Sleep Apnea Update

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Prevalence

- **The prevalence of significant sleep apnea is about 5%**
- **Incidence is about 2% per year for AHI ≥ 15**

Young T. Am J Respir Crit Care Med 2002. **Tischler PV. JAMA. 2003.**

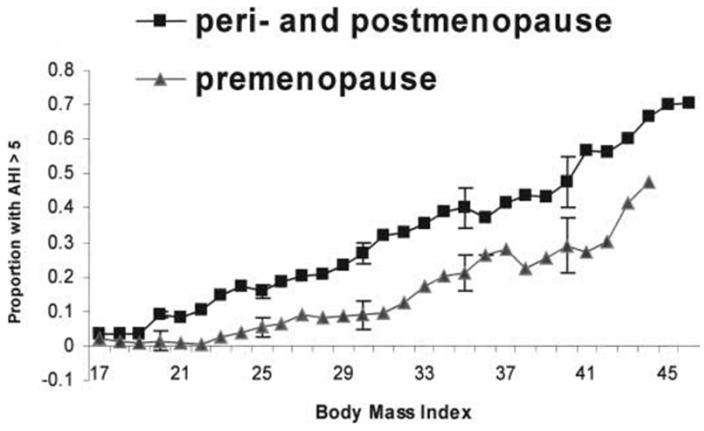
The Cleveland Family Study

Tischler PV. JAMA. 2003.

- **Factors associated with sleep disordered breathing**
  - **Age**
  - **Gender**
  - **BMI**
  - **Waist-Hip Ratio**
  - **Serum Cholesterol**

Gender Hormonal Effects

The risk for OSA is 3 times greater in post-menopause women



Young T, et al. Am J Respir Crit Care Med 2003; 167: 1181-1185

The effects of gender and BMI are affected by aging

After the age of 50, gender is no longer felt to be an important variable

After the age of 60, BMI is no longer felt to be an important variable

History in OSA

- **Snoring, choking, gasping**
- **Sleepiness**
- **Witnessed apneas**
- **Family history**
- **Erectile dysfunction**
- **Mood**
- **Memory attention problems**

The Epworth Sleepiness Scale

How likely are you to doze off or fall asleep in the following situations (0-3 scale):

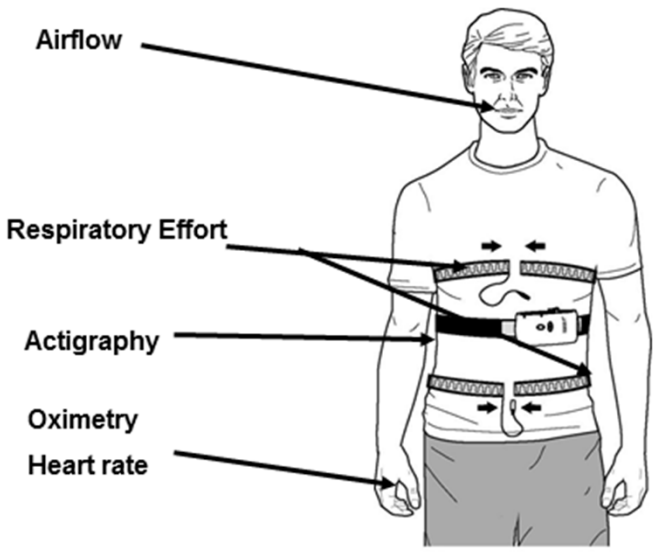
- **Sitting and reading**
- **Watching TV**
- **Sitting, inactive, in a public place**
- **As a passenger in a car for an hour**
- **Lying down in the afternoon**
- **Sitting and talking to someone**
- **Sitting quietly after a lunch without alcohol**
- **In a car, while stopped for a few minutes in traffic**

Physical Findings in OSA

- **Obesity is one of the best predictors of OSA**
  - **– 40% of those with BMI > 40**
  - **– 50% of those with BMI > 50**
- **Neck circumference is a surrogate for central obesity**
  - **– > 17 inches for men; > 16 inches for women**
- **Hypertension**
  - **– Loss of morning dip in BP**
- **Narrowed airway**

Testing

- In lab polysomnography
- Home sleep apnea testing
  - Best validated for those considered at high risk for moderate to severe obstructive sleep apnea
  - Not all home sleep tests are created equal



Apnea Hypopnea Index

$$\frac{\text{Total Apneas + Total Hypopneas}}{\text{Total Sleep Time}}$$

AHI ≥ 5 events/hr	mild
AHI ≥ 15 events/hr	moderate
AHI ≥ 30 events/hr	severe

Sequelae in OSA

The effects of sleep-disordered breathing include:

- **Daytime sleepiness**
- **Neuro-cognitive impairment (memory loss)**
- **Impaired quality of life**
- **Metabolic effects**
- **Cardiovascular effects**

Loss of Vigilance

Car Accidents in SDB (n=913)

Accidents	Single/5yr	Multiple/5yr
Population	♂	♂ ♀
	RDI > 5	RDI>15
Odds	3.4	7.3

Young T. Sleep. 1997; 20(8):608-13

OSA and Metabolic Dysfunction

- OSA is associated with glucose intolerance and insulin resistance, independent of potential confounders.
- OSA is an independent risk factor for the metabolic syndrome.
  - Hypoxemia may be the predisposing factor to the metabolic alterations associated with OSA.
- CPAP improves insulin sensitivity in some patients with OSA.

Coughlin et al. Eur Heart J. 2004. 2. Harsch I, et al. Am J Respir Crit Care Med. 2004.

Cardiovascular Outcomes associated with OSA

These include:

- **Systemic hypertension**
- **Pulmonary hypertension (only with sustained hypoxemia)**
- **Nocturnal arrhythmias**
- **Coronary artery disease**
- **Congestive heart failure**
- **TIA/stroke**
- **Death**

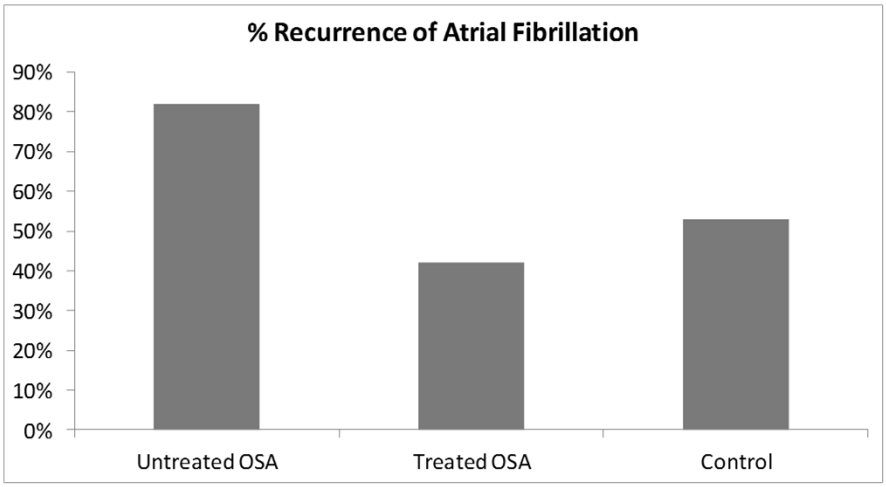
Wisconsin Sleep Cohort Study

TABLE 3. ADJUSTED ODDS RATIOS FOR HYPERTENSION AT A FOLLOW-UP SLEEP STUDY, ACCORDING TO THE APNEA–HYPOPNEA INDEX AT BASE LINE.*

BASE-LINE APNEA–HYPOPNEA INDEX	ODDS RATIO, ADJUSTED FOR BASE-LINE HYPERTENSION STATUS	ODDS RATIO, ADJUSTED FOR BASE-LINE HYPERTENSION STATUS AND NONMODIFIABLE RISK FACTORS (AGE AND SEX)	ODDS RATIO, ADJUSTED FOR BASE-LINE HYPERTENSION STATUS, NONMODIFIABLE RISK FACTORS, AND HABITUS (BMI AND WAIST AND NECK CIRCUMFERENCE)	ODDS RATIO, ADJUSTED FOR BASE-LINE HYPERTENSION STATUS, NONMODIFIABLE RISK FACTORS, HABITUS, AND WEEKLY ALCOHOL AND CIGARETTE USE
		odds ratio (95% confidence interval)		
0 events/hr†	1.0	1.0	1.0	1.0
0.1–4.9 events/hr	1.66 (1.35–2.03)	1.65 (1.33–2.04)	1.42 (1.14–1.78)	1.42 (1.13–1.78)
5.0–14.9 events/hr	2.74 (1.82–4.12)	2.71 (1.78–4.14)	2.03 (1.29–3.19)	2.03 (1.29–3.17)
≥15.0 events/hr	4.54 (2.46–8.36)	4.47 (2.37–8.43)	2.89 (1.47–5.69)	2.89 (1.46–5.64)
P for trend‡	<0.001	<0.001	0.002	0.002

Peppard et al. NEJM 2000

Recurrence of Atrial Fibrillation after Cardioversion is higher in patients with untreated OSA.



Kanagala et al. Circ. 2003.

*p < 0.009 compared to controls
**p < 0.013 compared to treated OSA

Stroke and Death

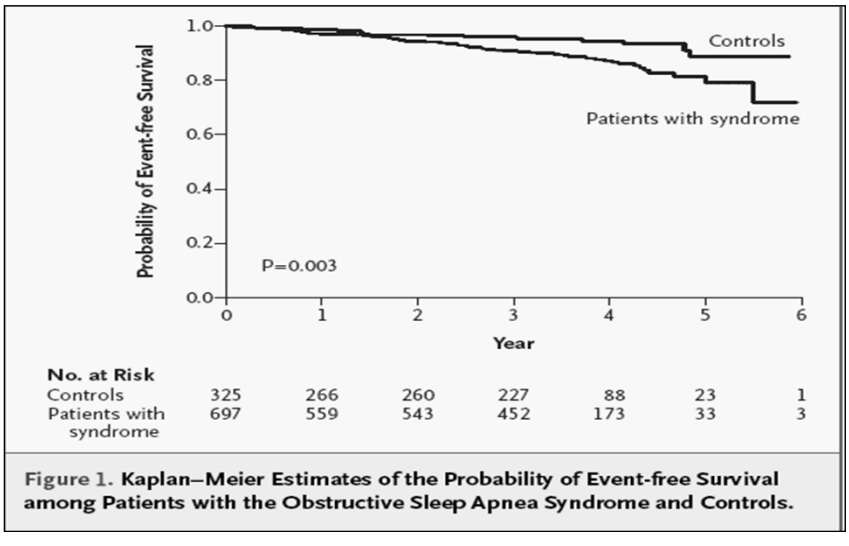
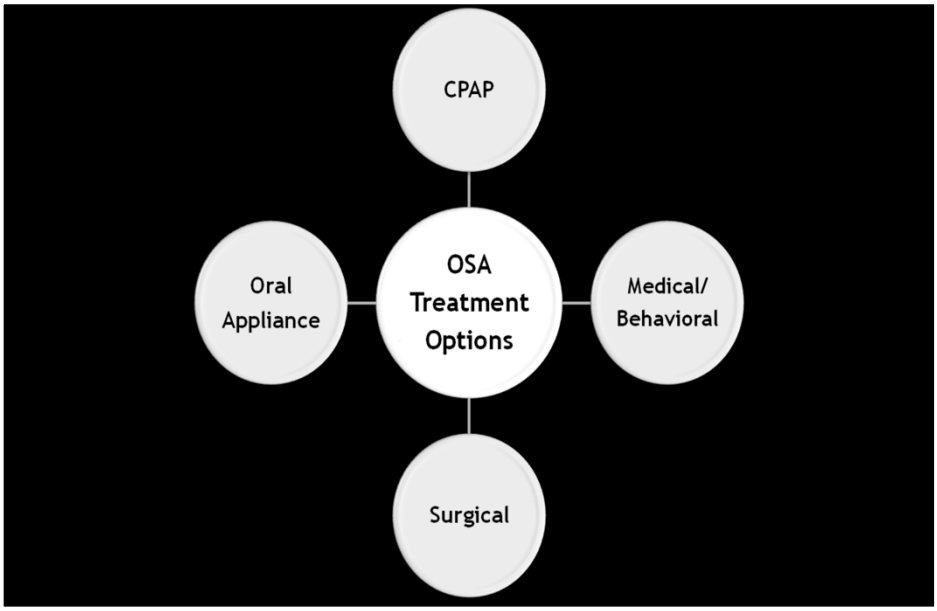


Figure 1. **Kaplan–Meier Estimates of the Probability of Event-free Survival among Patients with the Obstructive Sleep Apnea Syndrome and Controls.**

Yaggi, HK NEJM. 2005.

Treatment for OSA



Medical Treatments for OSA

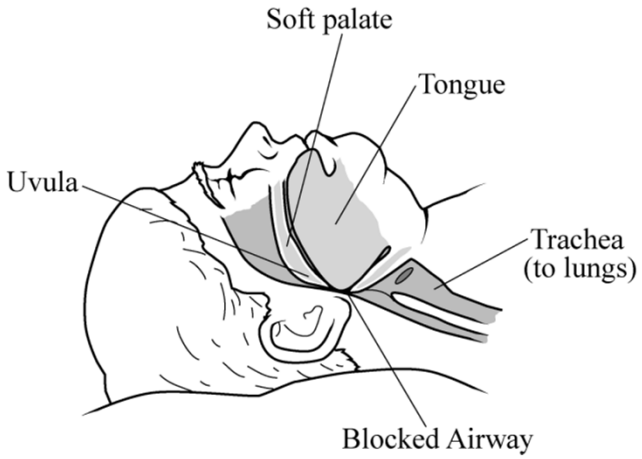
These include:

- **Weight loss**
- **Therapy for nasal congestion (allergic rhinitis)**
- **Lateral decubitus sleeping position**
- **Avoidance of alcohol**
- **Smoking cessation**
- **Avoidance of muscle relaxants**
- **Avoidance of sleep deprivation**

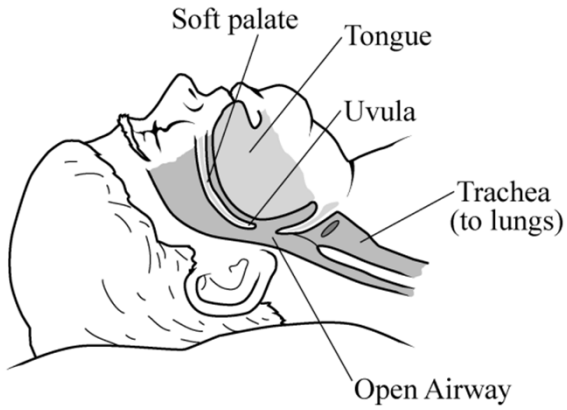
Medical Therapies for OSA: Conclusions

There are *NO* medical therapies that are indicated as primary treatment for OSAS.

Collapsed Airway in Obstructive Sleep Apnea



Airway with CPAP



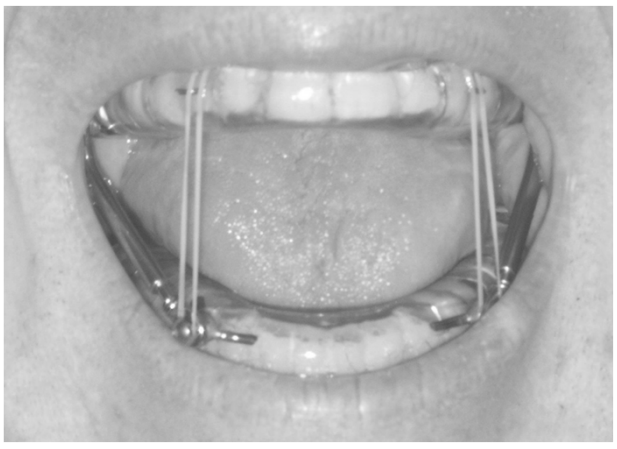
Compliance With CPAP

- **Definition of compliance**
  - **> 4 hours/night on 70% of nights**
- **Compliance probably about 50 - 60%**
  - **Patients overestimate nightly use**
- **Compliance patterns are determined early**
- **Few clear predictors of compliance:**
  - **Daytime sleepiness**
  - **More severe disease**

CPAP: Complications

- Rhinorrhea
- Nasal congestion or dryness
- Epistaxis
- Skin abrasions/rashes
- Chest discomfort
- Claustrophobia
- Air swallowing
- Inconvenient
- “Not sexy”

Mandibular Repositioning Appliances



Author: User:DMY

Oral Appliances

- Compared to CPAP:
  - Are *not* as effective for reducing AHI
  - Equal reductions in subjective sleepiness
- Preferred to CPAP in head-to-head trials
- Outperform *surgery* only in head-to-head trials
- Optimal appliance *not* clear
- *No* clear predictors of efficacy
  - Post-fit PSG needed to prove efficacy

Current Guidelines

- CPAP is better at reducing AHI
- First line alternative for those with mild to moderate OSA
- Second line option for those with severe OSA

Practical Considerations for Prescribing Oral Appliances

- Mild to moderate OSA (AHI 5-30)
- Preference for OAs over CPAP
- Retrognathia/Micrognathia
- Positional OSA
- CPAP intolerance with more severe disease
- Cost Variable: $750 to $3000

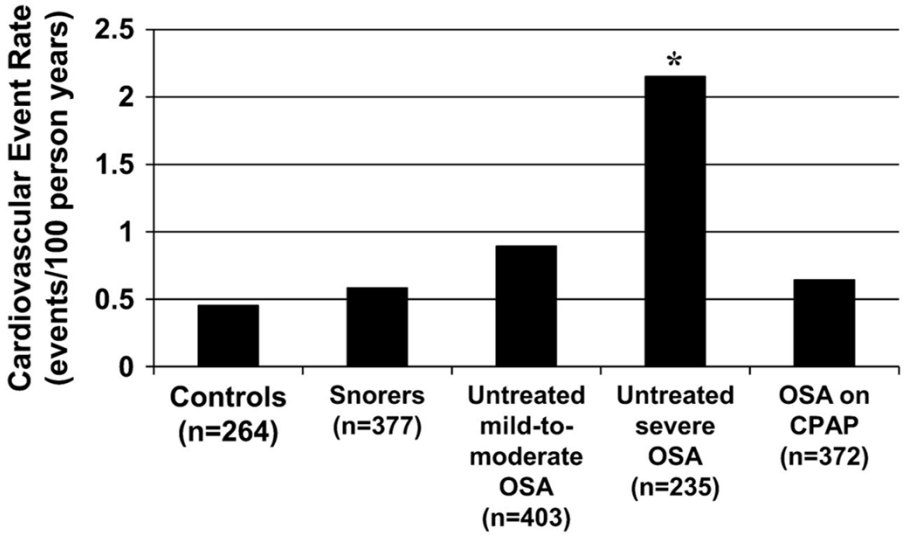
Surgical Options for Obstructive Sleep Apnea

Eugene Chio, MD
Assistant Professor
Director, Division of Sleep Surgery
Department of Otolaryngology – Head & Neck Surgery
The Ohio State University Wexner Medical Center

OSAHS

- Estimated to affect 12-20 (2-4%) million Americans
- >2:1 Male:Female ratio
  - 1:1 after menopause
- Progressive disorder that can worsen over time

Cardiovascular risks in OSA



Pack, AI. *Am J Respir Crit Care Med*. 2006

Treatment options

- Behavioral Modifications
  - Sleep positional therapy
  - Weight loss
  - Avoidance of sedatives/alcohol before bedtime
- May improve or eliminate OSA
- Not likely to cure someone with moderate to severe OSA

Treatment Options

- PAP
  - Cpap or BiPap
  - Gold standard of therapy
  - Compliance is a problem
    - 30-80% compliance rates
- Oral appliances
  - Allows for mandible to be positioned in a neutral or forward position
  - Prevents prolapse of tongue and hypopharynx
  - Not good option for pts w/ TMJ issues or edentulous pts

CPAP

Author: Zboralski

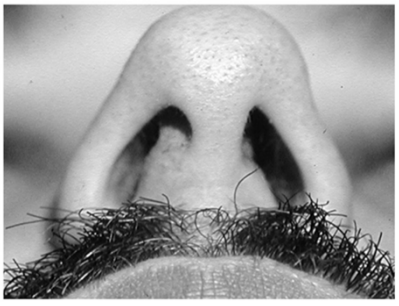
Treatment options

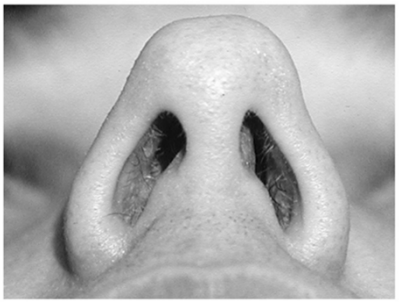
- Surgery to improve PAP use
  - Septo/turb/polyps
  - adenotonsillectomy
- Non-upper airway surgery
  - Tracheostomy
  - Bariatric surgery (BMI>40 or >35 with medical comorbidities)
- Upper airway surgery
  - Nasal, palatal, hypopharyngeal

Surgery for OSAHS

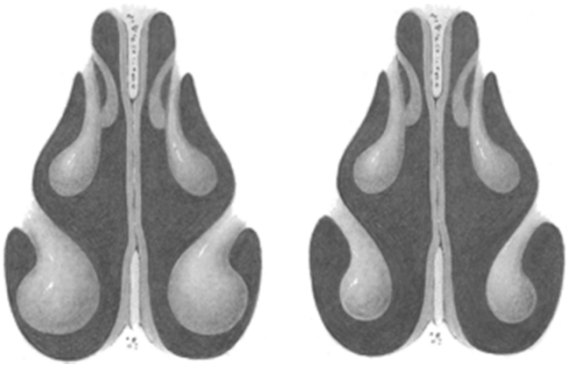
- Nasal surgery
  - Turbinate reduction/turbinectomy
  - Septoplasty
  - Nasal valve repair
- Pharyngeal surgery
  - Adenotonsillectomy
  - UPPP, ESP, ZPPP
  - Palatal stiffening (Pillar implants, RF somnoplasty)
- Tongue base/Hypopharyngeal surgery
  - Suspension techniques
    - Genioglossus advancement, hyoid / tongue base suspensions
  - Tongue base reductions
    - RFBOT, partial glossectomy, TORS
  - Hypoglossal nerve stimulator

Septoplasty



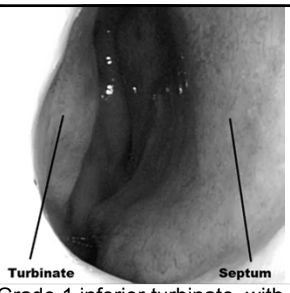


Turbinate reduction

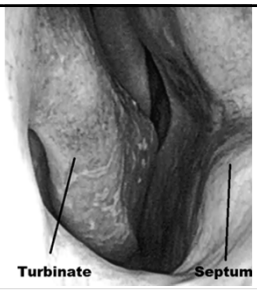


Before Surgery **After Surgery**

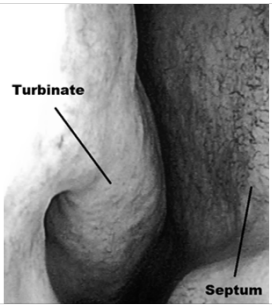
Images Courtesy of Sleep Apnea Surgery Center - Kasey Li, MD



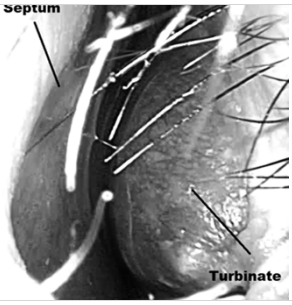
Grade 1 inferior turbinate, with a mild septal deviation.



Grade 2 inferior turbinate, mild septal deviation.



Grade 3 inferior turbinate, small septal spur.



Grade 4 inferior turbinate enlargement, straight septum.

Author: Drcamachoent **(CC BY-SA 3.0)**

Recovery from nasal surgery

- Nasal soreness for 1-2 weeks
- Oozing or drainage for the first week
- Nasal congestion for 1-2 weeks
- No nose blowing for 2-3 weeks

Nasal surgery

- Nasal surgery has not, by itself, been shown to decrease sleep apnea any significant amount
- Usually done in conjunction with other upper airway procedures to either maximize airway or to increase comfort of CPAP use

Palatal Surgical Options

- Uvulopalatopharyngoplasty (UPPP, UP3)
- Expansion sphincter pharyngoplasty (ESP)

UPPP

- Good results in reduction of snoring
- Unpredictable results for curing apnea
  - 20-25% successful in unselected OSA pts
  - 50-60% successful in selected pts

Pt selection for UPPP

- Theoretically pts with collapse at the level of the velopharynx should respond well to UPPP
- Identification of site of collapse has been difficult
- Even pts with collapse at velopharynx have had poor response to UPPP

Physical exam findings

- Size of tonsils
- Length of uvula
- Friedman tongue position (modified Mallampati)

Tonsil and uvular size

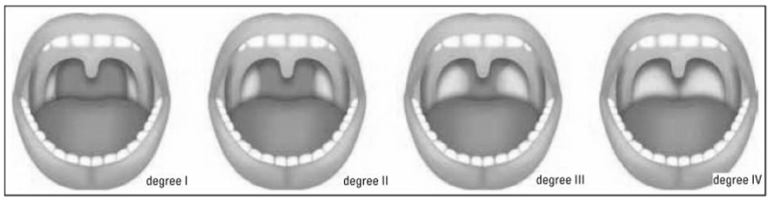


FIGURE 3 - Graduation of palatine tonsils: Degree I, Palatine tonsils occupy up to 25% of the oropharyngeal space; Degree II, Palatine tonsils occupy between 25% and 50% of the oropharyngeal space; Degree III, Palatine tonsils occupy between 50% and 75% of the oropharyngeal space; Degree IV, Palatine tonsils occupy more than 75% of the oropharyngeal space.

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Author: 1luckygamble
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Friedman tongue position

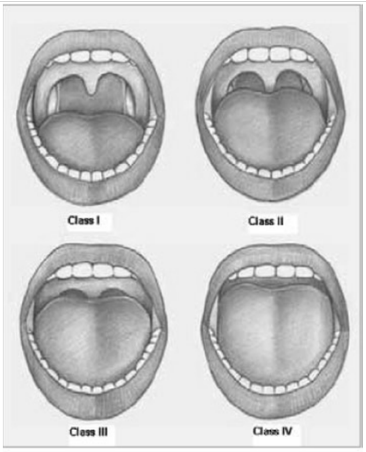

FIGURE 2 - Modified Mallampati Index: Class I, the entire posterior oropharynx wall is visible, including the inferior pole of the tonsils); Class II, part of the posterior oropharynx wall is visible; Class III, the uvular insertion and soft palate are visible (It is not possible to observe the posterior oropharynx wall); Class IV, only part of the soft palate and hard palate are visible.

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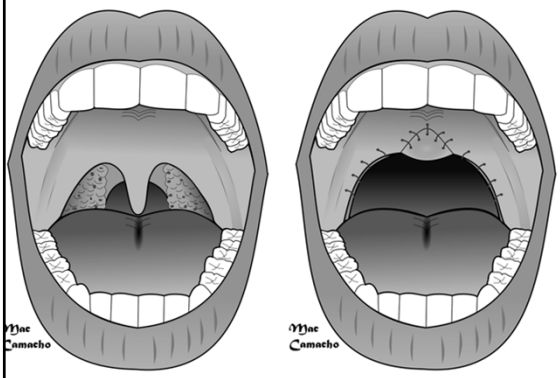
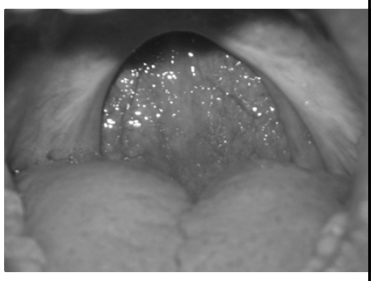
UPPP surgical technique



Author: Drcamachoent **(CC BY-SA 3.0)**



View of the throat 8 years following uvulopalatopharyngoplasty.

Author: Dmd3eorg
(CC BY-SA 3.0)

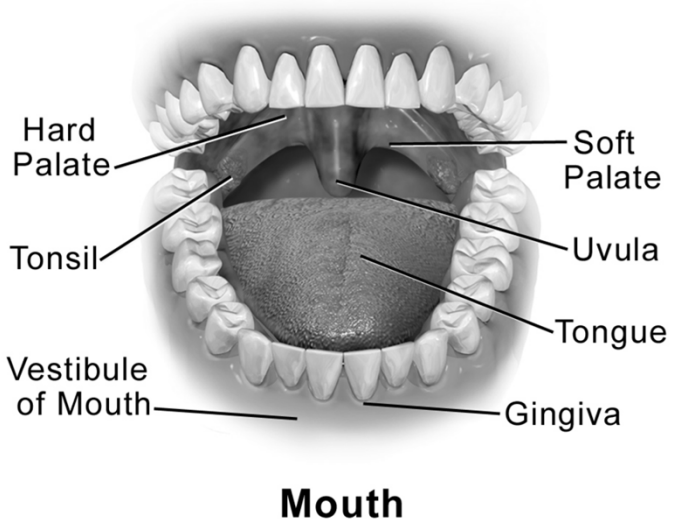
Expansion Sphincter Pharyngoplasty

Expansion sphincter pharyngoplasty: A new technique for the treatment of obstructive sleep apnea

Kenny P. Pang, FRCSEd, and **B. Tucker Woodson, MD,** Republic of Singapore; and Milwaukee, WI

- **Aimed at addressing lateral pharyngeal wall collapse seen on Mueller maneuver**

ESP technique

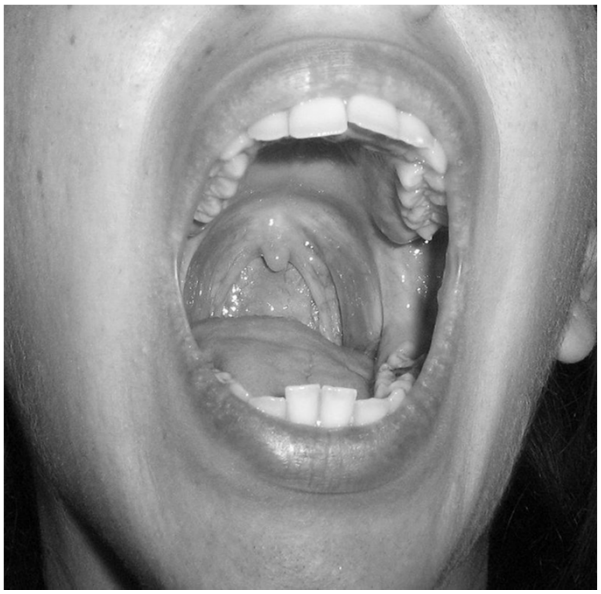


Mouth

Blausen.com staff. "Blausen gallery 2014". *Wikiversity Journal of Medicine*. DOI:10.15347/wjm/2014.010. ISSN 20018762

(CC BY 3.0)

ESP technique



Author: Lusb

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Recovery from palatal surgery

- Sore throat x 2-3 weeks
- Soft/liquid diet
- Off of work/school for approx 1 week
- Slight risk of bleeding (3-5%), most commonly 5-7 days after surgery

Tongue base procedures

- Reposition tissue
  - Hyoid myotomy and suspension
  - Tongue base suspension
- Reducing tissue
  - Radiofrequency (RF)
  - Lingual tonsillectomy
  - Midline partial glossectomy

Hyoid and tongue base suspension

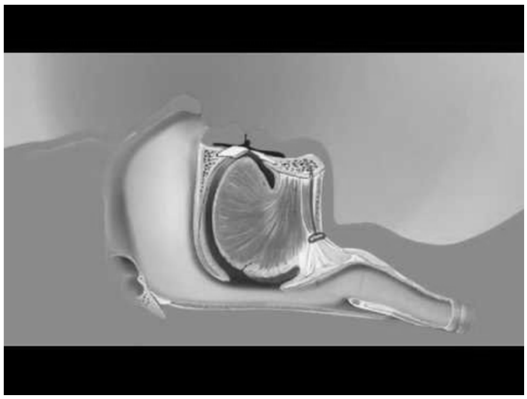


Image courtesy of www.sleep-apnea-guide.com

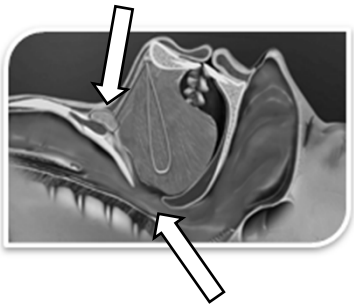


Image used with permission from Siesta Medical, Inc

Tongue suspension procedure

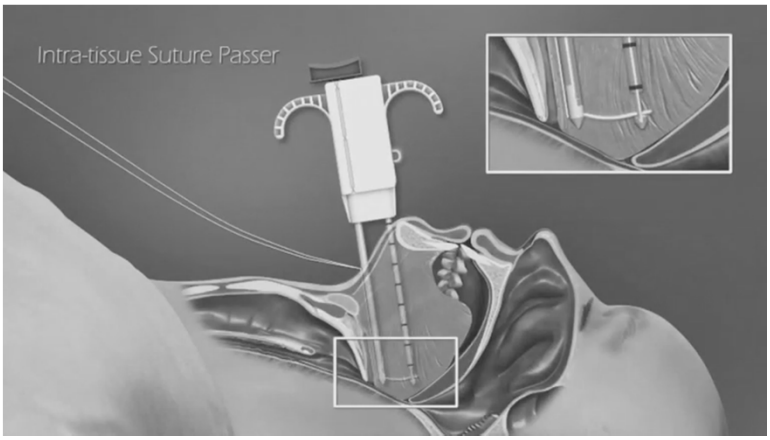
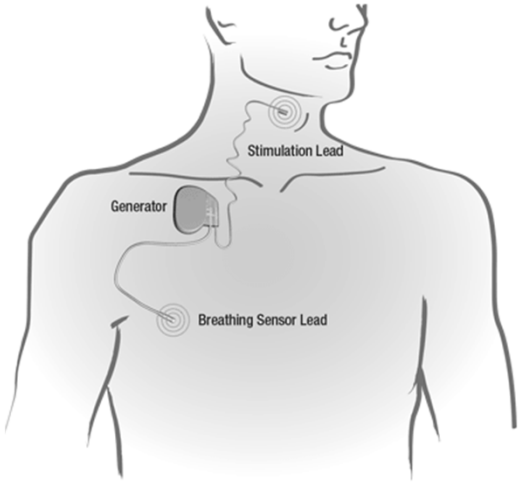


Image and video used with permission from Siesta Medical, Inc

Hypoglossal nerve stimulation

- The hypoglossal nerve (CN XII) is responsible for tongue movement (protrusion, retrusion, rolling, side to side)
- During sleep, muscle tone decreases and the tongue can prolapse into the throat and block off the lower airway
- Theoretically, stimulation of the tongue to protrude should open up the airway

Inspire® upper airway stimulation



Images courtesy of Inspire Medical Systems. Inc..

Results

- Nonrandomized study, 126 pts
- AHI at 12mo decreased 68%, from 29.3 to 9.0
- ODI decrease of 70% from 25.4 to 7.4

Current inclusion criteria for Inspire

- AHI between 20-65/hr
- BMI under 32kg/m^2
- Absence of complete concentric collapse at the level of soft palate on drug induced sleep apnea (DISE)

Inspire® at Ohio State

- Currently approved at OSU for a limited run
- Plan on being the first center in central Ohio to perform the implant
- Less than 40 surgeons currently trained nationwide to perform this procedure
- First dynamic (not static) therapy for tongue base repositioning