

# The Eye in Sleep Apnea



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# Financial Disclosures

- Honoraria
  - Review of Optometry
  - Optometric Management
- Paid Advisory Board Member
  - Zeiss
  - Zeavision
  - Thrombogenics
  - Genentech



# Financial Disclosures

- Consulting Fees
  - Zeiss, Eye Promise
- Proprietary Interests
  - None



# QUESTIONS AND COMMENTS?

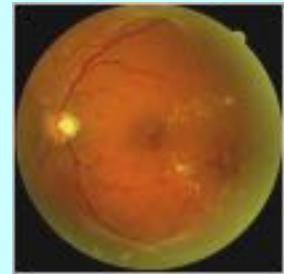
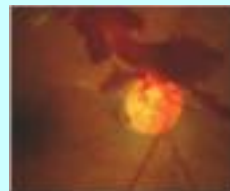


# Course Goal

- To provide the participant with clinically relevant information on sleep apnea syndrome (SAS) and its ophthalmic implications.



# 32 yo WM



- 5 ft 8 in tall, 265 lbs
- “sees red” OD
- Type 2 DM x 3 yrs
- Recent Dx. Obstructive Sleep Apnea (OSA)

## Statement of the Problem

- Sleep apnea syndrome (SAS) is a disease characterized by recurrent complete or partial upper airway obstructions during sleep.
- The majority of patients with SAS demonstrate this obstruction either at the nasopharynx or the oropharynx.
- The obesity epidemic is driving an increase in SAS prevalence in all ages.

## Obesity and OSA



An obese young woman with the short, thick neck typically seen in patients with obstructive sleep apnea.



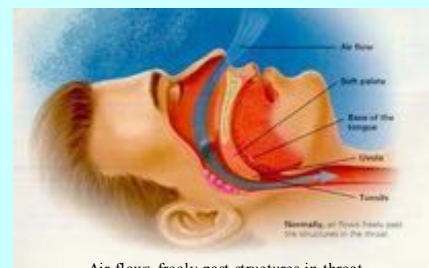
## Why We Should Care

- Risk factors for SAS include obesity, male gender, upper airway abnormalities, alcohol use, snoring, and wide neck girth.
- Reported ophthalmic findings in patients with SAS include floppy eyelid syndrome (FES), glaucoma, keratoconus, and non-arteritic anterior ischemic optic neuropathy (NAION).

## What is Sleep Apnea?

- Apnea is defined as complete cessation of breathing for more than 10 seconds in adults
- (SAS) is characterized by cessation of breathing during sleep, known as periods of apnea.

## Normal Air Flow



[http://www.nlm.nih.gov/health/06\\_230601a.html](http://www.nlm.nih.gov/health/06_230601a.html)

## Blocked Air Flow



During sleep apnea, air flow is completely blocked.

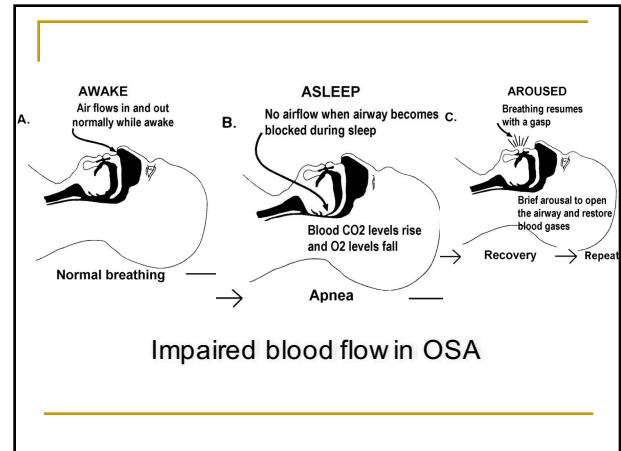
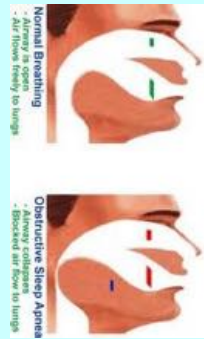
[www.sleepapnea.org/osa.htm](http://www.sleepapnea.org/osa.htm)

## Types of Sleep Apnea

- Central sleep apnea (CSA)
  - caused by the loss of ventilatory effort controlled by the nervous system.
- Obstructive sleep apnea (OSA)
  - caused by upper airway obstruction.
- The mechanisms underlying these different types of sleep apnea are likely to overlap.

## Obstructive Sleep Apnea

- An average of at least 10 apneic and hypopneic episodes per sleep hour.
- Leads to excessive daytime sleepiness because of marked fragmentation of sleep.



## Types of Sleep Apnea

- The majority of patients with SAS are diagnosed with OSA, the most common form of the disease.
  - Genetics have been found to be a factor.
- Prevalence of sleep-disordered breathing is approximately 2% in women and 4% in men between 30 and 60 years of age.
  - These estimates are low. It is estimated that as much as 80 percent of cases of OSA are undiagnosed!

## Does your patient have OSA?

- Snoring marked by frequent **changes in loudness and frequency** (as opposed to quiet and steady) is highly suggestive.
- Excessive daytime sleepiness/tiredness or fatigue, especially when not active.
- Episodes during sleep when breathing stops.
- Periods of loud snoring followed by silence or a total absence of breathing lasting from a few seconds up to a minute or longer.

## Risk Factors

- Obesity + type 2 DM
- Male sex
- Upper airway abnormalities
- Alcohol use
- Snoring
- Neck girth of more than 17 inches in men or 16 inches in women.

## Signs and Symptoms of SAS

- Loud snoring
- Feeling fatigue in the morning
- Falling asleep during the day
- Memory loss
- Poor judgment
- Personality changes

## Obstructive Sleep Apnea (OSA) and DM/DR

- \* Type 2 DM is the most highly associated systemic complication of obesity. \*
- 12 million American adults have OSA.
- It is often found in patients with obesity, diabetes and/or cardiovascular disease.
- OSA may aggravate DR, secondary to nocturnal hypertension and hypoxemia.

## Other Causes of Obstruction

- Physical obstruction of the airway can also result from a variety or combination of anatomical factors.
  - Enlarged tonsils
  - Enlarged uvula
  - Increased tongue size
  - Abnormal craniofacial morphology

## Questions and Comments



## The Sleep History for Optometrists

A brief sleep history in the eye clinic may consist of the following questions:

1. Do you have trouble sleeping at night? Why (heart failure, urination, other)?
2. Does someone sleep close enough to you to hear any nighttime noise, such as snoring?
3. Are you sleepy during the daytime or do you fall asleep at times when you should not?

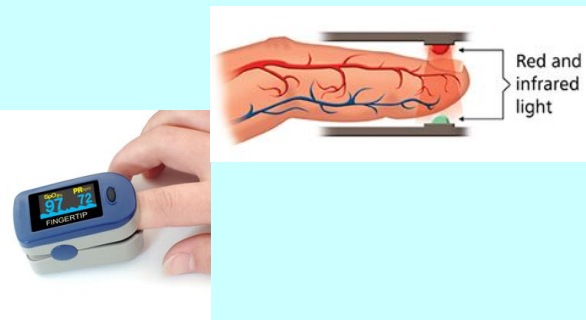
## The Sleep History for Optometrists

4. Do you snore or have frequent awakenings?  
Why (heart failure, urination, etc)?
5. Do you have frequent headaches, especially in the morning after awakening?
6. Do you have a known sleep disorder or have you ever had a sleep study (polysomnography)?

## Diagnosis and Management

- Diagnosis
  - Polysomnography
    - Eye movement observations (REM)
    - Electroencephalogram (arousals from sleep)
    - Chest wall monitors (respiratory movements)
    - Electrocardiogram
    - Electromyogram (limb movements)
    - Oximetry (measure oxygen saturation)

## Pulse Oximetry



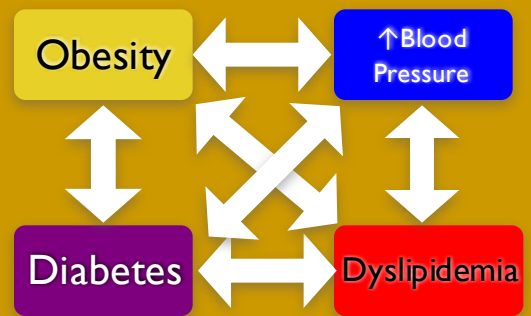
## Diagnosis and Management

- Respiratory disturbance index (RDI)
  - # obstructive breathing events (apneas) per hour
  - Used to diagnose and grade the severity of sleep apnea

## SAS and Systemic Disease

- Systemic arterial hypertension is present in about 50% of obstructive sleep apnea cases.
- Congestive heart failure
- Pulmonary hypertension
- Stroke
  - OSA is an independent RF
- Metabolic syndrome
- Type 2 diabetes mellitus

## Metabolic Syndrome



## SAS and Systemic Disease

- One half of all patients who have essential hypertension also have OSA.
- Likewise, half of patients who have OSA also have essential hypertension.
- Therefore, OSA appears to be a contributing factor in the development of essential hypertension.

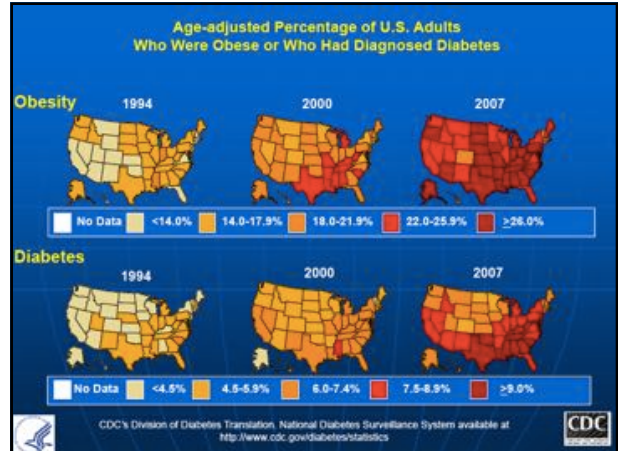
## Systemic Complications of OSA

- HTN
- Type 2 DM
- Depression
- Accidents (sleepy)
- Congestive Heart Failure
- Coronary Artery Disease
- Atrial Fibrillation
- Cognitive issues
- OSA is an independent RF for stroke.\*

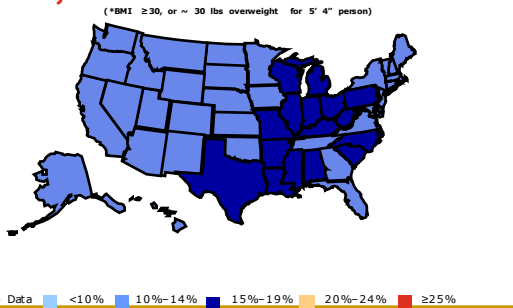


## Diabetes

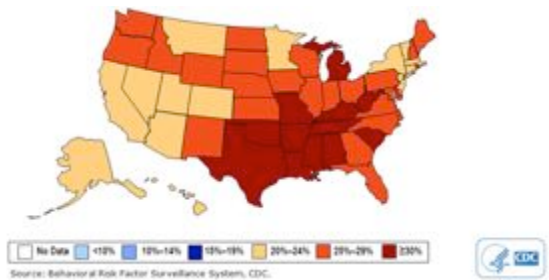
- M\_\_\_\_\_ S\_\_\_\_\_ is characterized by central (abdominal) obesity, dyslipidemia, raised blood pressure, and insulin resistance.
- “Diabetes”
  - Up to 97% of type 2 caused by excessive weight
  - Obesity = Increased weight caused by excess accumulation of fat.
  - “Over-fat” = normal BMI w/large waist



## Obesity Trends\* Among U.S. Adults BRFSS, 1994



## Obesity trends-2012



## “Diabetes Belt”

Age-Adjusted Prevalence of Diagnosed Diabetes  
Among U.S. Adults

2010



## Obesity and Body Mass Index (BMI)

- World Health Organization (WHO) Classification
  - For adults, Grade 1 (simply called overweight) is a BMI of 25-29.9 kg/m<sup>2</sup>.
  - Grade 2 (commonly called obesity) is a BMI of 30-39.9 kg/m<sup>2</sup>.
  - Grade 3 (commonly called severe obesity) is a BMI greater than or equal to 40 kg/m<sup>2</sup>.

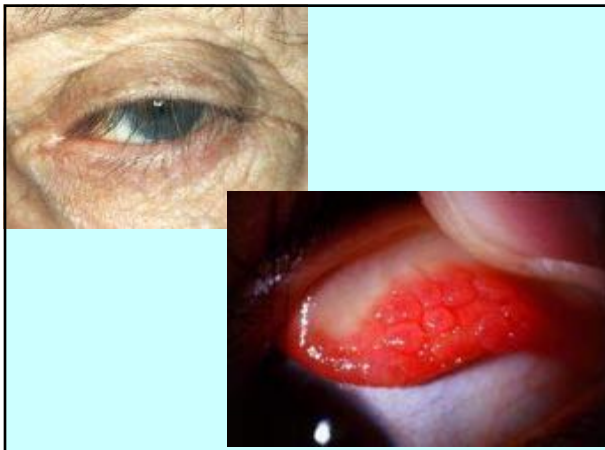
## SAS and Type 2 DM

- The ADA recommends that all type 2 patients be screened for OSA, and vice versa.



## Ocular Complications

- Changes in eyelid tissue
  - Floppy eyelid syndrome (FES)
- Changes in cornea
  - K-conus
- Changes in the optic nerve
  - The glaucomas??
    - open angle (OAG)
    - normal tension (NTG)
  - Non-arteritic anterior ischemic optic neuropathy (NAION)
- \*\*Changes in retina: DR, HR, RVO\*\*



## Floppy Eyelid Syndrome (FES)

- History: obesity, type 2 DM
- Treatment/Management
  - CPAP
  - Protect eye
  - Lubricate
  - Anti-inflamm



## Diagnosis/Management of FES

### Diagnosis

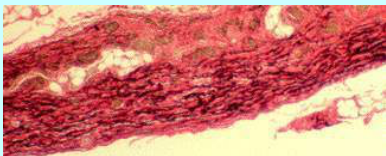
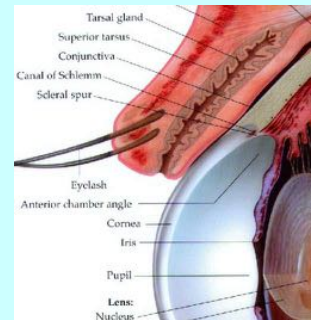
- Fluorescein staining
- Abnormally lax upper lid

### Treatment

- Goal: To protect ocular surface during sleep
  - Topical lubricants
  - Topical antibiotics for mild corneal/conj abnormalities
  - Educate patient to refrain from sleeping face-down
- Eyelid tightening procedure
  - Horizontal lid shortening

## FES and SAS: What's the connection?

- Theory: Abnormal tarsal and palatine elastin
- FES Patient Profile:
  - Middle aged, obese men
  - Snoring
  - Wide neck



- Tarsal elastin fibrils are visible as brown-black fibers against orange counter-stain.

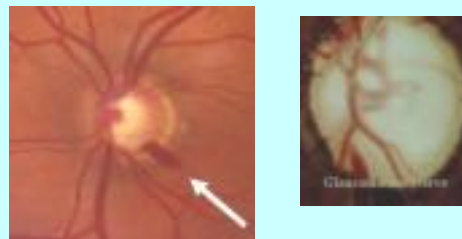
## Questions and Comments



## The Glaucomas

- Theory
  - Subjects tended to stop inhaling (not exhaling) due to airway closure, which should lead to lower intrathoracic pressure.
  - Subjects also experienced hypoxic effects, as cessations in breathing cause blood oxygen saturation levels to drop, possibly triggering optic nerve damage.
  - The optic nerve could be damaged due to hypoxia without a spike in IOP.
    - Yasuhiro Shinmei, Takuya Naita, Hiroshi Saito, Takeshi Ohguchi, Riki Kijima, Shinki Chin, Susumu Ishida. Continuous Intraocular Pressure Monitoring During Nocturnal Sleep in Patients With Obstructive Sleep Apnea Syndrome. *Investigative Ophthalmology & Visual Science*, 2016; 57 (6):2824

## Glaucomatous ON Cupping





## Glaucoma and SAS: What's the connection?

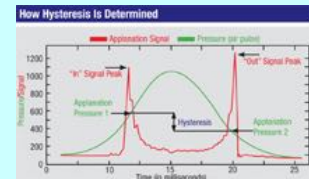
- Theories that link glaucoma to SAS
  - Impaired blood flow to optic nerve
    - Secondary to repetitive/long apneas
  - Optic N. vascular dysregulation
    - Secondary to arteriosclerosis, episodic nocturnal HTN/Hypotension
  - Hypoxic episodes causing direct nerve fiber damage

CH is the cornea's relative ability to absorb pressure by bending when pressure is applied.

### Corneal Hysteresis Is Reduced in Obstructive Sleep Apnea Syndrome

Nadarajah, Suchitra MSOphth<sup>1</sup>; Samsudin, Amir PhD<sup>1\*</sup>; Ramli, Norlina MSOphth<sup>1</sup>; Tan, Chong Tin MD<sup>2</sup>; Mimiwati, Zahari MSOphth<sup>1</sup>

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## SAS and the Eye

Non-arteritic anterior ischemic optic neuropathy (NAION)

- Diagnosis
- Treatment/management
  - Systemic

SAS/DM/HTN

GCA

NA-AION

A-AION

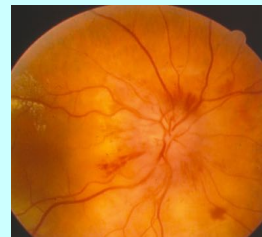


Hyperemic disc swelling

Pale disc swelling

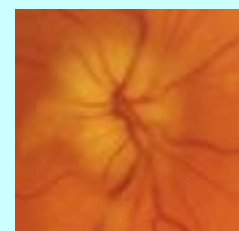
## NAION Pathophysiology

- Alteration of the blood supply to the optic nerve head
  - Ischemic process affecting the short posterior ciliary arteries
  - As the ischemic episode evolves, optic disc swelling compromises circulation, leading to further neuronal damage.
- **Common etiologies of NAION include CV Dx., DM**



**NAION  
Hyperemic Swelling**

**AAION  
Pale Swelling**



## S/P NAION Sector Disc Pallor



## Visual Field



Altitudinal defect in NAION

## Keratoconus

- Diagnosis
- The FES has been linked with both obstructive **sleep apnea** and **keratoconus** in several studies.
- Obesity and KC
- Treatment/management

## SAS and the Eye

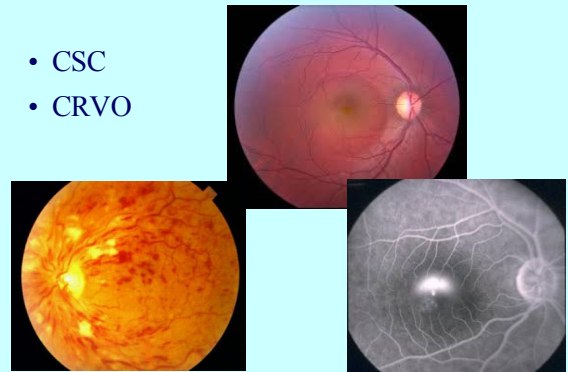
- Marfan's Syndrome-related Complications
  - Ectopia lentis
    - decentered crystalline lens, secondary to disruption of the surrounding zonular fibers
- Patients with ectopia lentis are at an increased risk for retinal detachment

## SAS and the Eye

- Other Related Ocular Disease
  - Diabetic retinopathy
  - Hypertensive retinopathy
  - Retinal vascular occlusions
  - Central serous chorioretinopathy

## Other Ocular Associations

- CSC
- CRVO



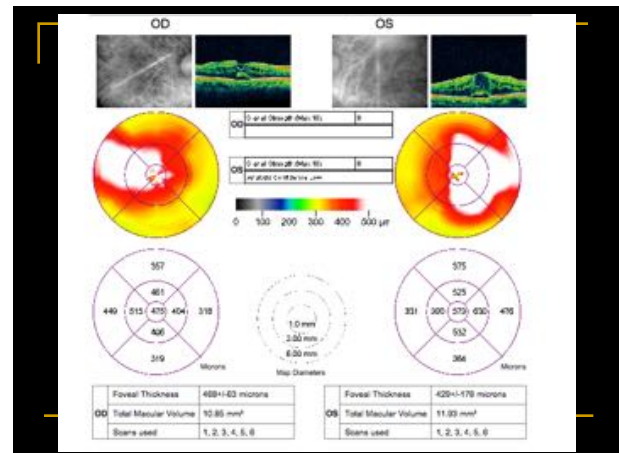
## Case: 55 YOHH

5 ft 10 in, 295 lbs  
Central blur OD/OS  
Type 2 DM x 3 yrs  
+OSA, +HTN, +Dyslipidemia

OD: 20/100



OS: 20/200



### QUESTION:

**WHICH FACTORS MOST INFLUENCE THE ONSET, PROGRESSION AND VISUAL OUTCOME OF DIABETIC RETINOPATHY?**

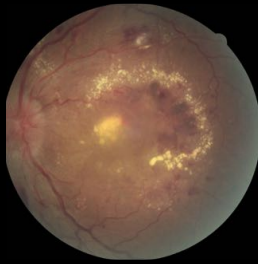
### Systemic Conditions that May Exacerbate DR

- Dyslipidemia
- Hypertension
- Carotid occlusive disease
- Kidney disease
- Sleep apnea
- Anemia
- Pregnancy
- Obesity
- Vasculitis
- Neuropathy
- Vitamin D deficiency



## Sleep Apnea and DR/DME

- DME
  - Higher prevalence
  - Recurrence rate higher
  - Unresponsive to Anti-VEGF
- PDR
  - Higher prevalence
  - Worsening
- Improvement of DME, PDR w/CPAP



West, S. D., et al. "The prevalence of retinopathy in men with Type 2 diabetes and obstructive sleep apnea." *Diabetic Medicine* 27.4 (2010): 423-430.

## QUESTIONS AND COMMENTS?



## Management of OSA

- Weight loss
- Continuous positive airway pressure (CPAP)
  - Blows air into nostrils
- BiPAP
- Tongue Retained Devices
  - Bring lower jaw forward
- Uvulopalatopharyngoplasty (UPPP)
  - Surgical removal of anatomic obstructions

## CPAP: "Up your nose with a rubber hose!"



## CPAP Therapy

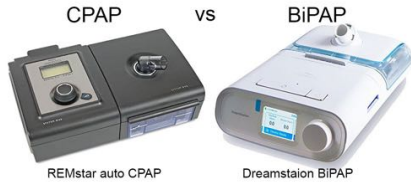


[www.austlinoms.com/sleep\\_apnea.htm](http://www.austlinoms.com/sleep_apnea.htm)

## Treatment and Management

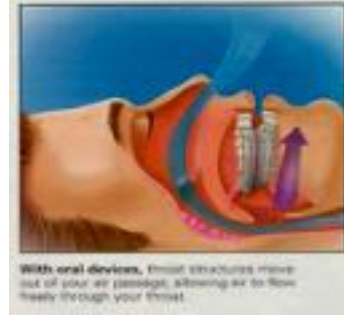
- Weight reduction (5-10%)
- All patients should be offered nasal CPAP therapy first.
- In patients with mild-to-severe OSA who refuse or reject nasal CPAP therapy, BiPAP therapy should be tried next.
- If this therapy fails or is rejected, oral appliance (OA) therapy should be considered.
- OAs may be considered first-line therapy for patients with mild OSA, particularly if they are unwilling to try nasal CPAP.\*

## BiPAP Therapy



The main difference between BiPAP and CPAP is that BiPAP machines have two pressure settings: the prescribed pressure for inhalation (ipap), and a lower pressure for exhalation (epap). Dual settings allow the patient to get more air in and out of their lungs.

## Tongue Retaining Device



With oral devices, throat structures move back of your air passage, allowing air to flow freely through your throat.

[www.usdise.com/stop\\_apno.htm](http://www.usdise.com/stop_apno.htm)

## Oral Appliances



The OA fits like a sports mouth guard or an orthodontic retainer. It supports the jaw in a forward position to help maintain an open upper airway.

## UPPP Surgery



During UPPP, your uvula and other tissue from the back of your mouth are removed.

## My SAS Story



## Medical Nutrition Therapy



## Food Matters

Optimal nutrition always starts with  
**food.**

## Eat

Diets that "starve" are seldom  
sustainable.

## Real Food

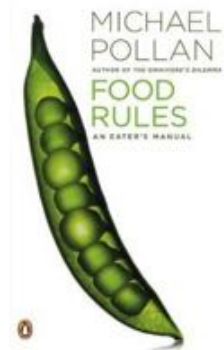
Not refined, synthetic, food-like  
products.

## Not too much.

Portion size

## Mostly plants.

A plant-intensive diet provides  
most essential nutrients.



## Treatment and Management of SAS

- Patients in whom non-invasive therapy (eg. CPAP, BiPAP, OAs) fails should be offered surgical options.
  - Patients should be made aware of the success rates for each surgical procedure.
  - They should be informed that they might require more than one procedure, some fairly extensive.
  - Refer patients only to centers that have personnel experienced in these special surgical techniques

## Summary and Conclusions

- A growing body of literature in the fields of sleep medicine and ophthalmic disorders suggests an association between sleep apnea syndrome and several ocular problems.
- Increased awareness of ocular problems associated with SAS will result in more cross-referrals between sleep specialists and ophthalmic clinicians.

## Now what?

- ODs should refer their patients with these ocular entities for a sleep study, particularly if the patient fits the demographic profile or complains of sleep disturbances.
- Similarly, sleep medicine specialists should recommend that all their patients have a thorough ocular health examination.



Thank you!

*Joe*

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