundant mucosa soft palate:		Oropharyngeal crowding:		inflamed:	
	Rhinitis:	Inf Turb Hyp:	DNS:	PNS:		
	Reflux:	Retrognathic:	Macroglossia:			

DISE DATA SHEET: DISE FINDINGS

DISE Findings:	Propofol mg	Midazolam mg	BIS score:	Glycopyrolate: Y/N	Decongested: Y/N
	Soft palate flutter:	Sneezing:		Secretions:	
	Velopharyngeal Collapse: Circ / AP / Lateral	%		of area at rest	
	Oropharyngeal Collapse: Circ / AP / Lateral	%		"	
	Base of Tongue collapse :Circ / AP / Lateral	%		"	
	Epiglottis: U-shaped / normal				
		Snoring (noise)	Airway size	Trapdoor epiglottis	
	At rest:				
	Lips sealed:				
	Mouth closed:				
Chin lift:					
Jaw thrust:					
VV classif:	P:	T:	L:	Tb:	E:

DISE DATA SHEET: MANAGEMENT

Post Op:	Eat & Drink + Home later
Follow up:	OPD Mr Hassaan only in 2 / 6/ 12 weeks AMH F / AMHTC
Treatment Plan: (Staged)	[Weight Loss] [Rhinitis Rx] [PPI Trial] [Sleep Hygiene] [Myofunct. Therapy] [Chinstrap] [MAD] [Sleep Position Modifier] [Allergy Testing] [+rpt sleep study] [Tonsillectomy] [RF Palate] [Procut Palatoplasty] [Expansion Sphincteroplasty] [RF BOT] [Lingual Tonsil Reduction] [RF turbinates][Septoplasty] [Barbed Suture] [Adenoidectomy] [Orthognathic Surgery] [TORS] [Hypoglossal N. Stimulator] [Restart / continue CPAP]

TREATMENT OPTIONS

NICE (NG202) 2021

- Lifestyle changes – alone for simple mild OSA
 - Manage weight gain / treat obesity
 - Cessation of smoking / Alcohol reduction
 - Sleep Hygiene
- CPAP for mild (+ comorbidities) or mod to severe
- Mandibular Advancement Splint (MAS)
- Sleep position modifiers - Philips Night Balance, Zzoma etc
- Treat nasal congestion (rhinitis) / obstruction
- Surgery for BMI < 35

CPAP

CONTINUOUS POSITIVE AIRWAY PRESSURE

Delivered via nasal / full face mask

Positive pressure splints the pharyngeal airway open

- Advantages
 - Gold standard therapy for OSA
 - 81% of patients in whom nasal CPAP ameliorated sleep apnea during a one-night trial wanted to try the device long term

- Disadvantages
 - Poor long-term compliance = 55-85%
 - Cumbersome, trouble at airports, not easy at campsites
 - CPAP rhinitis

CPAP COMPLICATIONS

- Air Leak – can suggest anatomical problem
- CPAP Rhinitis
- Skin ulceration
- Claustrophobia
- Aerophagy
- Noise of CPAP – better these days and preferential to snoring, by many bed partners

CPAP FAILURES?

- Assess upper airway
- Manage rhinitis, consider nasal surgery
- Mandibular Advancement Splint (MAS)
- Chin strap for snorers
- Pharyngeal surgery
- Combination therapy

These may reduce CPAP pressures and improve compliance

MANDIBULAR ADVANCEMENT SPLINT (MAS)



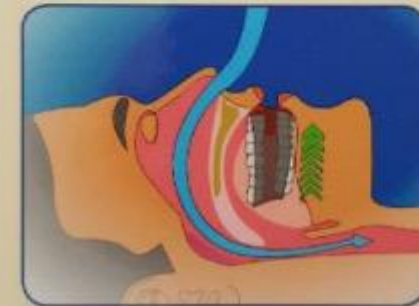
Snoring and Obstructive Sleep Apnea

Obstructive sleep apnea results from the temporary blockage of the upper airway during inspiration:



Blockage of the upper airway

A **Mandibular Advancement Device** is an important option in the treatment of snoring and obstructive sleep apnea:



Open airway with SomnoGuard

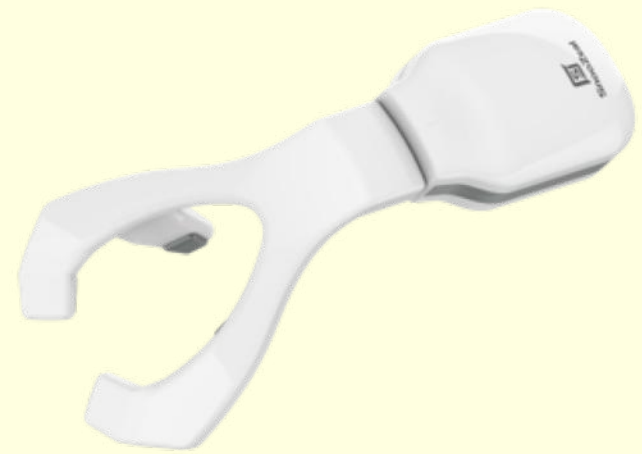
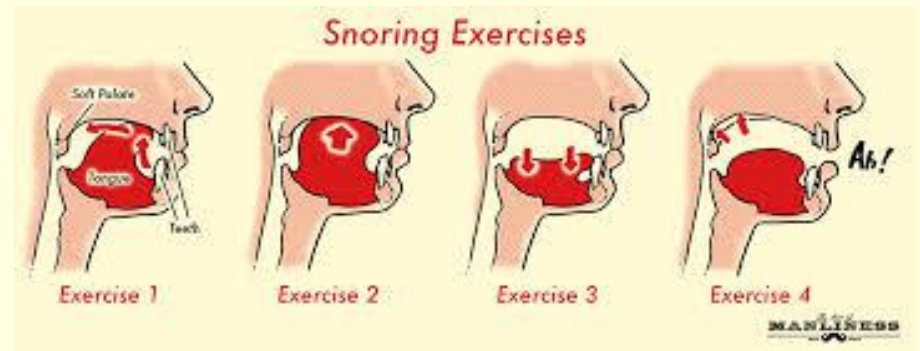
MANDIBULAR ADVANCEMENT SPLINT (MAS)

- MAS are not suitable if:
 - Poor dentition
 - Insufficient number of good quality teeth
 - Edentulous in one or both arches
 - Inadequate bony support for teeth which remain
 - Poorly controlled epilepsy
 - History of TMJ dysfunction
- Side effects include:
 - Sense of altered bite / altered dental occlusion
 - Increased salivation
 - TMJ dysfunction

NON-SURGICAL TREATMENT FOR SDB



[//www.youtube.com/watch?v=gQCIRug6bKI](https://www.youtube.com/watch?v=gQCIRug6bKI)



The didgeridoo



UPPER AIRWAY SURGERY – WHY?

- Can help resolve upper airway obstruction
- Improve upper airway dimensions
- May reduce CPAP pressure
- Improve CPAP compliance

TREATMENT OPTIONS - SURGICAL

- Septoplasty / Rhinoplasty / Inferior turbinate reduction
- Nasal polypectomy
- Tonsillectomy / Adenoidectomy
- Uvulopalatopharyngoplasty (UPPP)
- Laser Assisted uvulopalatoplasty (LAUP)
- Celon palatoplasty
- Radio frequency to soft palate / Tongue base
- Barbed suture pharyngoplasty
- Midline tongue base reduction (+/-TORS)
- Lingual lymphatic tissue reduction
- Wedge epiglottoplasty

TREATMENT OPTIONS - SURGICAL

- Bariatric surgery
- Hypoglossal Nerve stimulation
- Skeletal/ soft-tissue procedures
 - Genioglossus Advancement (GA),
 - Hyoid suspension,
 - Maxillomandibular Expansion or Advancement
- Tracheostomy

UVULOPALATOPHARYNGOPLASTY

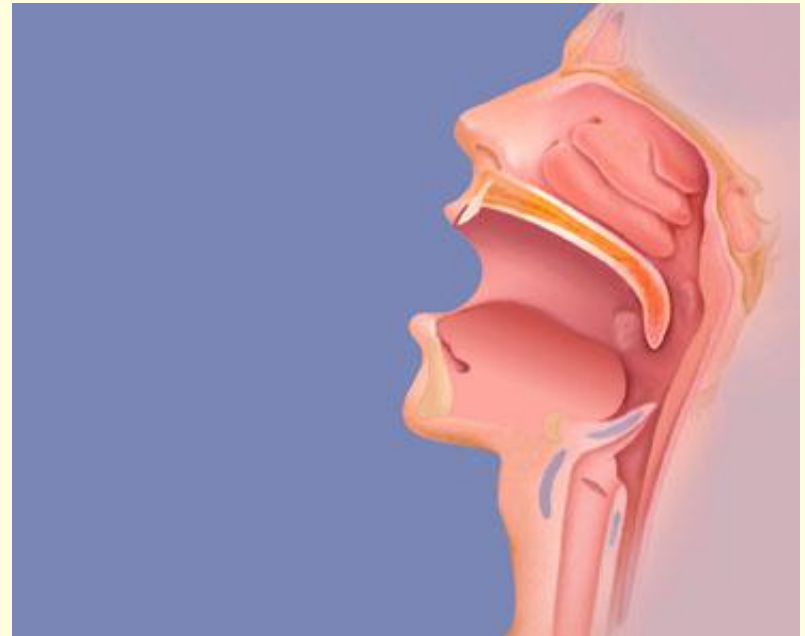
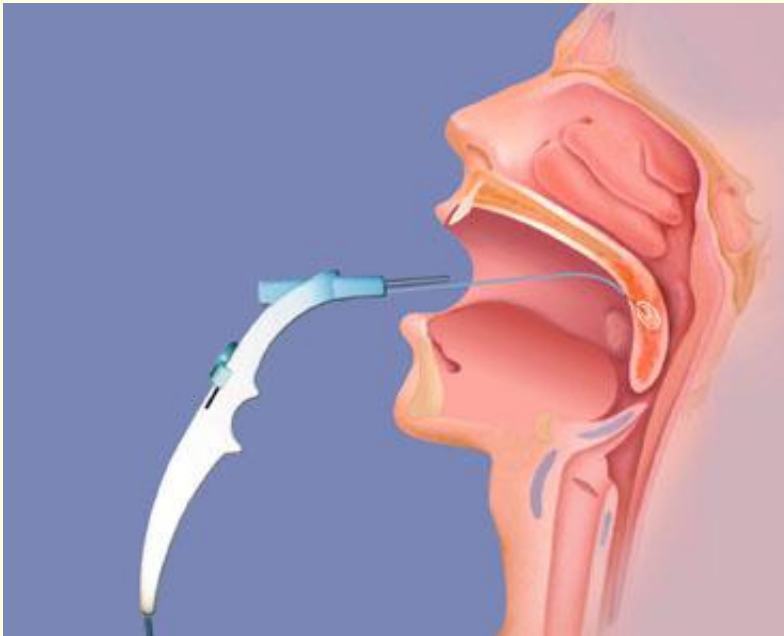
- First operative procedure specifically designed to treat OSA.
- Designed to enlarge the potential airspace in the oropharynx.
- 45-85% success rate.
- Selection bias alters success rate in entire OSA population.
- UPPP reduces the AHI only in those patients whose airway obstruction is predominantly in the retropalatal region.
- Effectiveness limited in tongue base pharyngeal collapse.

RADIOFREQUENCY SURGERY

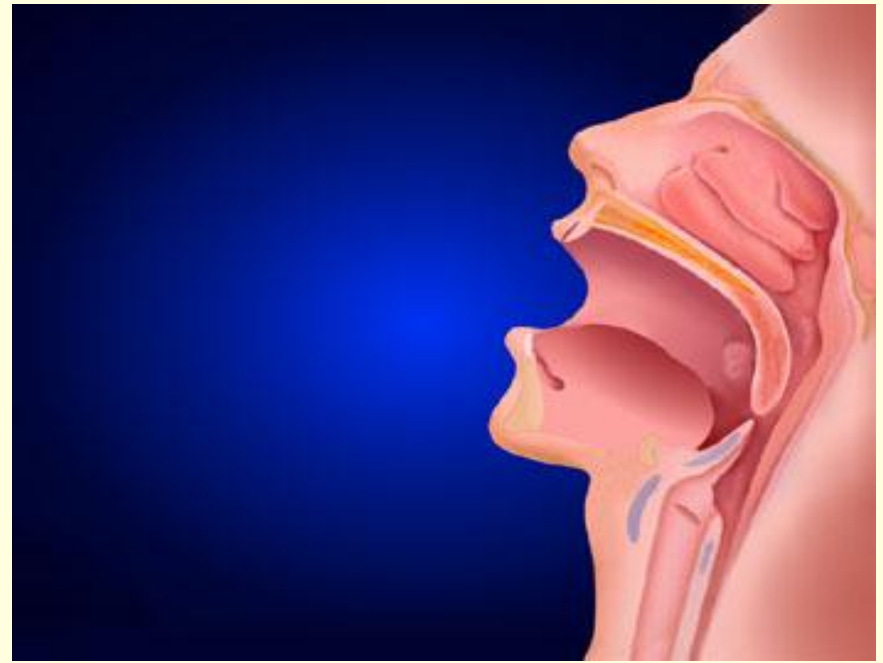
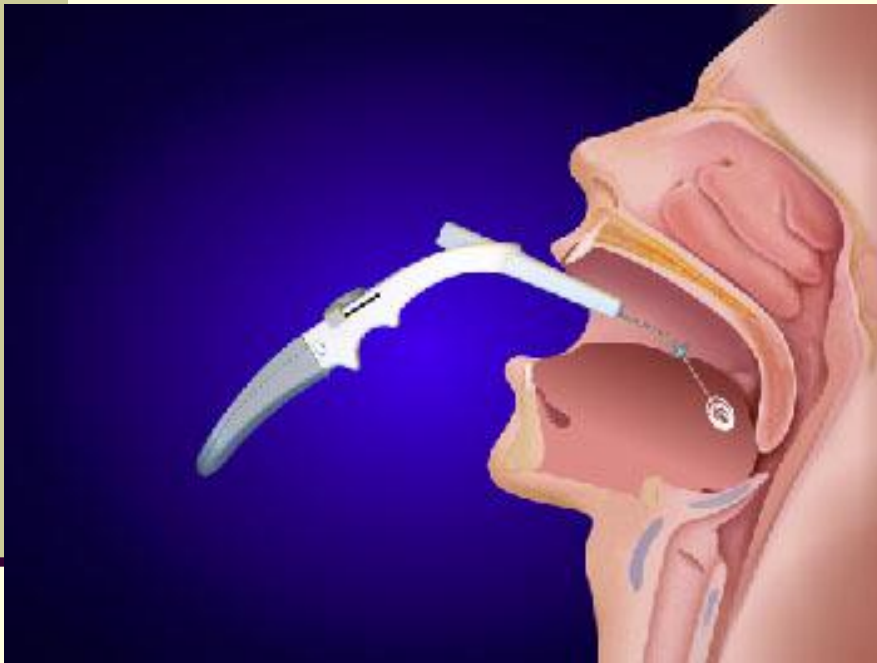
- Radiofrequency (RF) ablation
 - - low temperature
 - multilevel
 - minimally invasive
 - less postoperative pain
 - LA or GA



RADIOFREQUENCY PALATOPLASTY



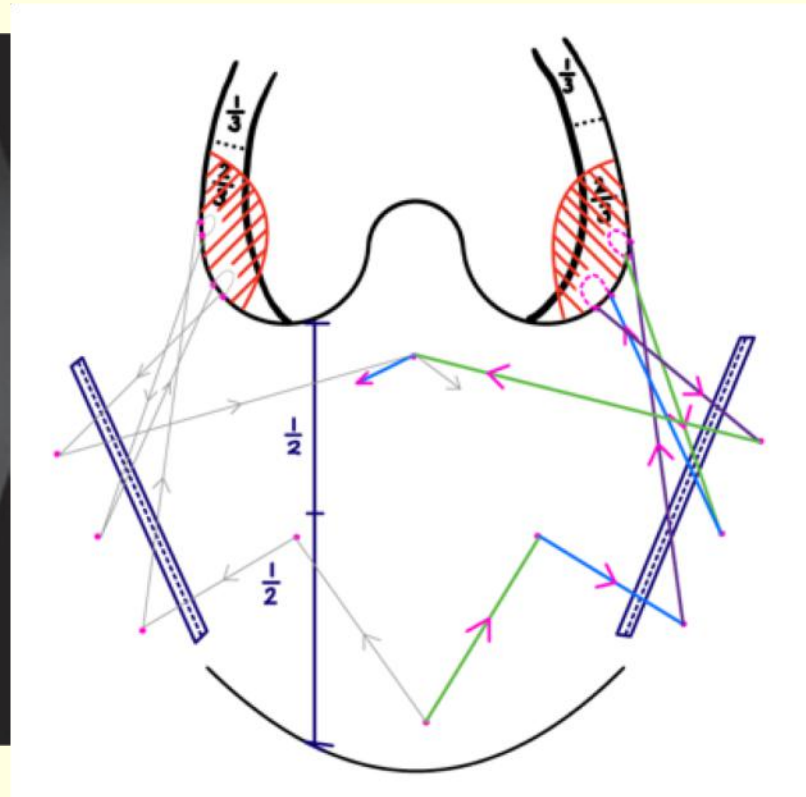
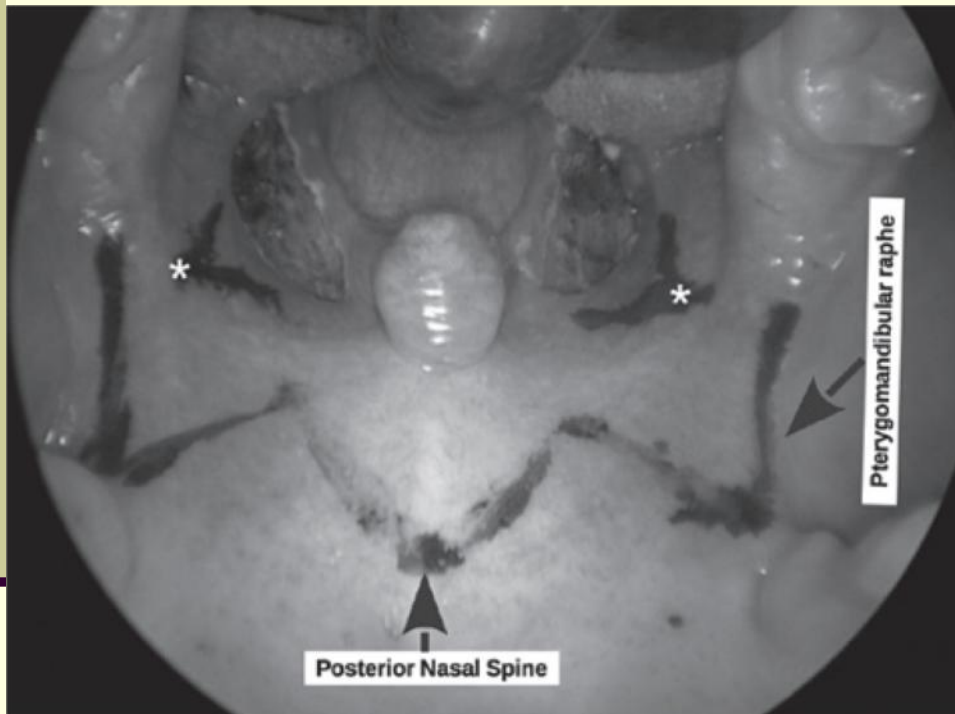
RADIOFREQUENCY TONGUE REDUCTION



RADIOFREQUENCY TURBINATE REDUCTION



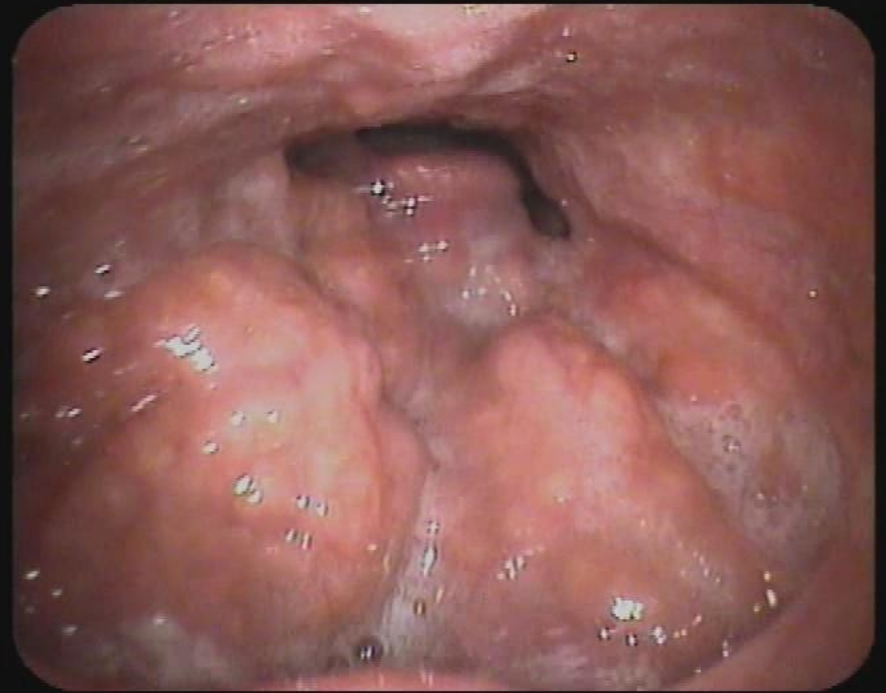
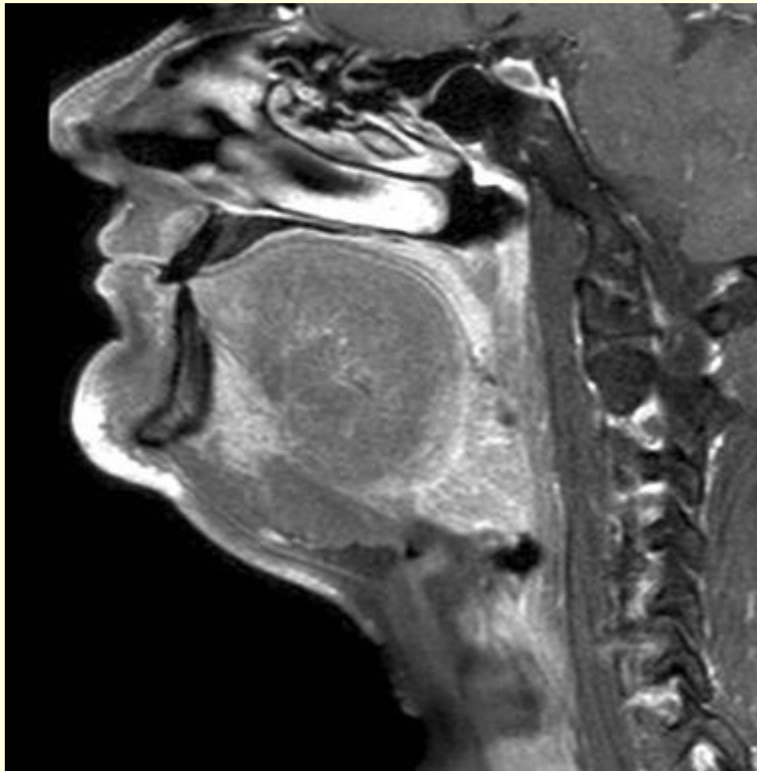
BARBED SUTURE PHARYNGOPLASTY



TORS: DA VINCI ROBOTIC SYSTEM

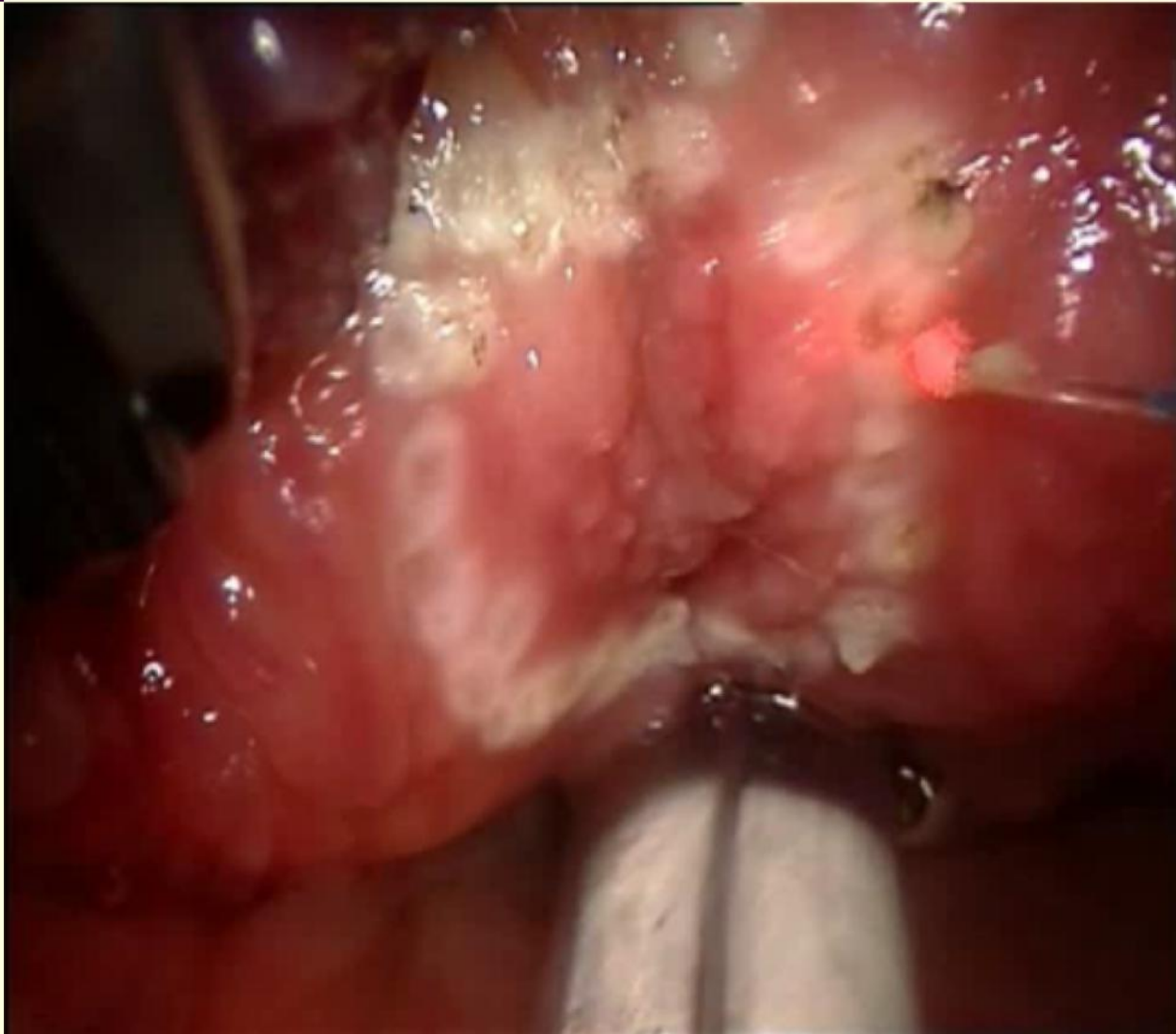


TORS FOR OSA

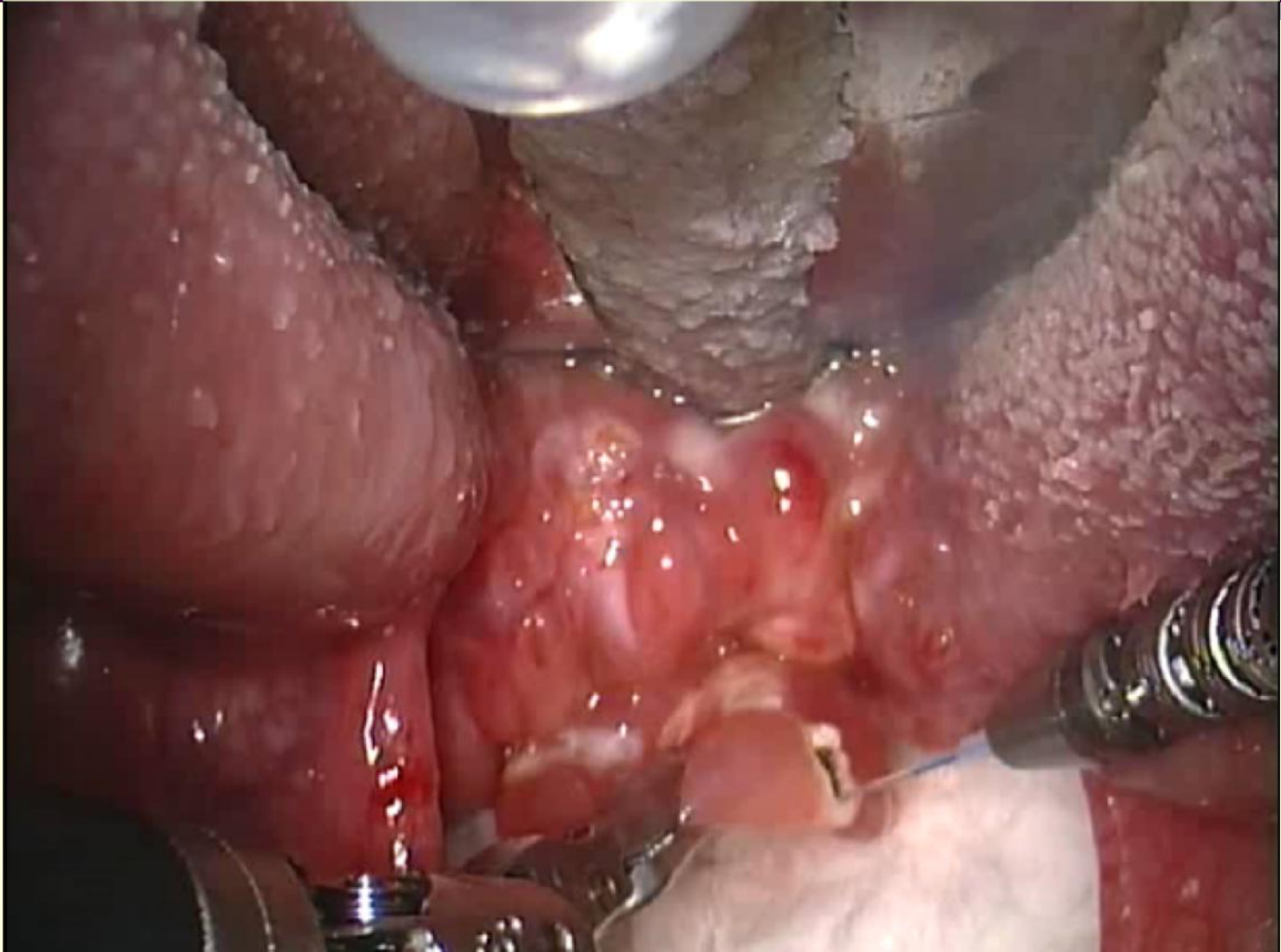


Best for low, localised, lymphatic base of tongue obstructions / restriction

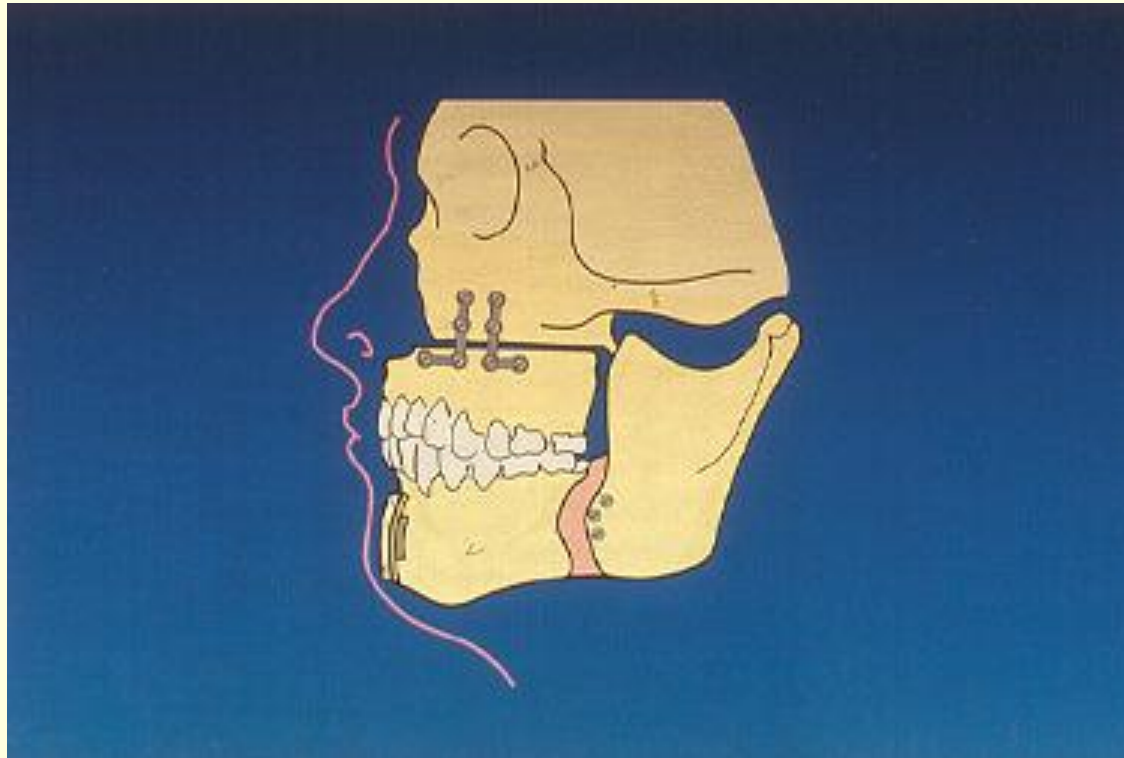
TONGUE BASE RESECTION



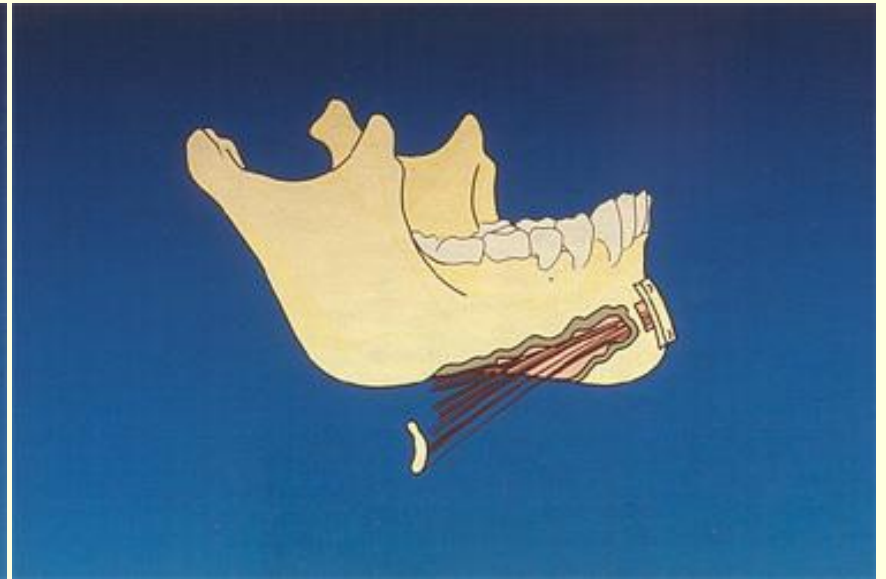
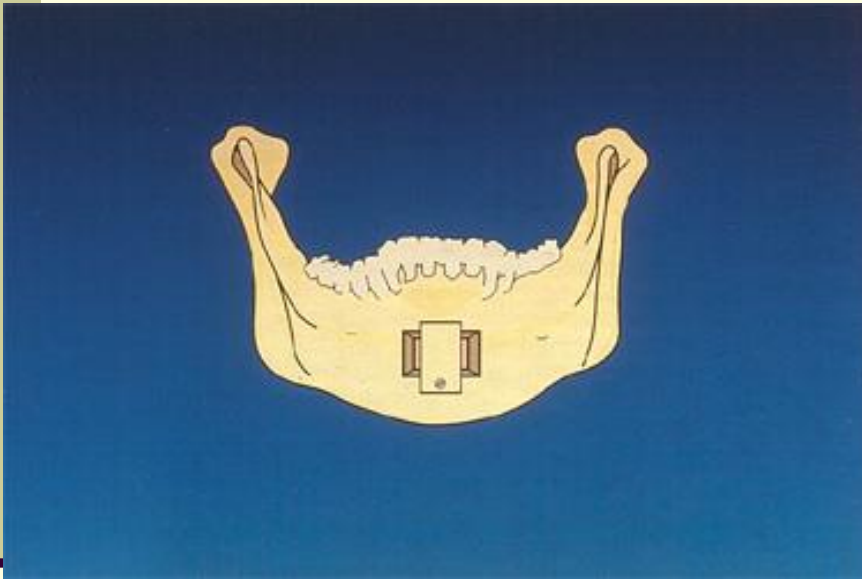
LASER EPIGLOTTOPLASTY



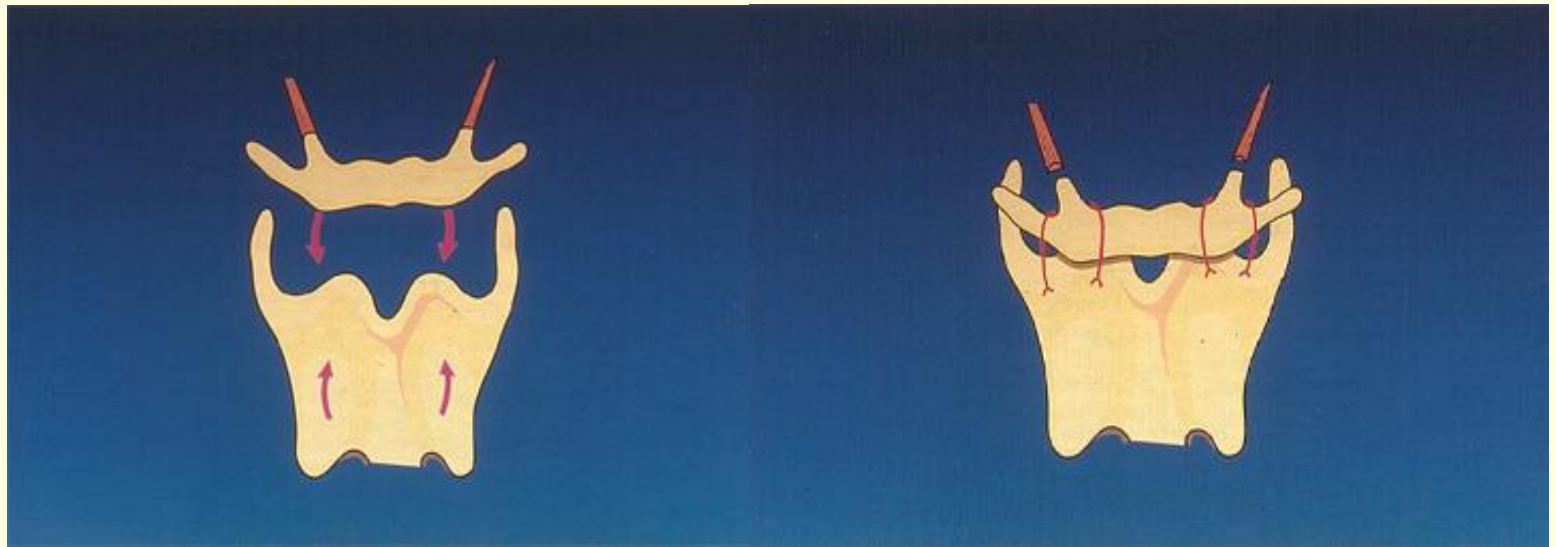
MAXILLOMANDIBULAR SURGERY



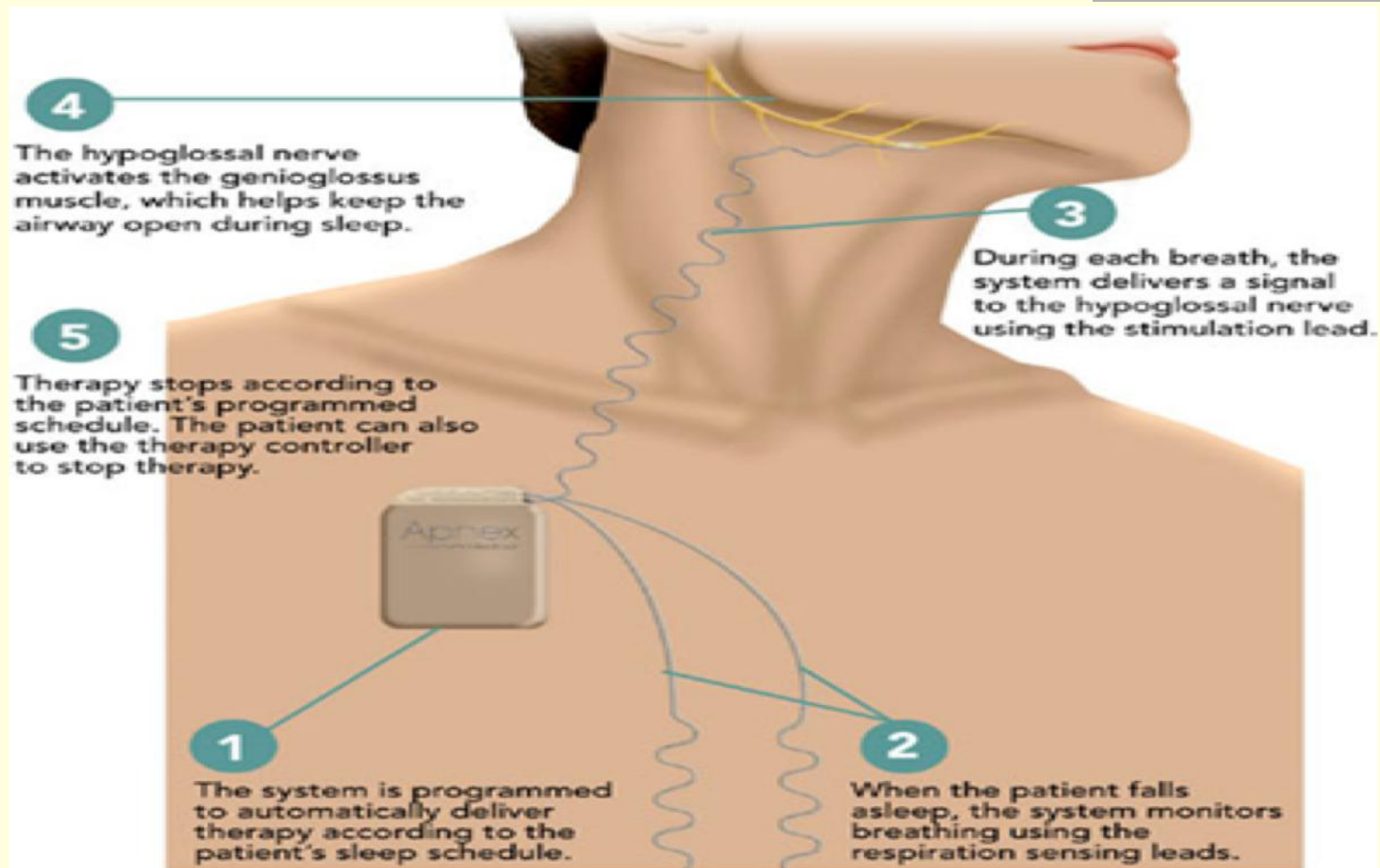
GENIOGLOSSUS ADVANCEMENT



HYOID ADVANCEMENT



HYPOGLOSSAL NERVE STIMULATION



BARIATRIC SURGERY

- Effective for OSA and Metabolic Syndrome
 - David Arterburn BMJ September 2008
- Reduces mortality in two studies with >23,000 patients
 - Sjostrom, 2007 and Adams, 2007

TRACHEOSTOMY

- Near 100% success for obstructive sleep apnea. Exception is obesity-hypoventilation syndrome.
- Substantial medical and psychological morbidity
 - Tracheal stenosis
 - Innominate Artery erosion
 - Recurrent purulent bronchitis
 - Speech difficulties
 - Aesthetic disfigurement

(Mehra P, Wolford L: Surgical management of obstructive sleep apnea. Baylor University Medical Center Proceedings 13:338, 2000)

Obstructive sleep apnoea/hypopnoea syndrome and obesity hypoventilation syndrome in over 16s

Economic analyses

NICE guideline NG202

Economic analysis report

August 2021

Table 3: Summary of base-case cost inputs

Input	Cost
Diagnostic tests	
Home Oximetry	£34
Home RP	£189
Hospital RP	£636
Treatment	
Conservative management (year 1)	£146
Conservative management (per annum year 2 onwards)	£0
MAS (year 1)	£601
MAS (per annum year 2 onwards)	£263
CPAP (year 1)	£447
CPAP (per annum year 2 onwards)	£254

Table 2: Summary of base-case cost inputs

Input	Year 1	Year 2
Conservative management	£146	£0
CPAP	£447	£254
Boil and bite mandibular advancement splints	£354	£242
Semi-bespoke mandibular advancement splints	£359	£247
Custom-made mandibular advancement splints	£601	£263

CONCLUSION

- Role for upper airway surgery
- Evaluation of upper airway (SNE / DISE)
- Patient selection (general factors BMI etc)
- Combined treatment modality
- Multilevel surgery
- Surgery + MAS – Reduce CPAP pressure
- Multidisciplinary approach



Thank you and Questions