

Fundamentals of Dental Sleep Medicine

Muskoka Simcoe Dental Society

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Presented by

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Member of American Academy of Dental Sleep Medicine and

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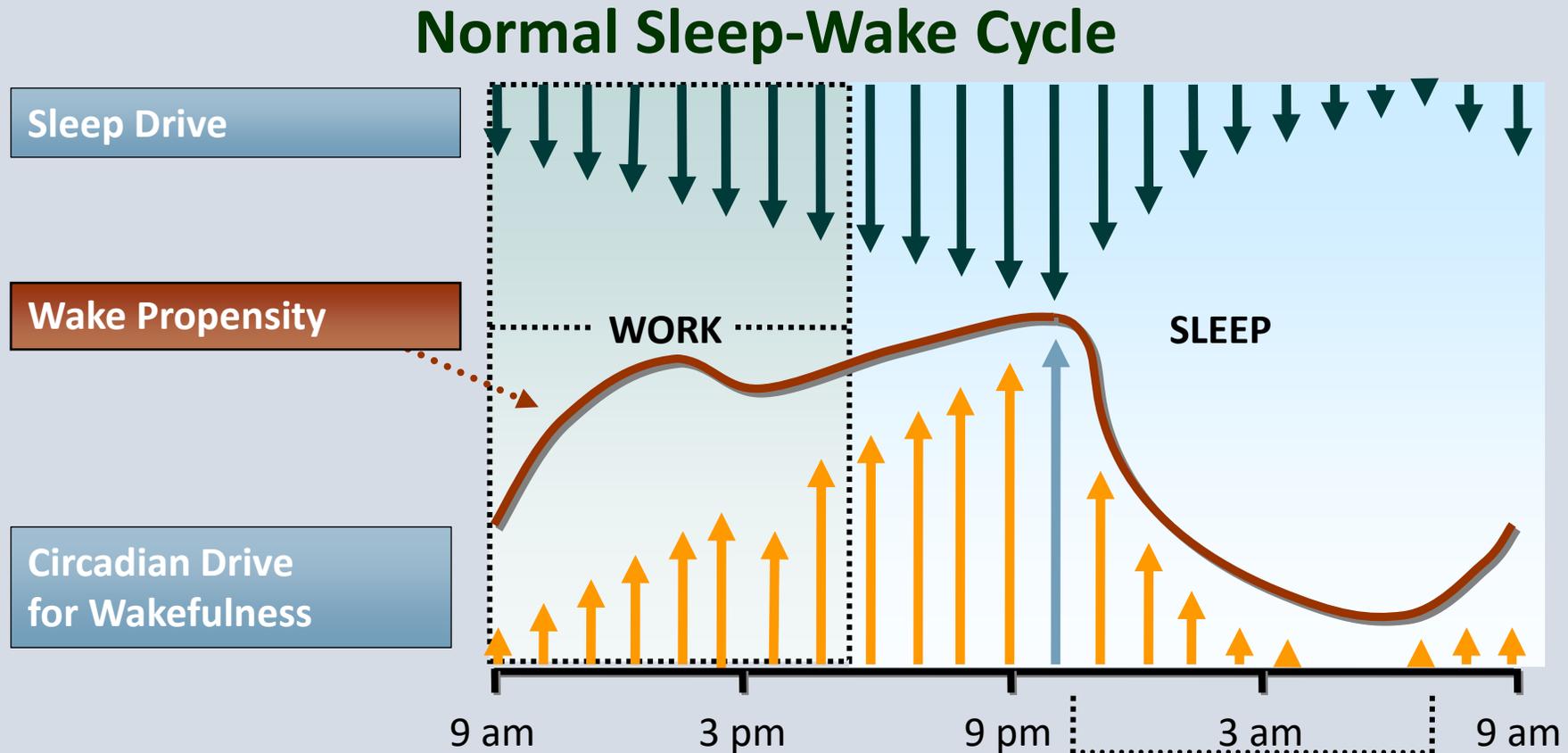
- Normal sleep
- Sleep disordered breathing
 - Obstructive Sleep Apnea (OSA)
 - Pathophysiology and co-morbidities
 - Signs, symptoms and screening
- Treatment options
- Oral appliance therapy
- Bruxism and OSA
- TMD and OSA
- Paediatric OSA

- **Normal sleep**
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Normal Sleep

- “A reversible behavioral state of perceptual disengagement from, and unresponsiveness to the environment.”
- 1/3 of your life.
- Necessary for life.

Physiologic Determinants of Sleepiness



Slide courtesy of Scott Williams MD

Adapted from: Kryger MH, et al. Principles and Practices of Sleep Medicine. 2000.

Light



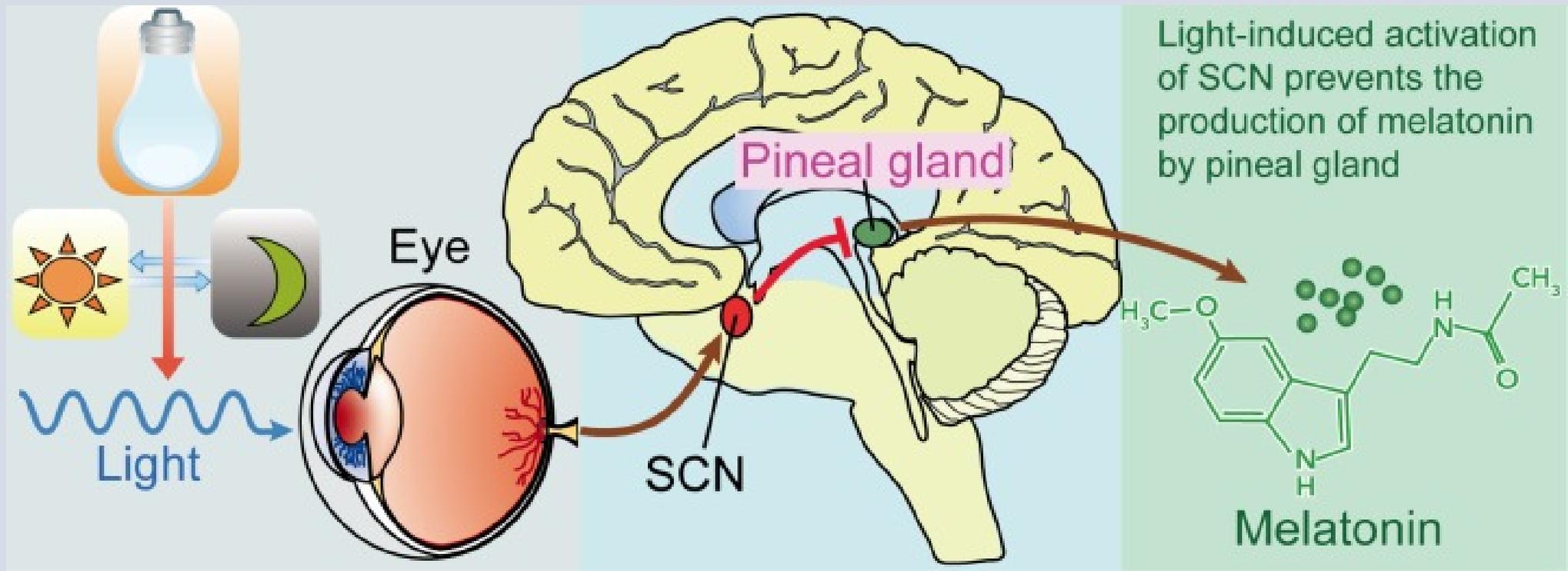
Output Rhythms:

Physiology

Behavior



Suprachiasmatic
Nucleus (SCN)



Which of the following is true?

Getting less than recommended 8 hours of sleep each night...

- a) Disrupts blood sugar levels
- b) Increases risk for stroke
- c) Increases risk for Alzheimer's disease
- d) Increases risk for cancer

Which of the following is true?

Getting less than recommended 8 hours of sleep each night...

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- c) Increases risk for Alzheimer's disease
- d) Increases risk for cancer
- e) All of the above**

Purpose of Sleep

- Maintain alertness
- Energy conservation
- Healing and growth
- Hormonal regulation
- Consolidate memory and learning
- May combat oxidative stress
- Improved immunity
- Helps aid proper brain metabolism

National Sleep Foundation recommendations for sleep time duration

Age	Hours of Sleep
Newborn	14-17
Infant	12-15
Toddler	11-14
Pre-Schooler	10-13
School-aged Children	9-11
Teenagers	8-10
Adult	7-9
Older Adult	7-8

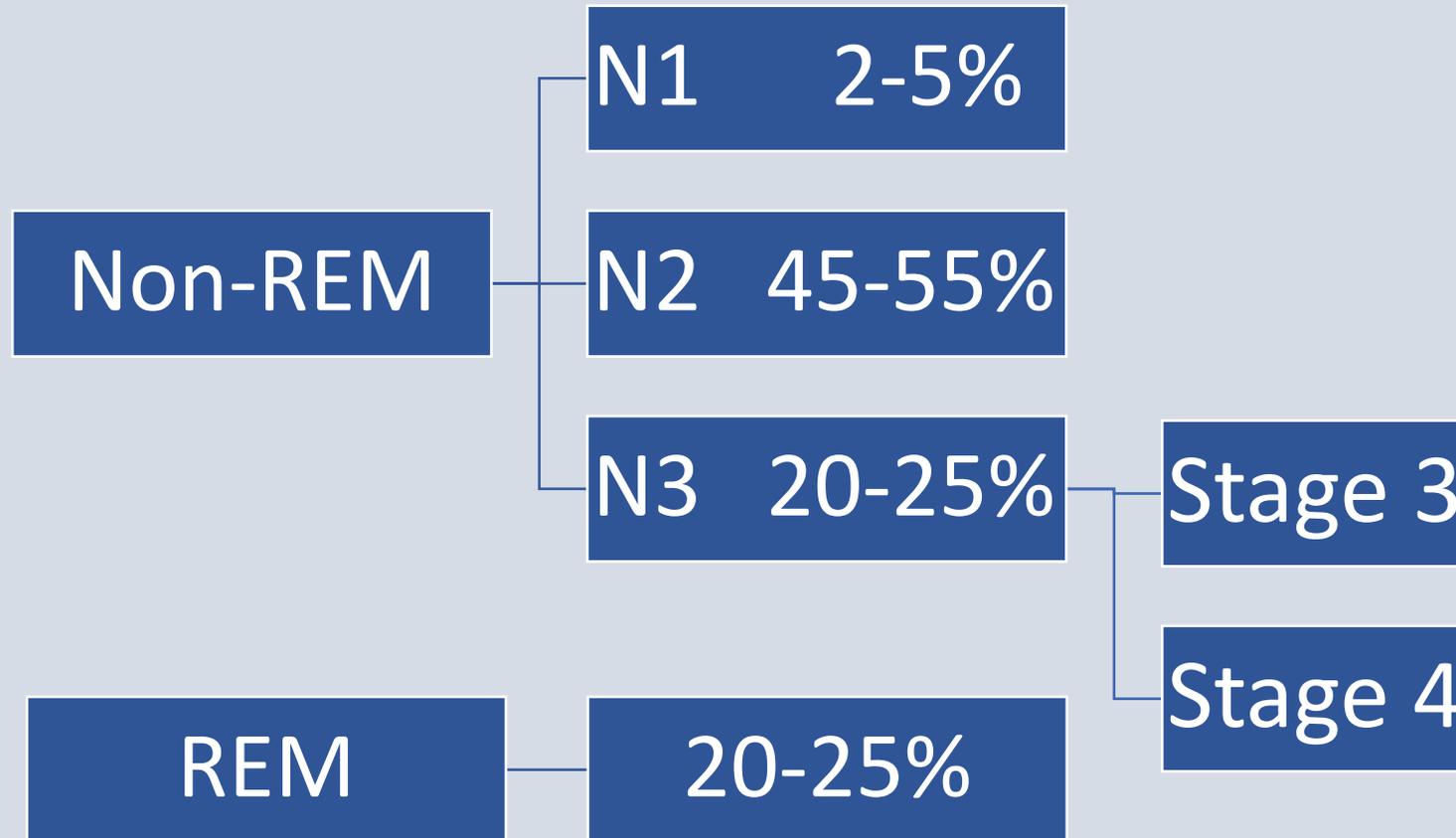
Getting less than recommended 8 hours of sleep each night...

- Impairs your immune system doubling risk for cancer (<6 hr.)
- Increases your risk of Alzheimer's disease
- Disrupts blood sugar levels
- Increased risk of coronary artery disease
- Increases risk of atherosclerosis (stroke, CV disease, congestive heart failure)
- Contributes to anxiety, depression, and suicidal risk
- Increases risk for fatal and non-fatal car accidents
- Shortens life expectancy

Sleep States

NREM non-rapid eye movement or non-REM

REM rapid eye movement



Non-REM Sleep

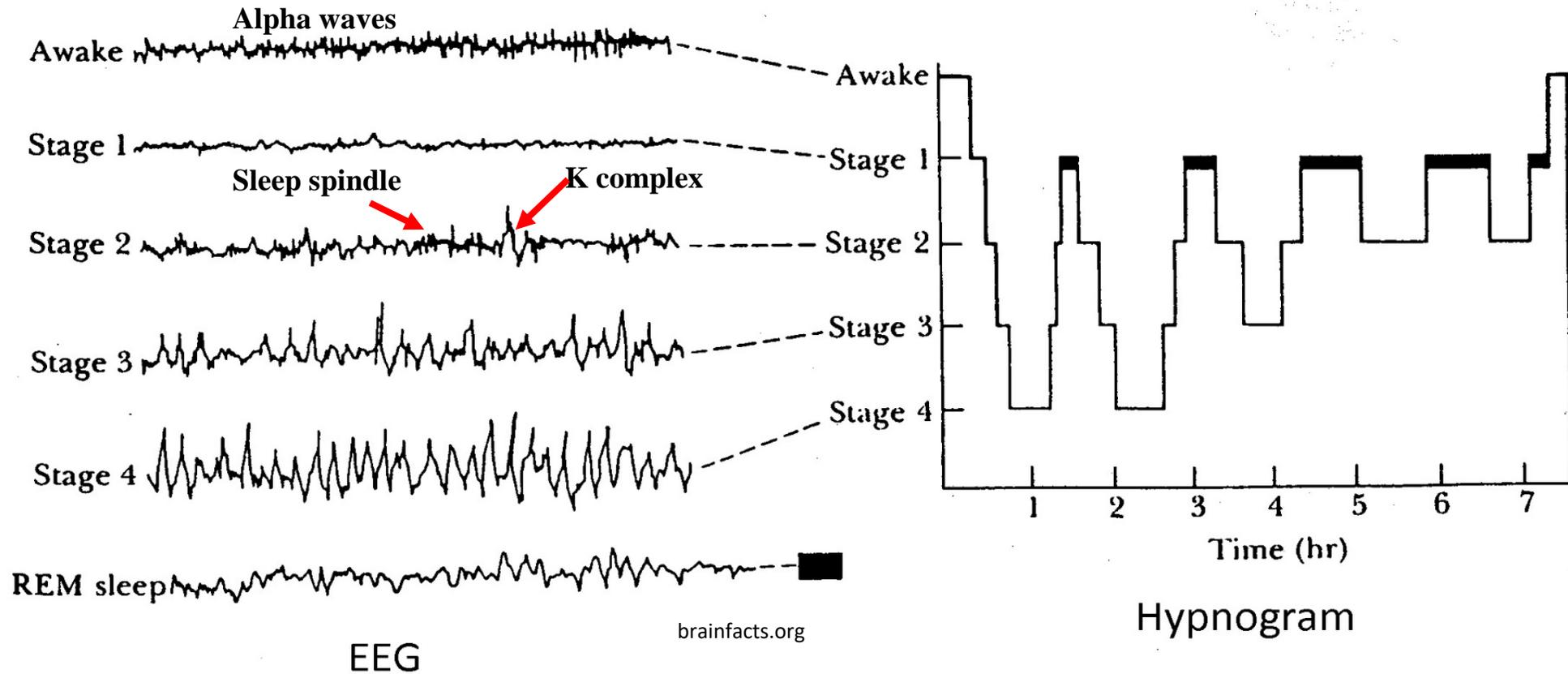
- Makes up majority of sleep
- N3 also referred to as “slow wave sleep”
- Relatively inactive brain
- Reduced body temperature
- Reduced metabolism
- Release of growth hormone

REM Sleep

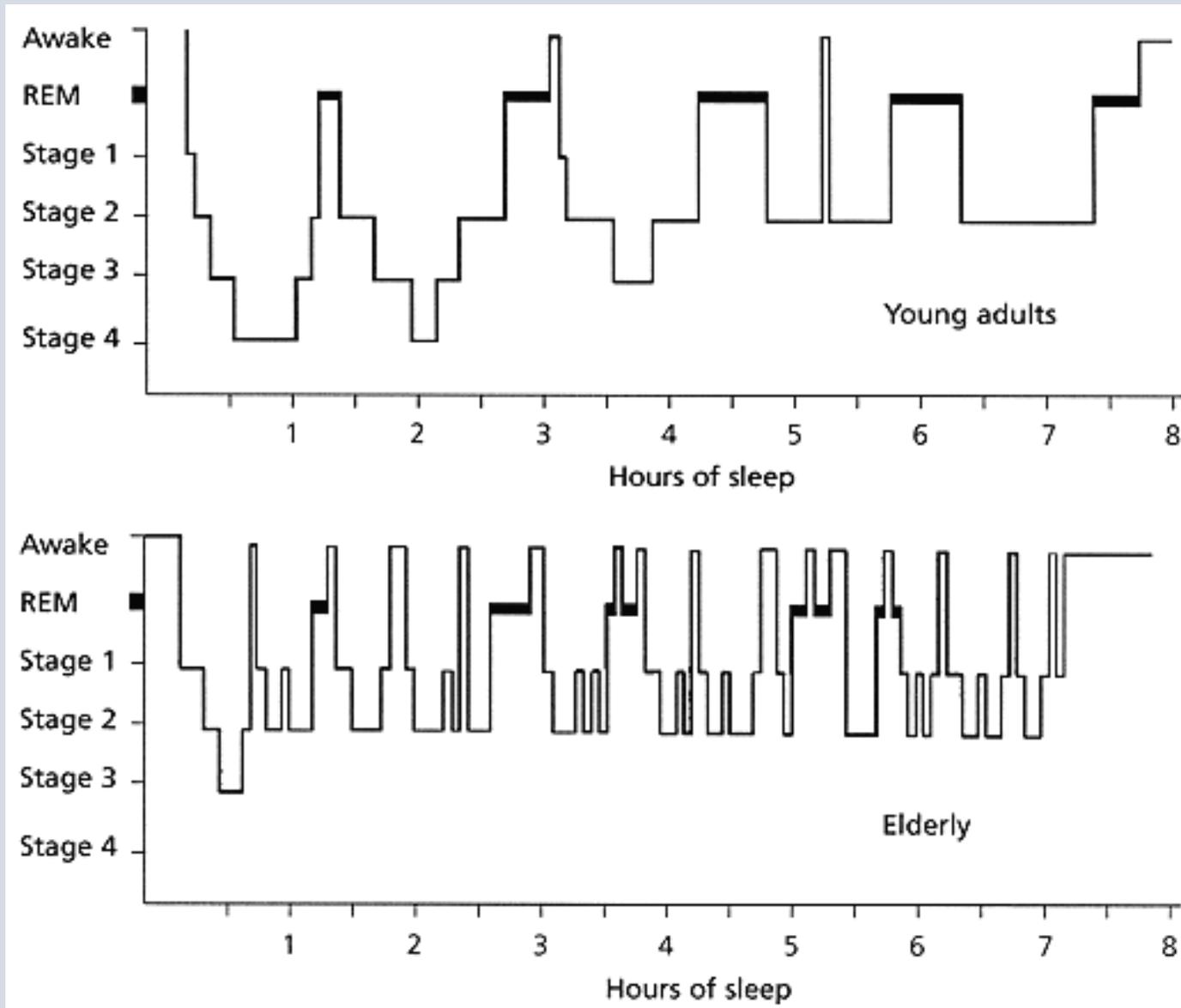
- 20-25 % of sleep
- Also referred to as “dream sleep”
- Increased brain activity
- Increased in BP, HR, and respiration
- Muscle hypotonia (“paralysis”)

Distinction between sleep stages made by **EEG** during a sleep study (polysomnogram)

Distinction of stages by EEG waveforms



Comparison of Sleep Cycles in Young Adults and the Elderly



The best temperature for the bedroom while sleeping is

- a) 62 degrees Fahrenheit.
- b) 65 degrees Fahrenheit.
- c) 68 degrees Fahrenheit.
- d) 72 degrees Fahrenheit.
- e) 75 degrees Fahrenheit.

The best temperature for the bedroom while sleeping is

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b) 65 degrees Fahrenheit.

c) 68 degrees Fahrenheit.

d) 72 degrees Fahrenheit.

e) 75 degrees Fahrenheit.

Type 3 Monitor

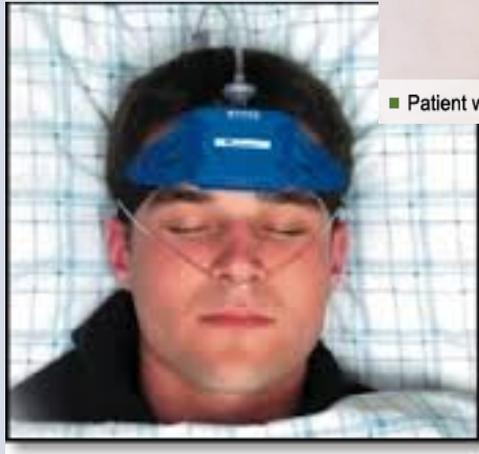


Watch
PAT

Braebon
Medibyte



■ Patient wearing the MediByte



ARES

Sleep Study Report

07/12/13,

17352

Sleep Summary

Start Study Time	02:45:43
End Study Time	07:32:54
Total Study Time	287.2

Respiratory Totals and Indices

Obstructive Apneas	12	2.5
Central Apneas	0	0.0
Mixed Apneas	3	0.6
Hypopneas	75	15.7
Total (RDI)	90	18.8
RERAs	123	25.7

Pulse Rate Statistics (bpm)

Mean	78.5
Minimum	62.0
Maximum	114.0

Oxygen Saturation Statistics

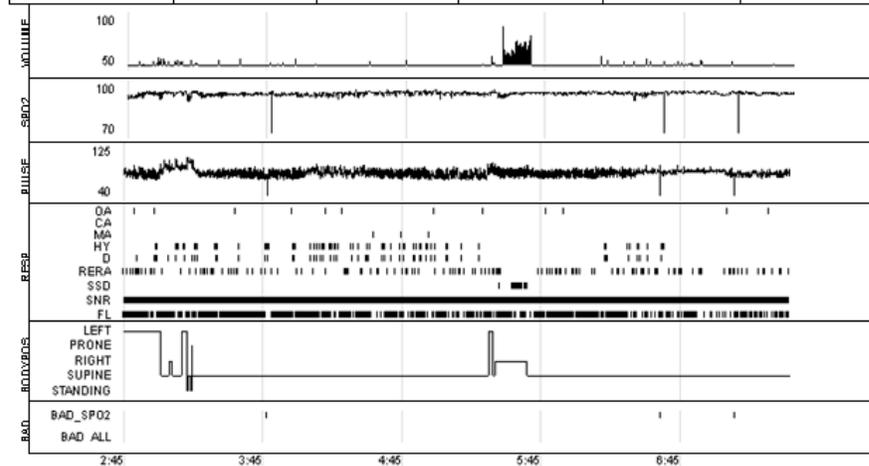
Mean SpO2	96.8%	
Min SpO2	90.0%	
Max SpO2	100.0%	
Time SpO2 in Range	%	Minutes
90-100 %	100.0%	286.9
80-89 %	0.0%	0.0
70-79 %	0.0%	0.0
60-69%	0.0%	0.0
50-59%	0.0%	0.0
< 50 %	0.0%	0.1
	Total	Index
Desaturations 4% OR >	49	10.2

Respiratory Results by Body Position

Body Position	Supine	Prone	Left Side	Right Side	Total Non Supine
% Time in Pos	87.7%	0.0%	6.5%	5.5%	12.1%
Snoring events	3991	0	238	150	388
Apnea + Hypopnea Events	84	0	6	0	6
Apnea + Hypopnea Index	20.0	0.0	19.2	0.0	10.4

Snoring Volume Table dB(A)

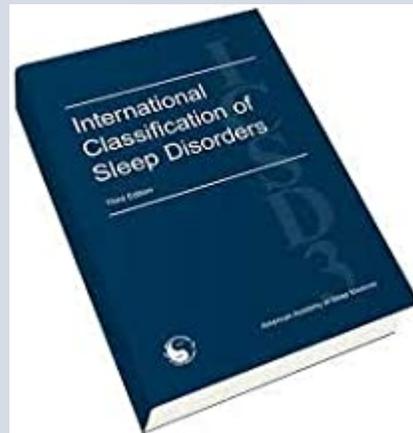
Body Position	Supine	Non-Supine	Right Side	Left Side	Prone
Min	50.0	50.0	50.0	50.0	-
Max	56.2	92.6	92.6	53.4	-
Mean	55.7	61.1	61.1	-	-



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International Classification of Sleep Disorders 3rd Edition

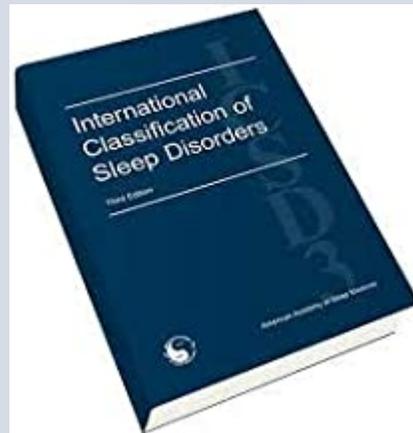
- Insomnia
- **Sleep Related Breathing Disorders**
- Central Disorders of Hypersomnolence
- Circadian Rhythm Sleep-Wake Disorders
- Parasomnias
- Sleep Related Movement Disorders
- Other Disorders



International Classification of Sleep Disorders 3rd Edition

Sleep Related Breathing Disorders

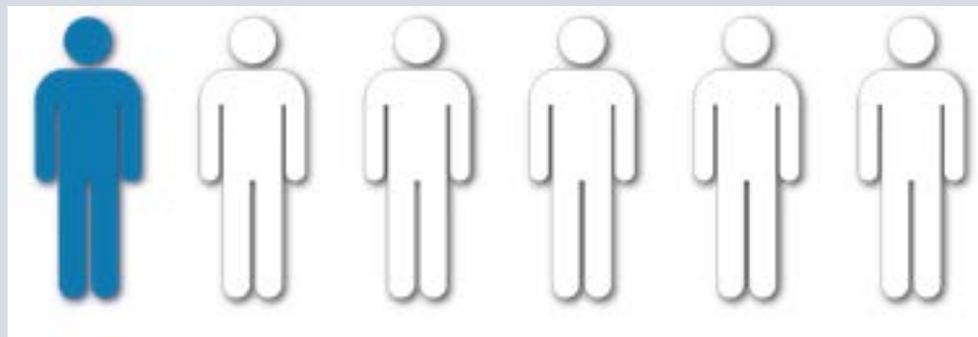
- **Obstructive Sleep Apnea Disorders (OSA)**
- Central Sleep apnea Syndromes
- Sleep Related Hypoventilation Disorders
- Sleep Related Hypoxemia Disorder



Conditions a dentist can help

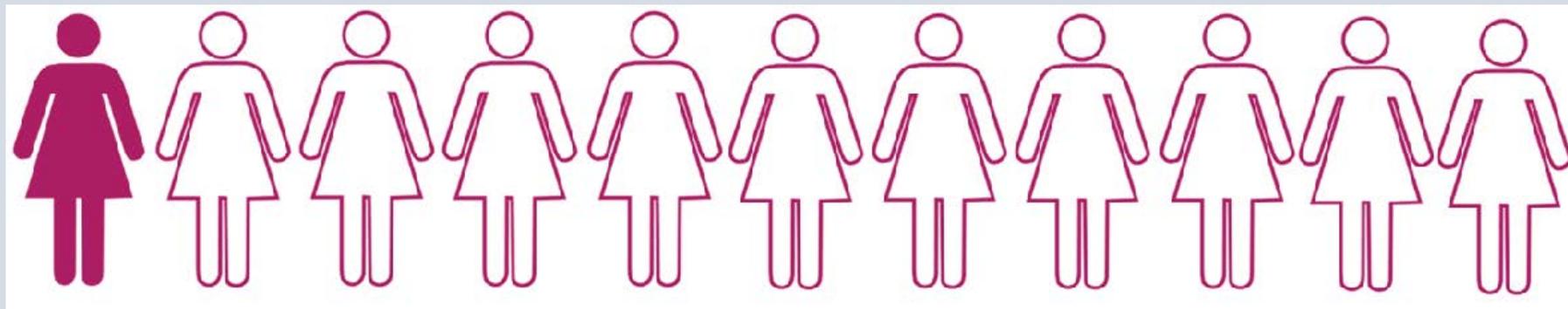
(Diagnosis is mandatory)

- Primary Snoring
- Upper Airway Resistance Syndrome
- Obstructive Sleep Apnea



Men 30-49 10%

Men 50-70 17% (one in six)



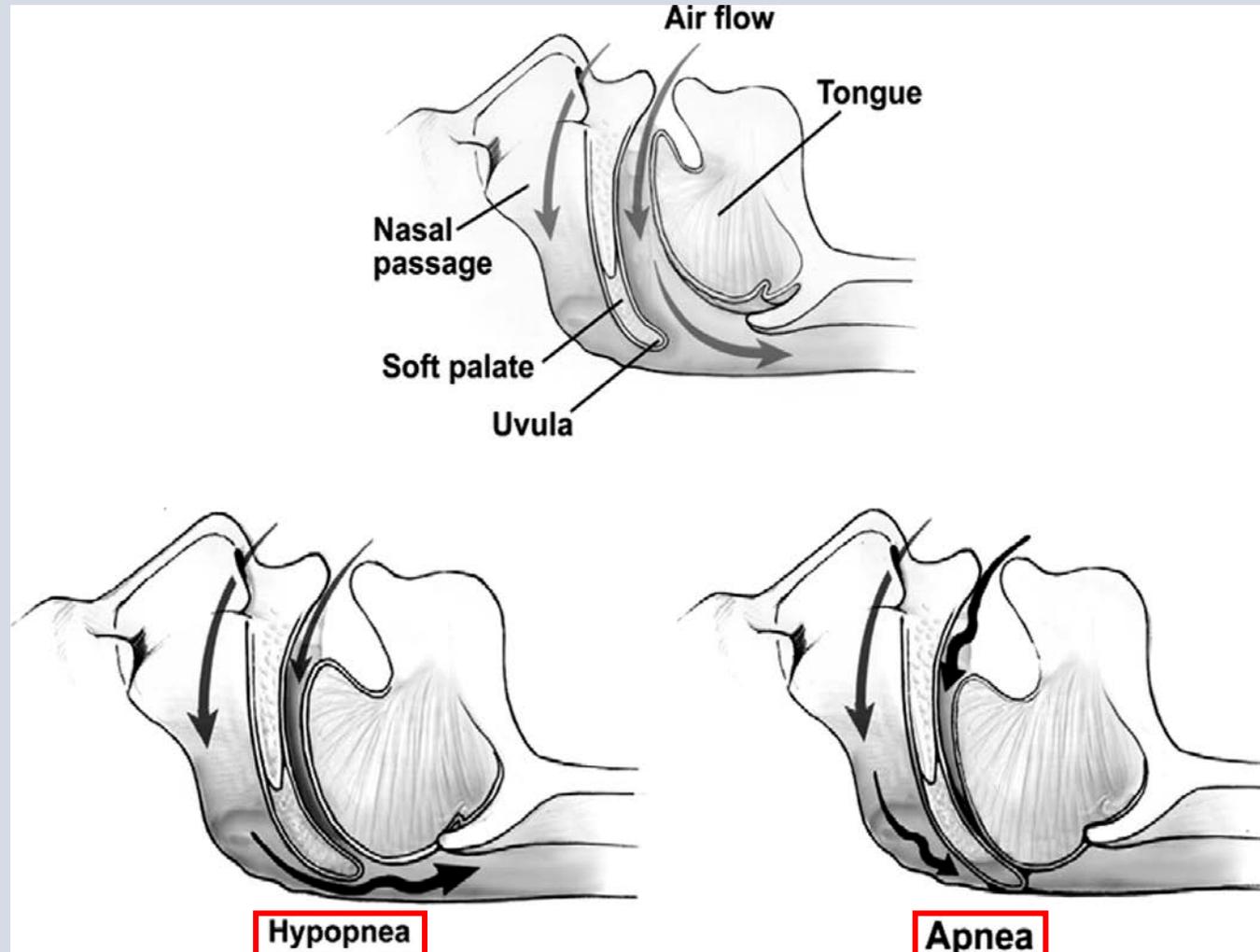
women 30-49 3%

women 50-70 9% (one in 11)

European study of non-obese individuals showed in **40 -80 year age group 23% in women and 50% in men**

- Normal sleep
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Figure 1. Partial and complete airway obstruction resulting in hypopnea and apnea, respectively.



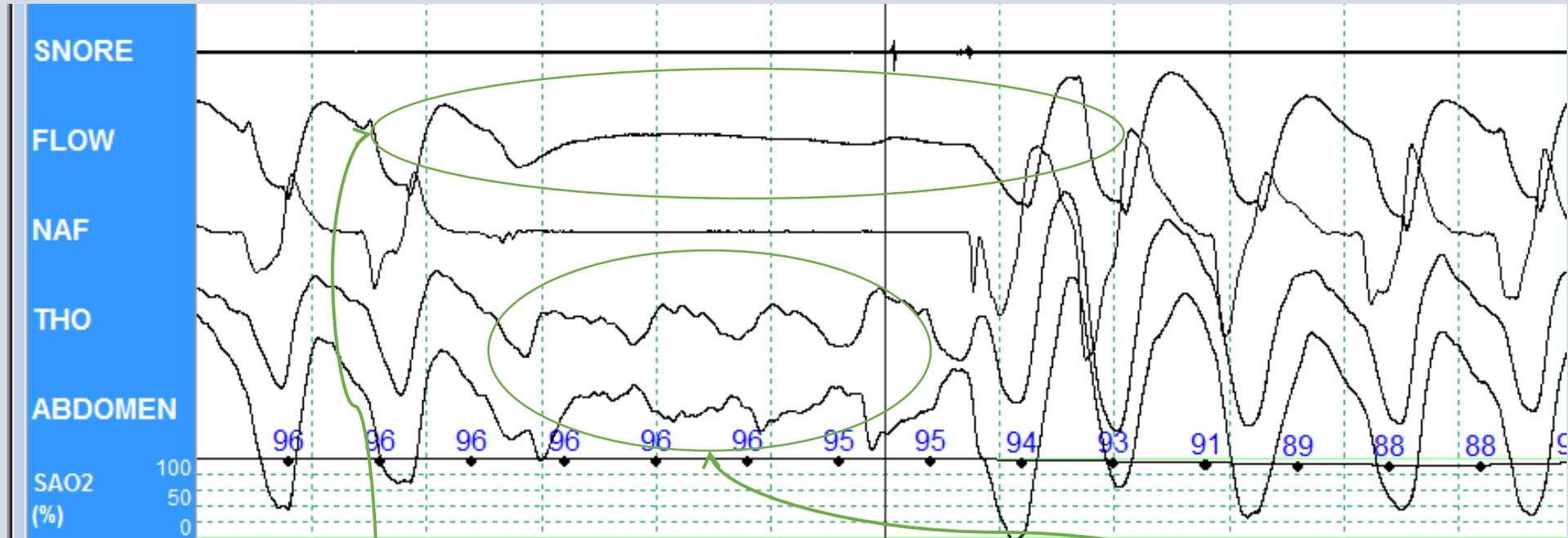
Somers V et al. *Circulation* 2008;118:1080-1111



Definitions

- Apnea
 - reduction $\geq 90\%$ of airflow ≥ 10 sec.
- Hypopnea
 - reduction of airflow by $\geq 30\%$ for ≥ 10 sec associated with an O2 sat drop of $\geq 3\%$, or an arousal.
- RERA- respiratory effort-related arousal
 - reduction of airflow by $< 30\%$ associated with an arousal.

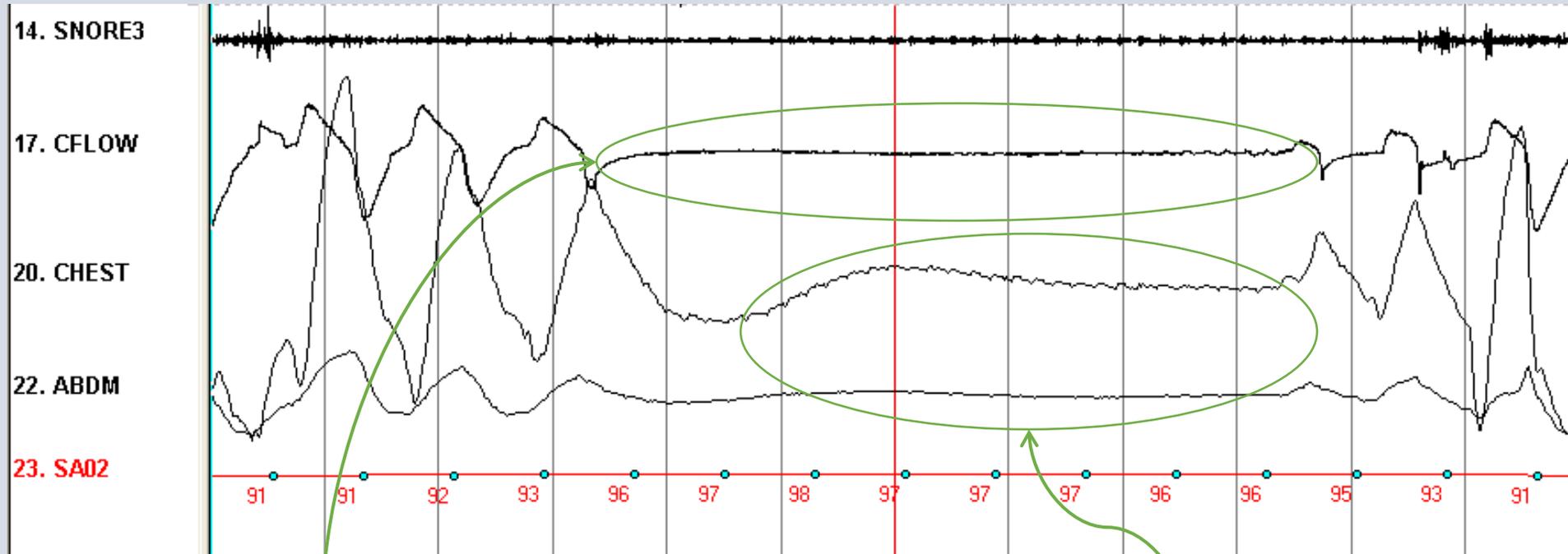
Obstructive Apnea



Airflow stops for more than 10 seconds

The chest and abdomen continue to move up and down throughout this event. It is an obstructive apnea.

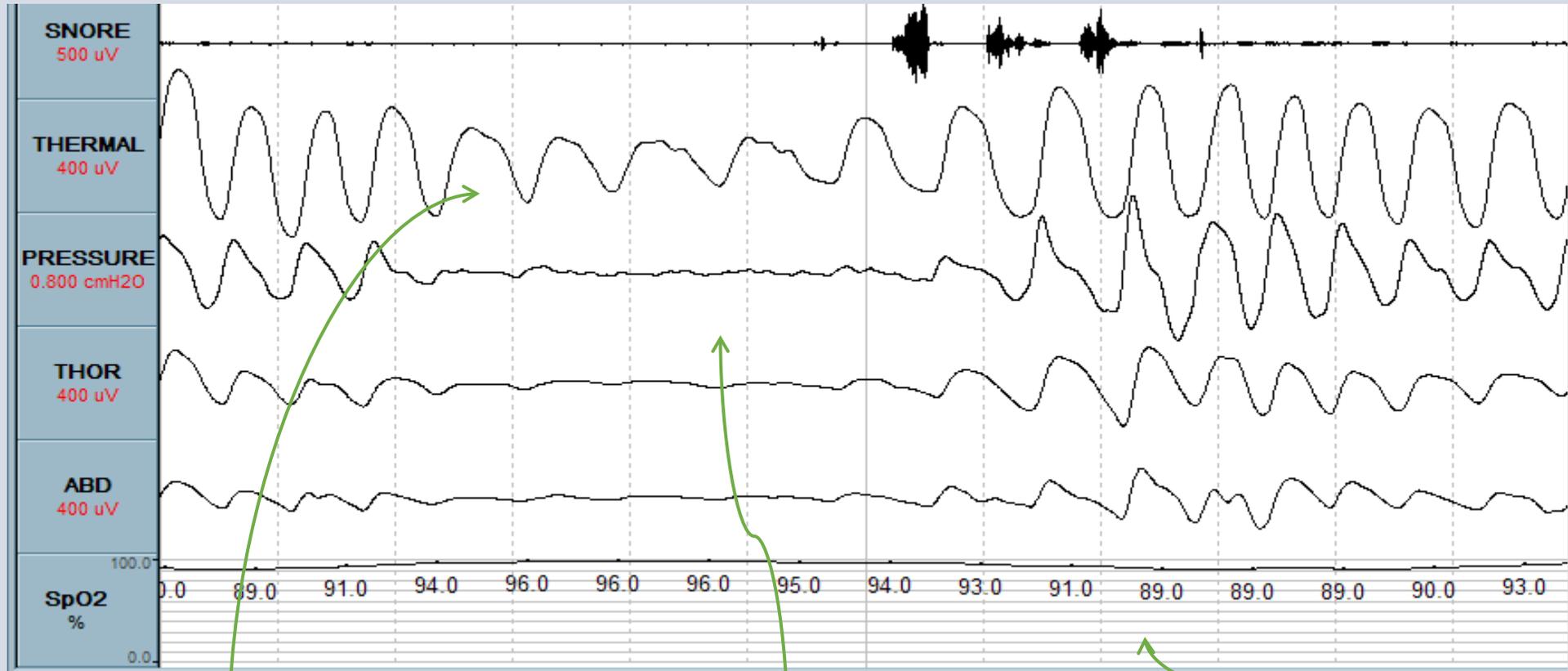
Central Apnea



Event has no air flow as measured by CPAP flow output

No respiratory effort is seen

Hypopnea



The thermal signal is not reduced by 90% or more

The nasal pressure signal is reduced by more than 30%

Oxygen desaturation from 96% to 89% occurs with this event.

Apnea-hypopnea index = AHI

Number of apneas plus hypopneas per hour of sleep

Normal

AHI ≤ 5

Mild OSA

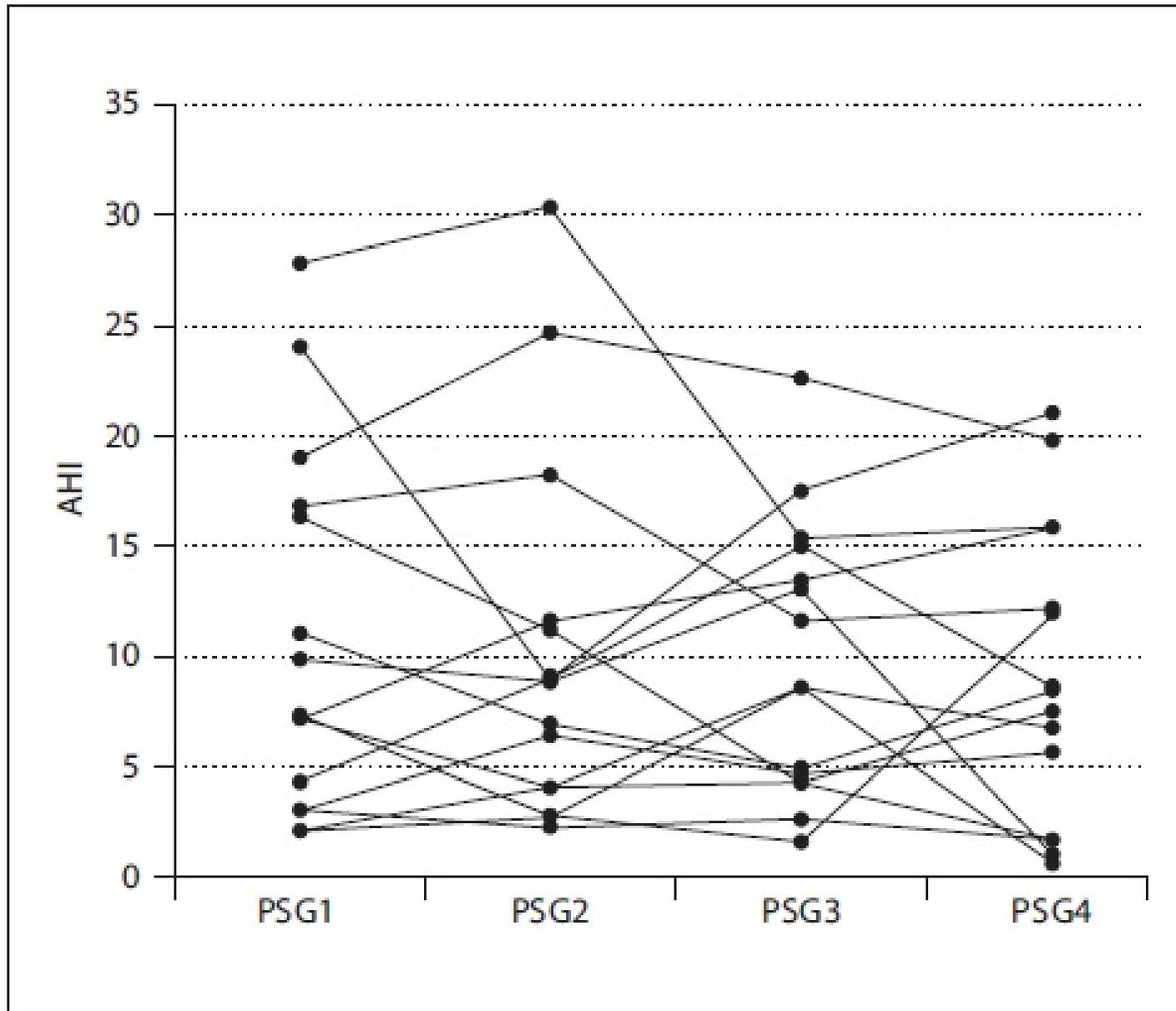
AHI 6 > 15

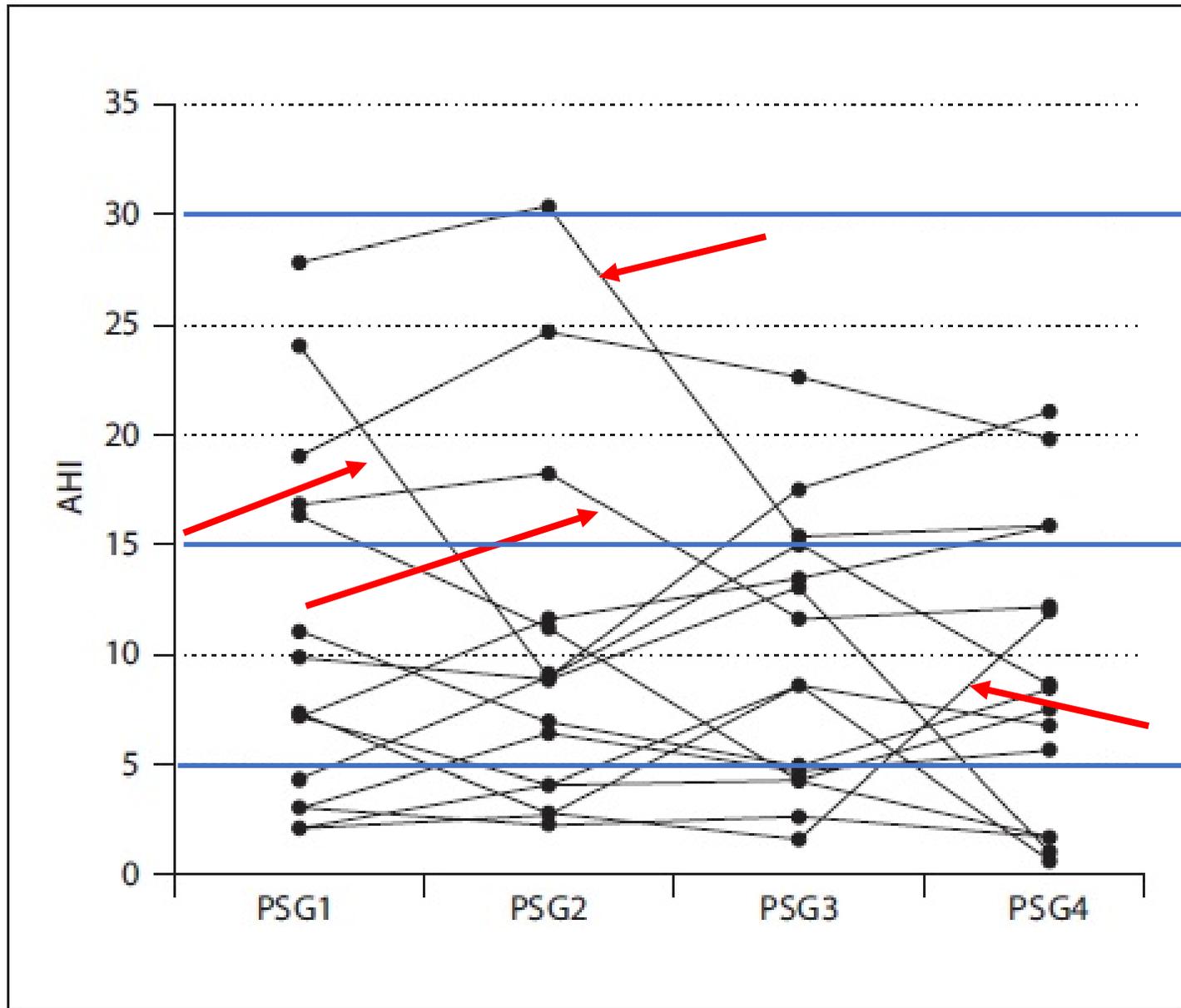
Moderate OSA

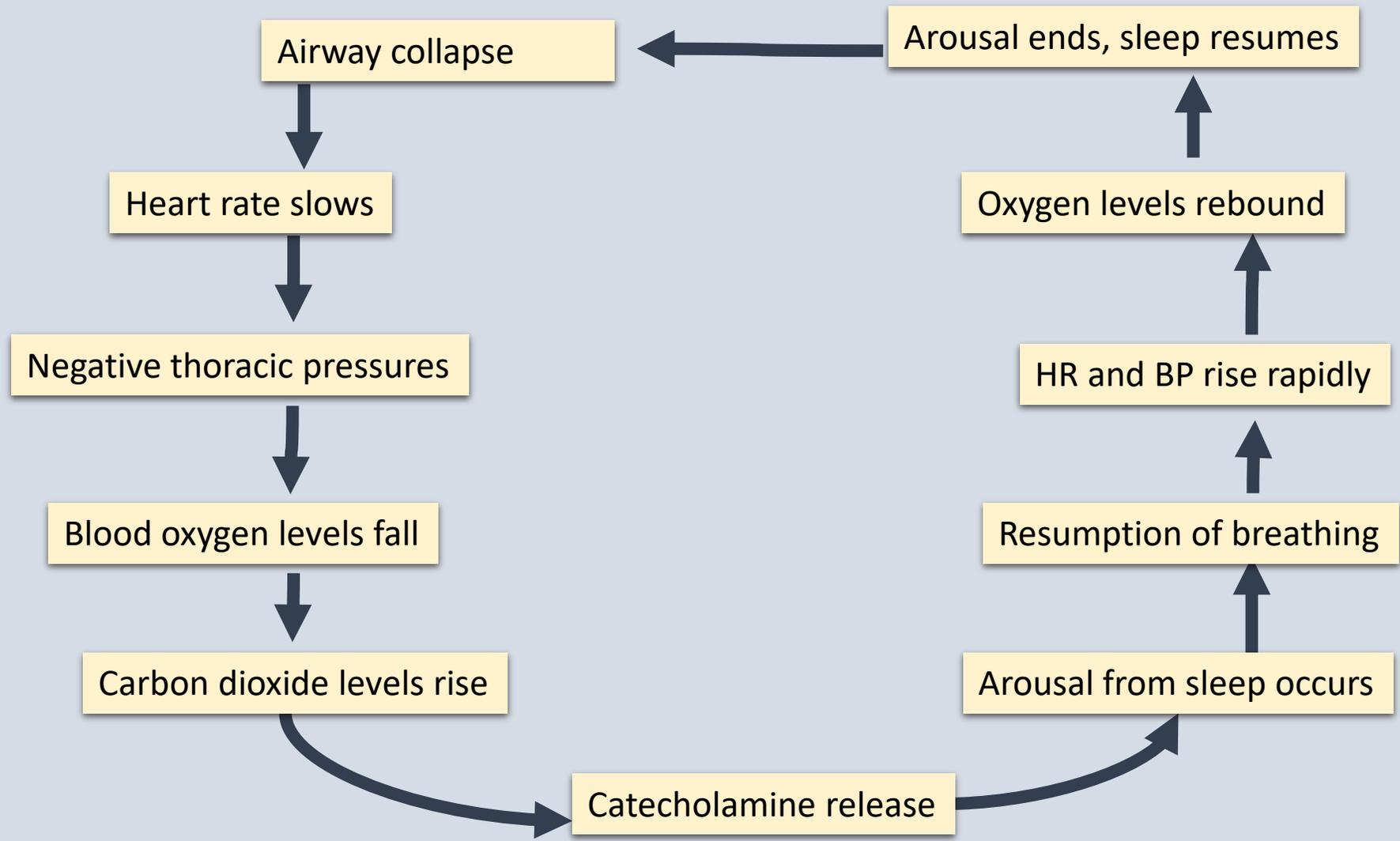
AHI 16 > 30

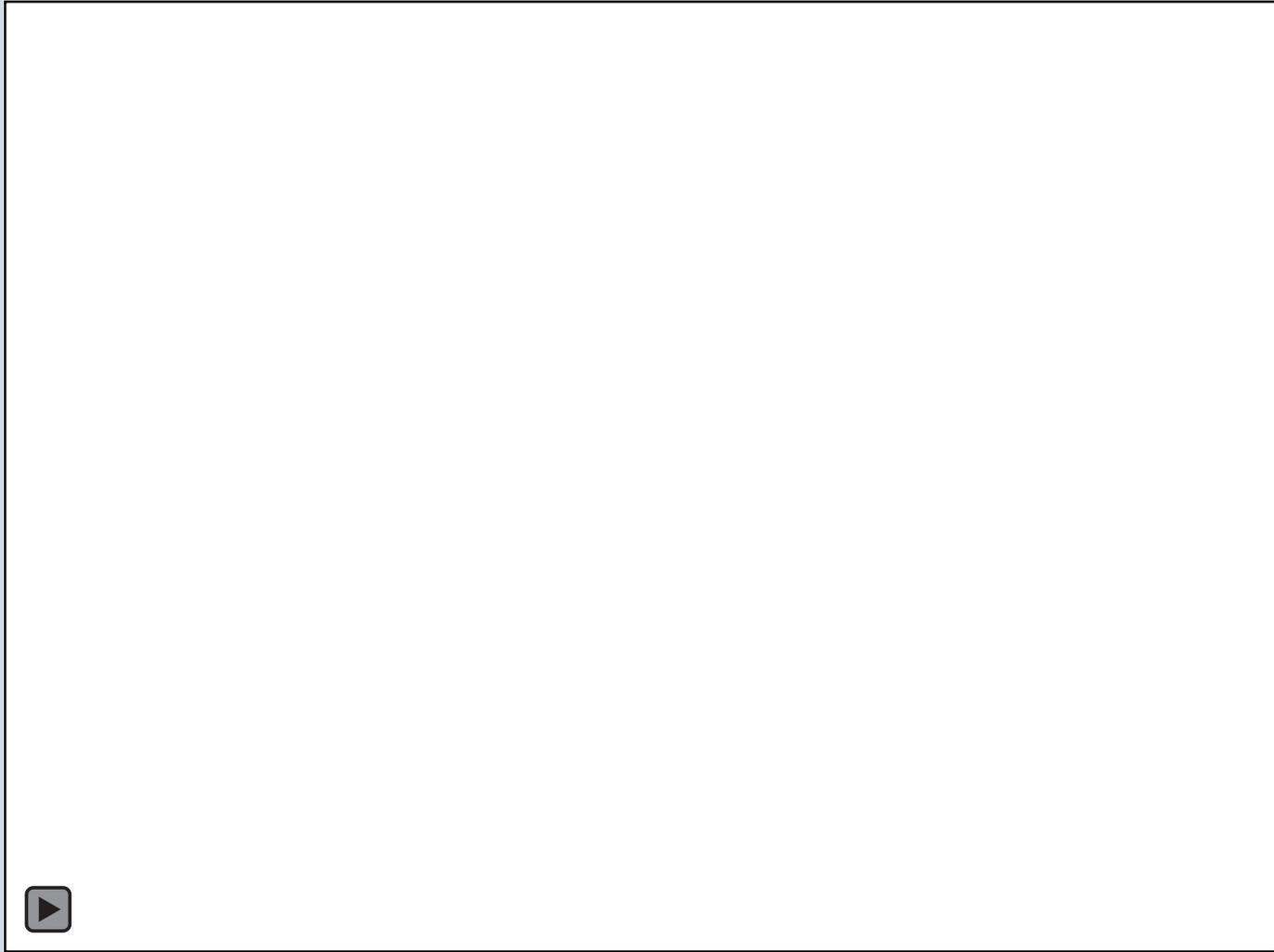
Severe OSA

AHI > 30









So what does this do to the patient?

Here are some documented extremes

- O2 sat can drop below 60% with OSA
- During apneic event heart rate drops (diver's response). Documented **heart** stopping for more than 10 seconds.
- At end of apneic event BP can rise as high as 240/130, systolic has been measure to over 300 mm Hg.
- Intrathoracic pressure during attempted inspiration can drop by
-65 mm. Hg

- Increase sympathetic outflow
- Release of vasoactive substances
- Increased oxidative stress
- Increased systemic inflammation (increase in c-reactive protein and interleukin-6)
- Insulin resistance and glucose intolerance



Without MAS

With MAS



Velopharynx

Oropharynx

Hypopharynx

Airway volume 12.6 cm³

Airway volume 14.7 cm³

Responder airway

Risk factors for OSA

Male sex

Obesity

Aging

Retrognathia

Edema (smoking, allergies)

Alcohol

Medications

Non-anatomic contributors to OSA

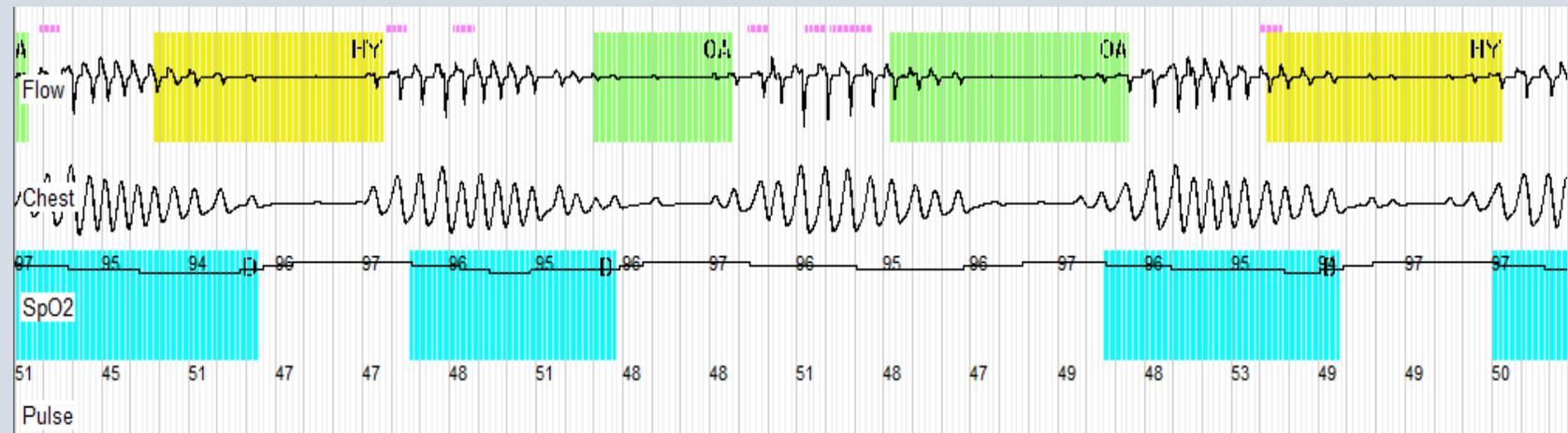
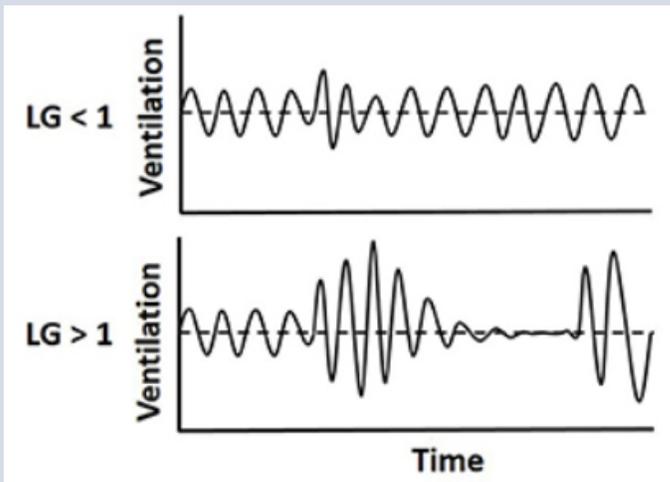
Upper airway muscles

Poor airway muscle responsiveness

Poor airway muscle coordination

Low arousal threshold

Poor ventilatory control—Loop Gain



Non-anatomic contributors to OSA

What percentage of patients with OSA have a non-anatomic factor that contributes to their obstructive sleep apnea?

- a) 12%
- b) 28%
- c) 57%
- d) 69%

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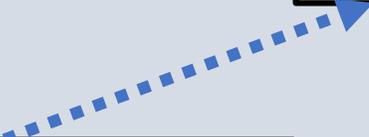
c) 57%

d) 69%

Impaired anatomy (narrow/collapsible upper airway)
In all OSA patients but to differing degrees



Repetitive airway obstruction during sleep
(OSA)



Ineffective upper airway
dilator muscles (35%)



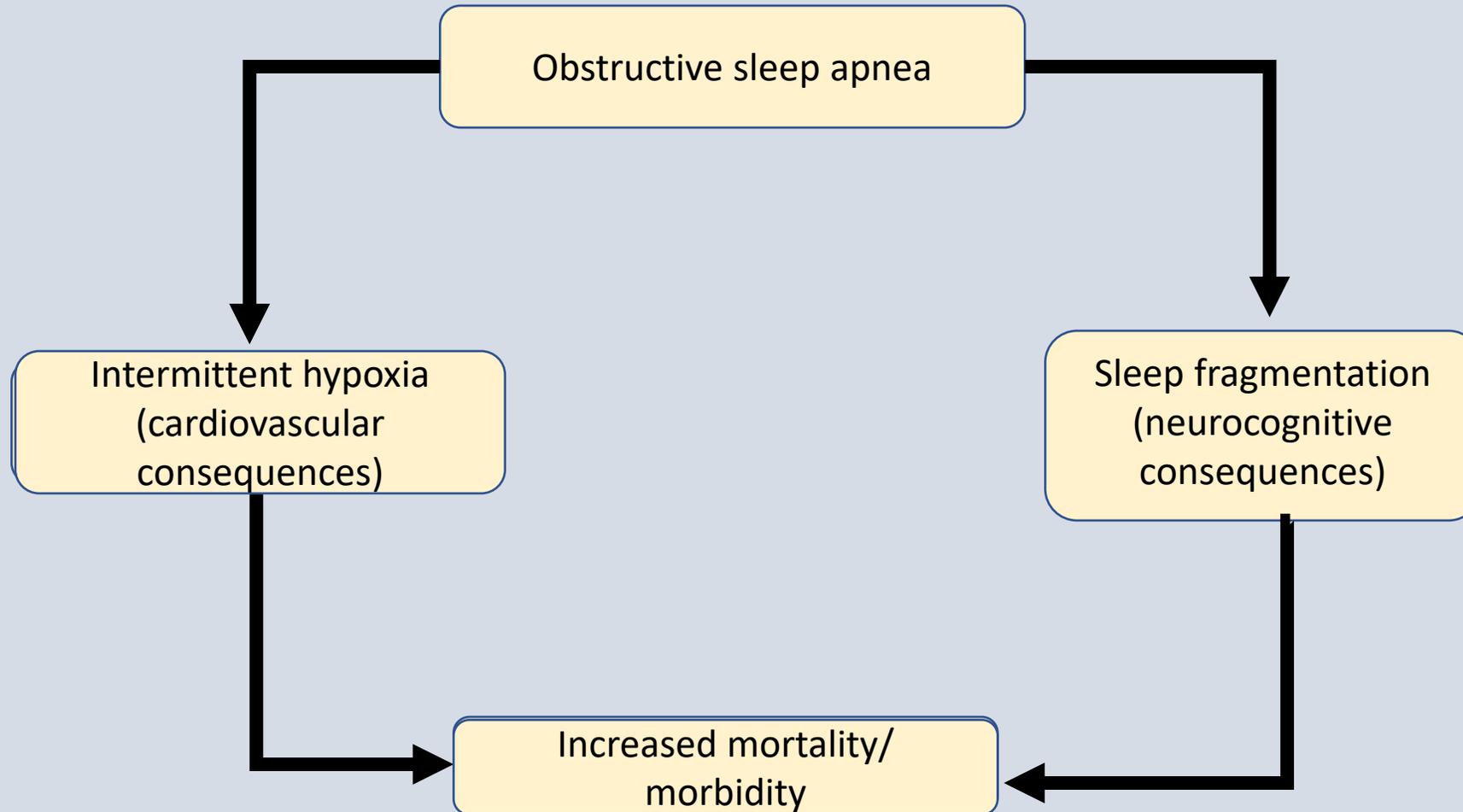
Unstable ventilatory control
(high loop gain) (38%)

Low respiratory arousal
threshold(37%)

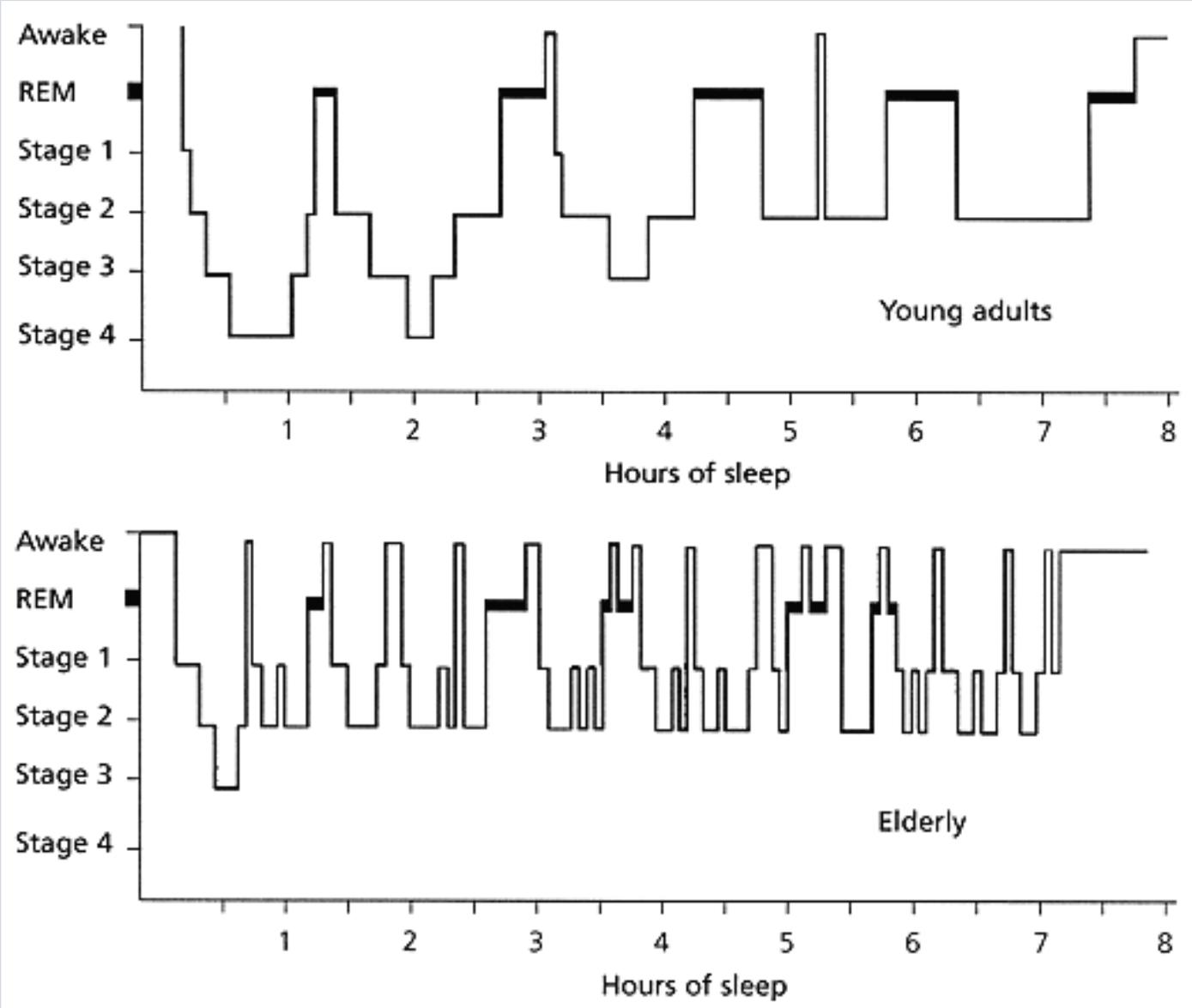
From: Sleep Medicine for Dentists:
An Evidence-based Overview
2nd Edition Quintessence

69% of OSA patients have
non-anatomic component

Comorbidities and OSA



Comparison of Sleep Cycles in Young Adults and the Elderly



Comorbidities and OSA

Hypertension

Cardiovascular disease

Atrial Fibrillation

Obesity

Type II Diabetes

Headache

Anxiety

Depression

Insomnia

Cardiovascular Consequences

Systemic hypertension

Pulmonary hypertension

Coronary artery disease

↑ risk of stroke

↑ risk of cardiac arrhythmias

↑ inflammation

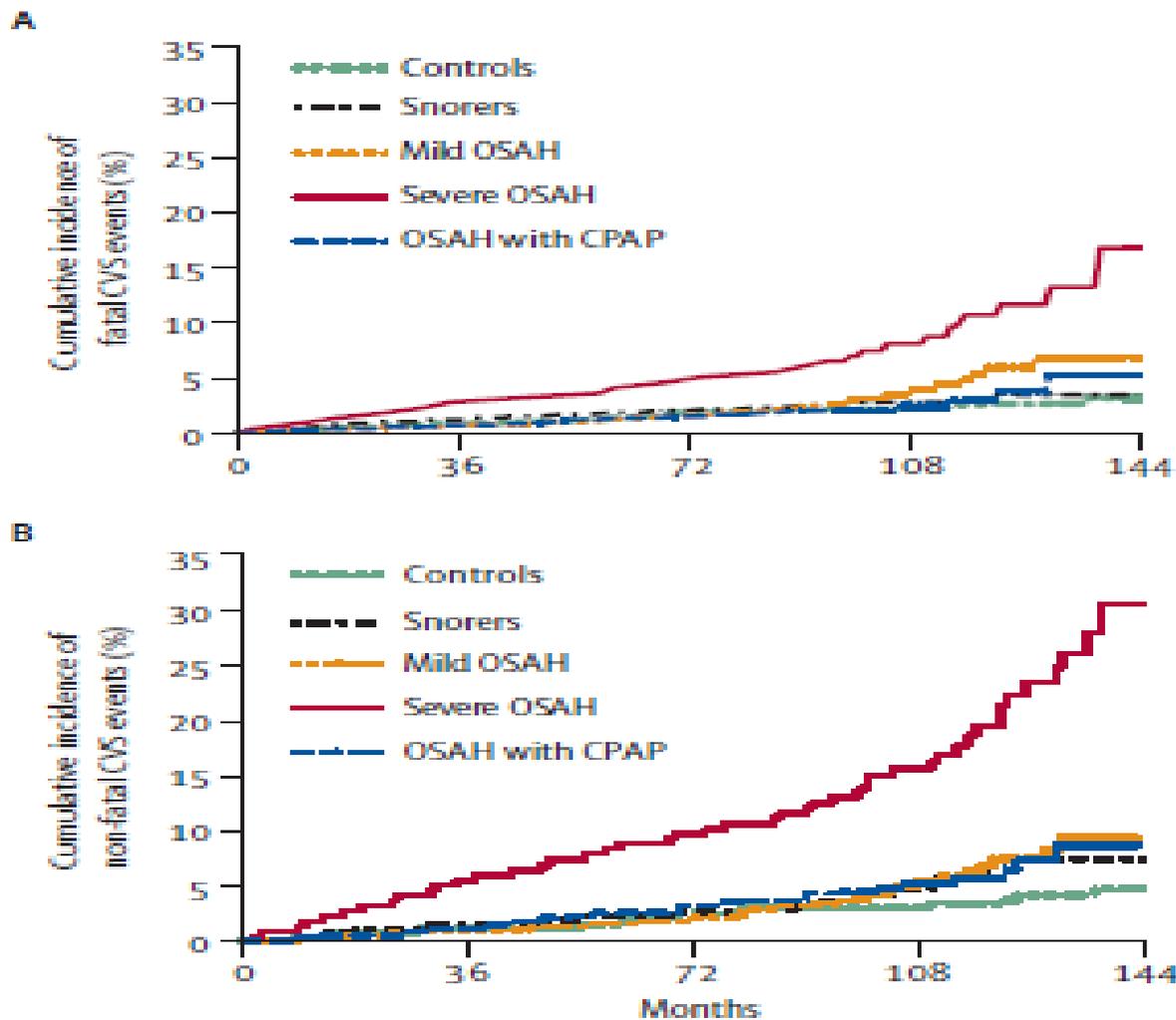
↓ quality of life

Intermittent hypoxia is
primary mechanism

Metabolic changes

-Type 2 diabetes etc.

-Weight gain (poor regulation of
levels of leptin and ghrelin)



Numbers at risk:

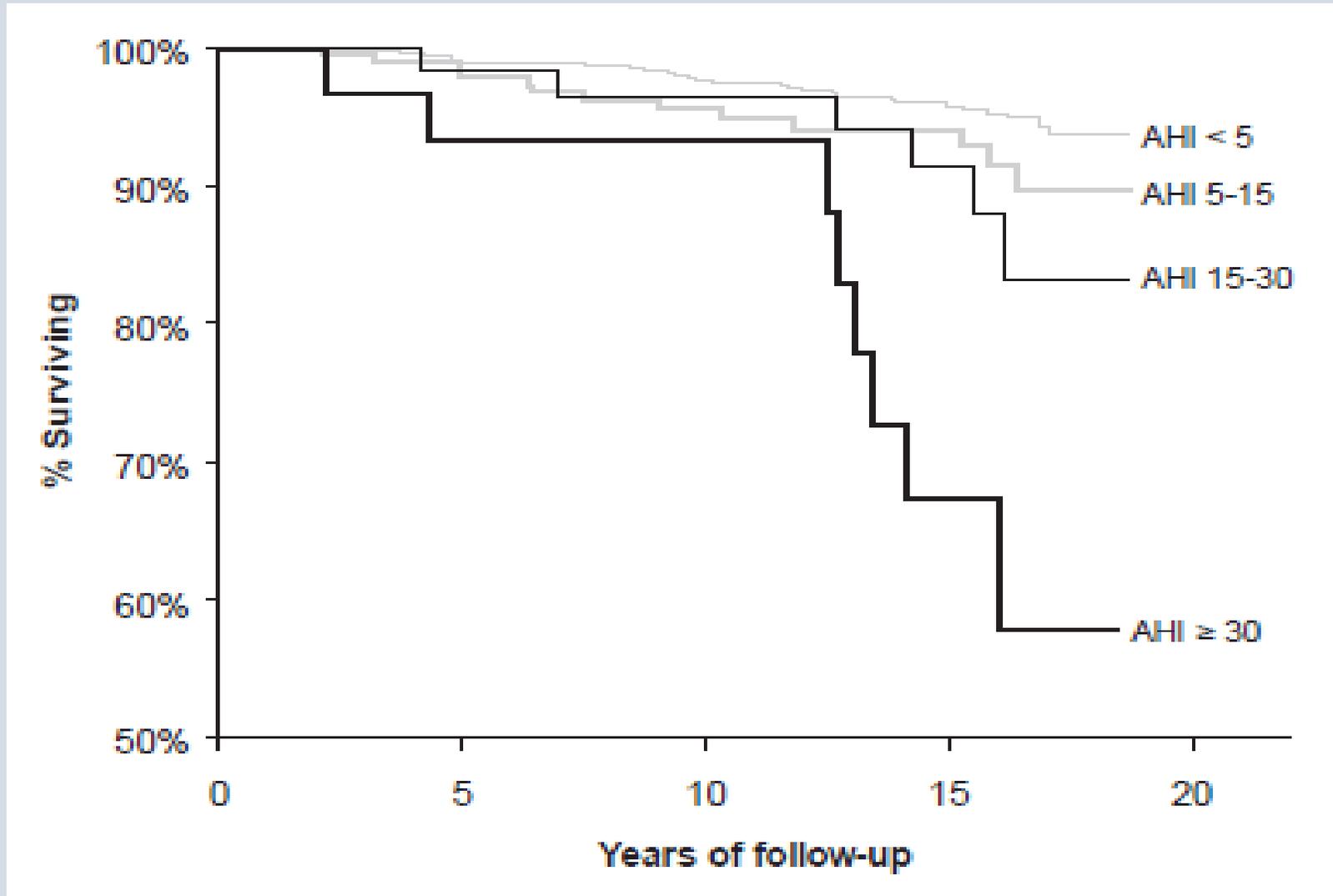
Controls	264	262	259	258
Snorers	377	372	361	232
Mild OSAH	403	401	392	264
Severe OSAH	235	229	221	167
OSA with CPAP	372	364	361	229

Groups:

- Controls (264)
- Snorers (377)
- Untx'd mild-moderate OSA (403)
- Untx'd severe OSA (235)
- OSA compliant on CPAP (372)
- Untx'd severe OSA had 3x's risk compared to controls after adj.

Marin et al. *Lancet* 2005

Mortality and OSA severity



Young et al. *SLEEP* 2008;31(8):1071-1078.

SRBD and Cardiovascular Disease

Disorder	Prevalence
Drug Resistant Hypertension ¹	83%
Heart Failure ¹	11-37%
Stroke ²	44-72%
Hypertension ³	30%
Atrial Fibrillation ⁴	40-50%
Coronary Artery Disease ⁵	30%
Type II Diabetes ⁶	36%

¹Kato M, et al. 2009

²McNicholas WT, et al 2007

³Jean-Louis, Girardin, et al 2008.

⁴Hohl M. et al 2014

⁵Schafer H et al. 1999

⁶Einhorn D et al 2007

Neurocognitive Consequences

- ↓ cognitive function
- ↓ short-term memory
- ↓ reaction time
- ↑ processing time
- ↑ rate of motor vehicle accidents (x3-7)
- ↑ rate of workplace accidents
- ↑ depression
- ↑ risk of mild cognitive impairment
- ↑ risk of earlier onset Alzheimer's disease
- Word finding difficulty
- Mood alteration

Consequence of
sleep fragmentation
and oxygen desaturation

Sleep stages and memory processing

- Declarative memory
 - Episodic—events, places
 - Semantic—facts and concepts
- Non-declarative memory
 - Procedural and memories not consciously executed
 - How to do things: ride a bicycle etc,

Sleep stages and memory processing

- Declarative memory dependent on SWS coupling with sleep spindles
- REM, stage 2 and SWS have all been implicated in sleep-dependent memory processing,
- Each stage contributes differently to these processes
- Learning improves after sleep compared to controls
- Adequate sleep quantity and quality not only aids in consolidation of memory but also “clears the decks” for next day learning.

How does OSA effect memory and learning?

- OSA results in greater N1 and less N3 (less SWS) and REM
- OSA pts perform worse on motor sequence learning
- OSA pts have decrease spindles, necessary for memory consolidation
- OSA patients exhibit decreased perfusion of certain regions of the brain *while awake*
- Elderly OSA pts with no cognitive impairment score worse on memory tests.

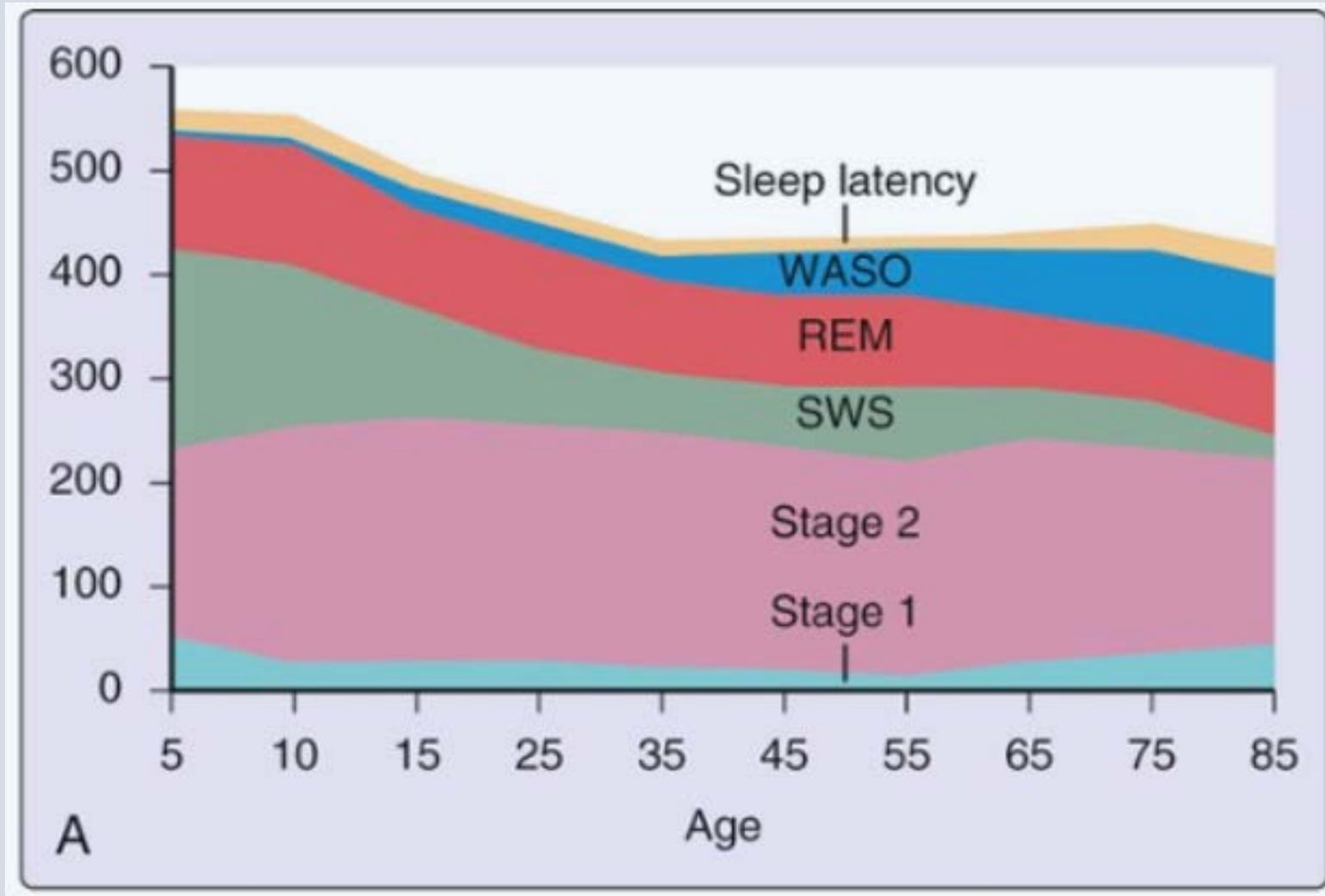
Haba-Rubio, Neurology 2017

Djonlagic, PLoS One. 2014

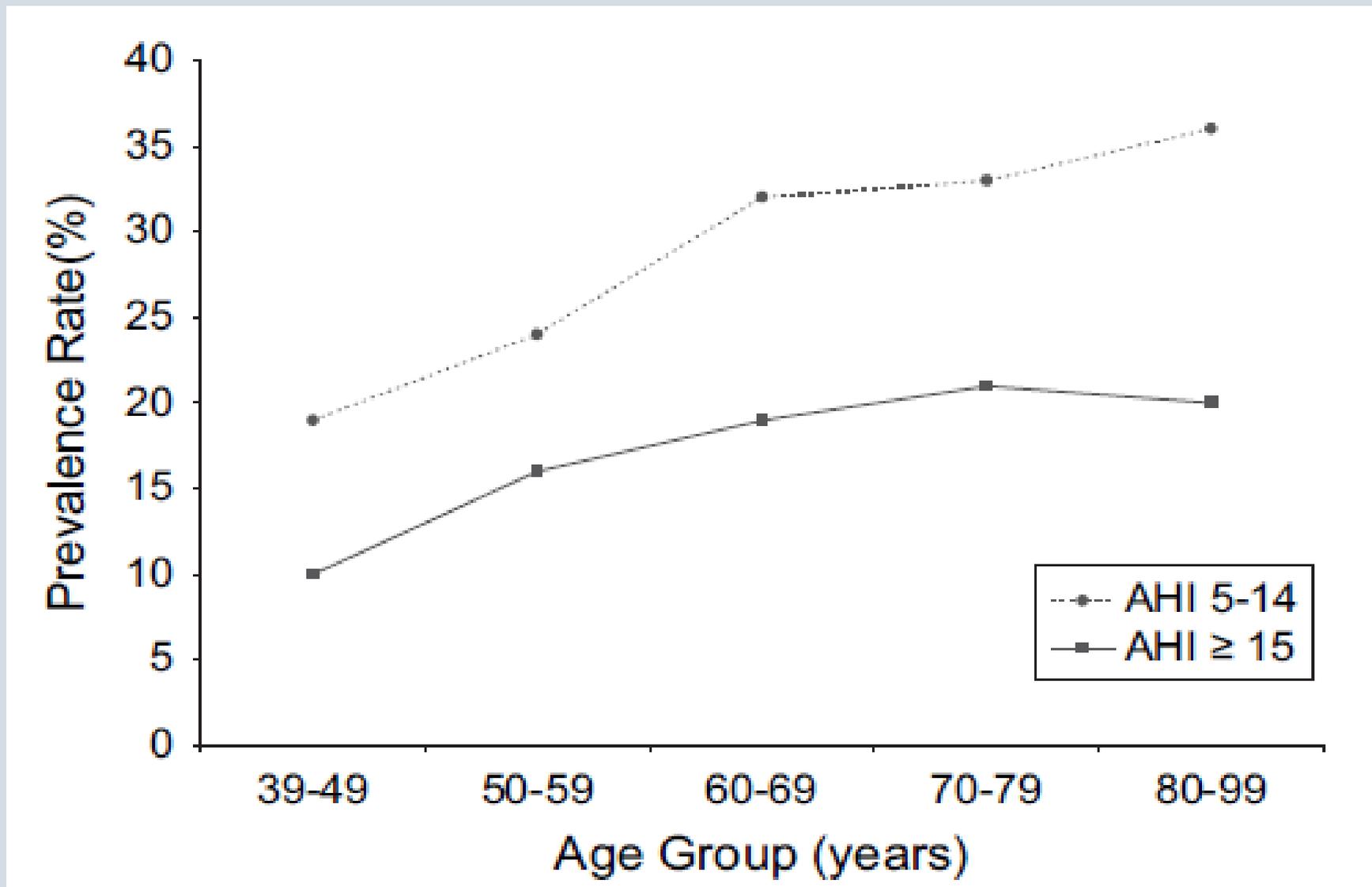
Ju J Am Geriatr Soc 2012

Blackwell, J Am Geriatr Soc. 2015

OSA and Aging



OSA prevalence with age



Why does OSA change with age?

- Increased BMI
- More collapsible airway
- Decreased lung volume
- Increased loop gain
- Lower arousal threshold
- Rostral fluid shift
- Decreased dilator reflex
- Larger pharyngeal fat pads (independent of BMI)
- Longer airway (women only)

Mild Cognitive Impairment and sleep disturbances

- OSA contributes to cognitive decline, especially affecting attention and executive function
- Cognitive decline worse in those with difficulty maintaining sleep and those with excessive daytime sleepiness
- **Metanalysis of more than 4 million people showed that those with SDB were 35% more likely to develop cognitive impairment and had slightly worse performance in executive function but not on global cognition or memory.**
- Jaussen,t Sleep 2012, Johar, Sleep 2016, Keage Sleep Med. 2012, Leng, JAMA Neurol. 2017

Alzheimer's Disease and OSA

Risk factors for Alzheimer's Disease

- Age
- Smoking
- Type 2 DM
- Mid-life hypertension
- ApoE4 gene
- Head injury Hx
- Female gender
- Sleep problems

Pathogenesis of Alzheimer's Disease

- Cascade hypothesis—amyloid β ($A\beta$)
- Tau pathology
- Inflammation
- Oxidative stress

Alzheimer's Disease and Sleep

- A β accumulates during wakefulness (metabolic product)
- When A β levels increase there is a greater chance of plaque formation
- A β cleared at night related to Slow Wave Sleep. Glial cells shrink during sleep allowing Glymphatic system to clear A β to cerebrospinal fluid.
- A β levels measured in cerebrospinal fluid (CSF) predict the degree of reduced SWS time in AD patients.
- Sleep restriction (normal Adults) increases A β burden.

Evidence linking OSA to AD

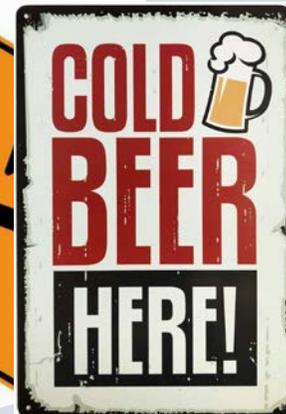
- Among women with a mean age of 82 years, sleep disordered breathing was associated with an increased risk of cognitive impairment. **OR 1.85** after 5 years(1)
- SDB (self-reported) associated with **5 years earlier onset** of AD, 11 year earlier MCI (2)
- OSA is associated with longitudinal changes in amyloid burden in a sample of **cognitively normal elderly**. (3)
- OSA and Alzheimer's show reduced A β in CSF (4)

(1)Yaffe, JAMA 2011, (2) Osorio Neurology 2015
(3) Sharma, AJRCCM 2017 (4) Ligouri Sleep 2017

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Dental office screening for sleep apnea

SIGNS



Signs of SDB

Reported by “bed-partner” (We don’t use “spouse, husband, wife” etc.)

- Snoring
- Restless sleep
- Gasping for air (witnessed apneas)
- Cessation of breathing

Signs of SDB

Observed clinically by dentist or hygienist

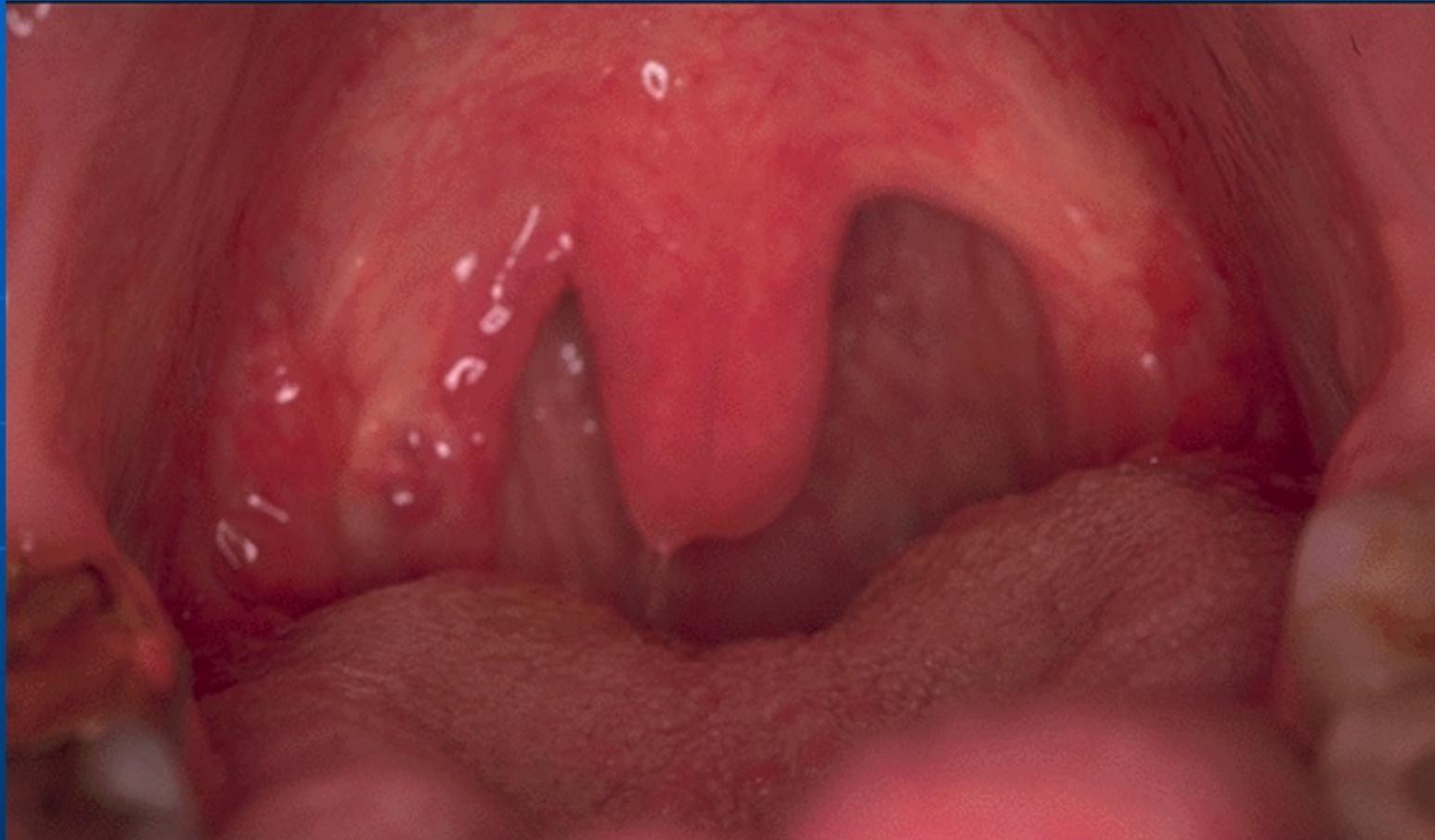
- Bruxism
- Large uvula
- Long soft palate
- Crowded oral pharynx
- Scalloped tongue
- Large Tongue
- Evidence of GERD
- Overweight
- Large neck

Some or none of these may be present but when seen together should sound an alarm

BEST PUN—To educate Staff on what to look for

- **B**ruxism
- **E**rosion
- **S**calloped tongue
- **T**ongue size
- **P**alate length
- **U**vula size and colour
- **N**eck size

Enlarged Soft Palate & Uvula



Obstructed Airway





Enlarged Tongue



The Mallampati Score



CLASS I
Complete
visualization of
the soft palate



CLASS II
Complete
visualization
of the uvula



CLASS III
Visualization
of only the
base of the uvula



CLASS IV
Soft palate
is not
visible at all





Dental office screening for sleep apnea

SYMPTOMS

Symptoms of SDB

- Snoring
- Daytime sleepiness
- Fatigue
- Unrefreshing sleep
- Morning headache (lack of O₂, not necessarily bruxism!)
- Irritability
- Impaired concentration
- Memory loss

Patient may experience some or none of these symptoms

Epworth Sleepiness Scale-

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you. Use the following scale to choose the most appropriate number for each situation:

0 = would never doze

1 = slight chance of dozing

2 = moderate chance of dozing

3 = high chance of dozing

Situation	Chance of dozing (0-3)
Sitting and reading	
Watching TV	
Sitting, inactive in a public place (e.g. theatre or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in the traffic.	
TOTAL	

>10 indicates Excessive Daytime Sleepiness

Not a screening tool for sleep apnea

What percentage of OSA patients have Epworth Sleepiness Score greater than 10?

a)25%

b)43%

c)57%

d)83%

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a) 25%

b) 43%

c) 57%

d) 83%

90% of OSA pts with $ESS \leq 10$ have attention deficits

Berlin Questionnaire

Berlin Questionnaire[®]
Sleep Apnea

Height (m) _____ Weight (kg) _____ Age _____ Male / Female

Please choose the correct response to each question.

Category 1	Category 2
1. Do you snore? <input type="checkbox"/> a. Yes <input type="checkbox"/> b. No <input type="checkbox"/> c. Don't know	6. How often do you feel tired or fatigued after your sleep? <input type="checkbox"/> a. Almost every day <input type="checkbox"/> b. 3-4 times per week <input type="checkbox"/> c. 1-2 times per week <input type="checkbox"/> d. 1-2 times per month <input type="checkbox"/> e. Rarely or never
<i>If you answered 'yes':</i>	
2. You snoring is: <input type="checkbox"/> a. Slightly louder than breathing <input type="checkbox"/> b. As loud as talking <input type="checkbox"/> c. Louder than talking	7. During your waking time, do you feel tired, fatigued or not up to par? <input type="checkbox"/> a. Almost every day <input type="checkbox"/> b. 3-4 times per week <input type="checkbox"/> c. 1-2 times per week <input type="checkbox"/> d. 1-2 times per month <input type="checkbox"/> e. Rarely or never
3. How often do you snore? <input type="checkbox"/> a. Almost every day <input type="checkbox"/> b. 3-4 times per week <input type="checkbox"/> c. 1-2 times per week <input type="checkbox"/> d. 1-2 times per month <input type="checkbox"/> e. Rarely or never	8. Have you ever nodded off or fallen asleep while driving a vehicle? <input type="checkbox"/> a. Yes <input type="checkbox"/> b. No
4. Has your snoring ever bothered other people? <input type="checkbox"/> a. Yes <input type="checkbox"/> b. No <input type="checkbox"/> c. Don't know	<i>If you answered 'yes':</i>
5. Has anyone noticed that you stop breathing during your sleep? <input type="checkbox"/> a. Almost every day <input type="checkbox"/> b. 3-4 times per week <input type="checkbox"/> c. 1-2 times per week <input type="checkbox"/> d. 1-2 times per month <input type="checkbox"/> e. Rarely or never	9. How often does this occur? <input type="checkbox"/> a. Almost every day <input type="checkbox"/> b. 3-4 times per week <input type="checkbox"/> c. 1-2 times per week <input type="checkbox"/> d. 1-2 times per month <input type="checkbox"/> e. Rarely or never
	Category 3
	10. Do you have high blood pressure? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know

10 questions in 3 categories

High Risk: if there are 2 or more categories where the score is positive.

Low Risk: if there is only 1 or no categories where the score is positive.

Commonly used—familiar

Easy to administer

Is for predicting OSA--not for evaluation of therapy

Available online

STOP-bang

Do you Snore?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Do you feel tired, fatigued or sleepy during the day?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Has anyone Observed you stop breathing in your sleep?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Do you have high blood pressure?	<input type="checkbox"/> Yes <input type="checkbox"/> No

STOP Total

What is your height? _____ ft. _____ in.
 Neck size? _____ cm.

What is your weight? _____ lbs.

If height is	ft. in.	4'10"	5'0"	5'2"	5'4"	5'6"	5'8"	5'10"	6'0"	6'2"	6'4"
& weight is >	lbs.	167	179	191	204	216	230	250	258	272	287

Then BMI > 35

B	A	N	G
BMI	Age	Neck Size	Gender
>35	>50 yr.	>40 cm. >15.7"	=Male

Stop Bang Total

STOPbang

- **For general population**

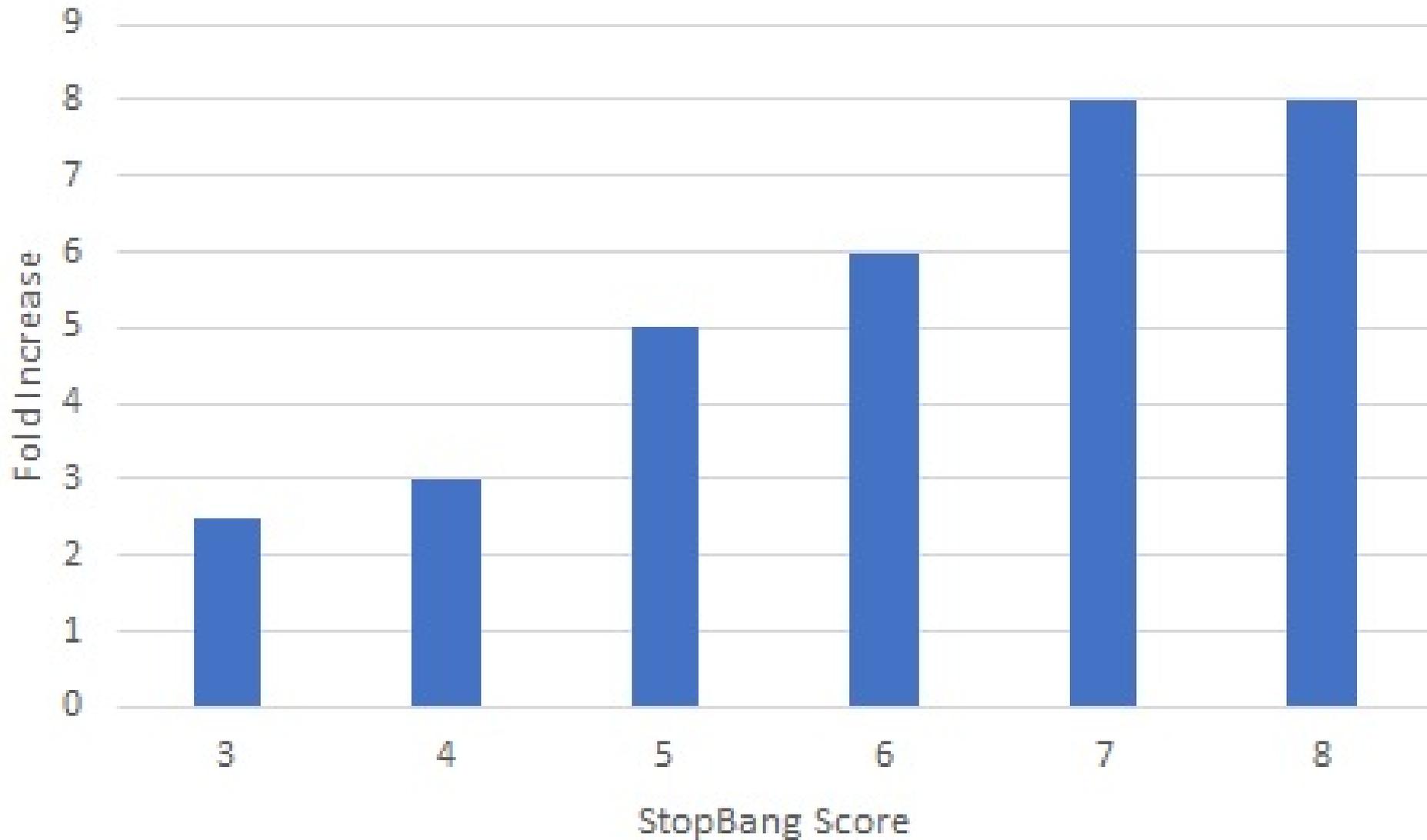
OSA - Low Risk : Yes to 0 - 2 questions

OSA - Intermediate Risk : Yes to 3 - 4 questions

OSA - High Risk : Yes to 5 - 8 questions

circumference 17 inches / 43cm in male or 16 inches / 41cm in female

- **Stopbang.ca** for more information
- Useful for predictive screening
- Easy to administer
- **Put up on treatment rooms to start conversation.**



STOP-bang scores indicate increased risk for having OSA

STOP!

- Do you Snore loudly?
- Do you often feel Iired, fatigued, or sleepy during the day?
- Has anyone ever Observed you stop breathing, choking or gasping during your sleep?
- Do you have, or are you being treated for high blood Pressure?

If you answer "yes" to two or more of these questions please talk to your dentist or dental hygienist for more critical information that may affect your health and improve your quality of life.

- STOP Questionnaire
- No measuring involved
- Patient can self-assess

What are causes of daytime fatigue?

- Anemia
- Underactive thyroid
- Depression, anxiety
- Fibromyalgia
- Food allergies
- Diabetes
- Sleep apnea, and other sleep problems

So you and/or the patient suspect OSA. Now what do I do?

- Discuss with the patient and suggest discussion with family physician and **send note** to the doctor.
- Refer the patient to a dentist who is qualified to manage OSA.
- Dentists cannot refer directly to a sleep physician.
- **ALWAYS** refer the patient to a sleep laboratory for a diagnosis prior to providing treatment.

Dear Dr. Blank,

Our mutual patient Don Farquhar and I recently discussed his complaint of snoring that disturbs his bed-partner. He scored 2 out of 4 on the STOP questionnaire indicating he has a moderate risk for obstructive sleep apnea. He also reports feeling unrested on awakening and fatigued though the day. His father had been diagnosed with obstructive sleep apnea.

I have discussed the nature and potential risks of obstructive sleep apnea with him and, if you agree, Don is interested in following up with a sleep study.

Thanks,

Dr. Teeth-Only

- Normal sleep
- Sleep disordered breathing
 - Obstructive Sleep Apnea (OSA)
 - Pathophysiology and co-morbidities
 - Signs, symptoms and screening
- **Treatment options**
- Oral appliance therapy
- Bruxism and OSA
- TMD and OSA
- Paediatric OSA

Treatment Options

- **CPAP:** very efficacious but adherence problems. Less than 50% continue to use their CPAP long-term
- **Oral appliance therapy:** effective in about 70% of patients. With 80% adherence
- **Surgery**
- **Positional** therapy (keeping patient off their back)
- **Lifestyle changes** including weight reduction, smoking cessation, reduction of alcohol intake
- **Hypoglossal nerve stimulation**

PAP Therapy



CPAP

Continuous Positive Airway Pressure

BiPAP

Bilevel Positive Airway Pressure

AutoPAP

Auto-adjusting Positive Airway Pressure

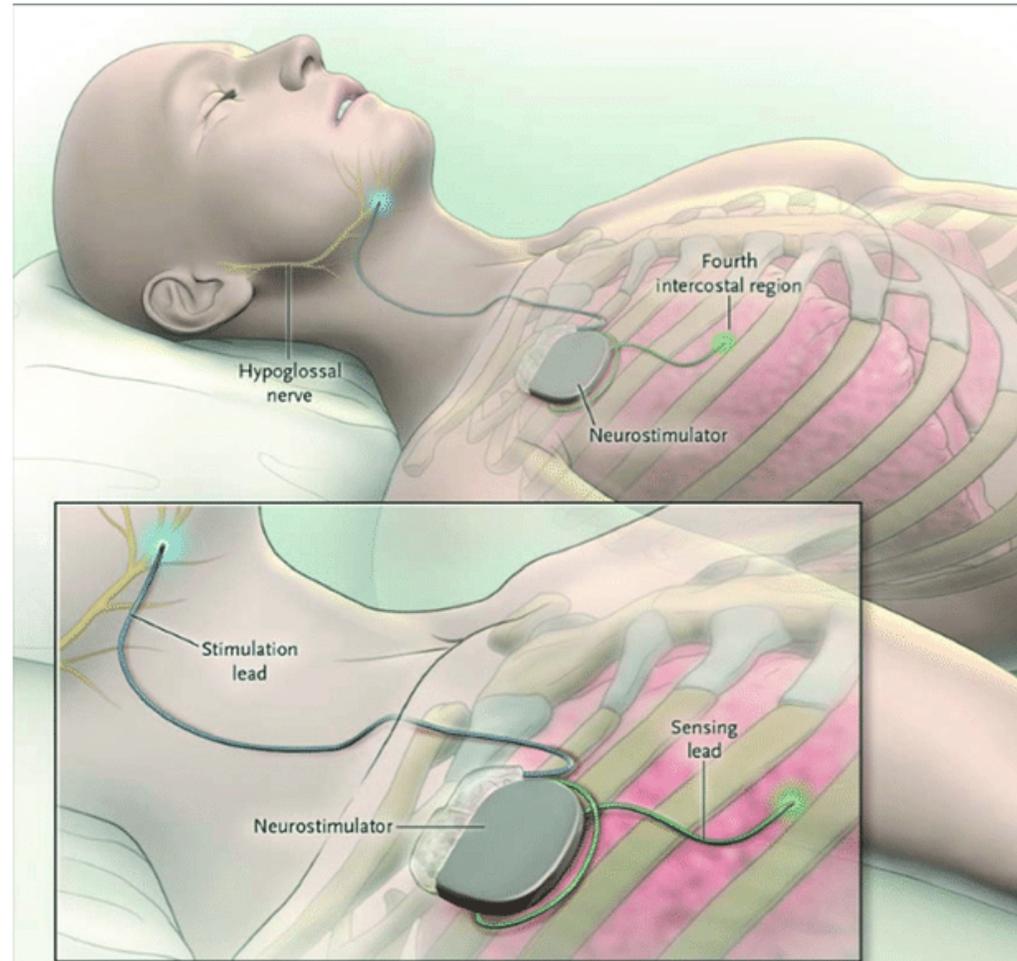
Surgical Options

- Uvulopalatopharyngeoplasty (UPPP) no longer performed
- Relocation Pharyngoplasty
- Correction of inadequate nasal flow (adjunctive)
- Maxillo-mandibular advancement
- Gastric bypass
- Tracheostomy

Positional Therapy



Hypoglossal nerve stimulation “Inspire”



- Normal sleep
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- Paediatric OSA

Over 150 different oral appliances approved

Somnodent



Herbst



Panthera D-SAD



Dream TAP



OTC boil-and-bite



Prosomnus Micro2



TRD



Oral Appliance Therapy (OAT)

Mandibular Advancement Device (MAD)

Indications:

- Primary snoring
- Mild to moderate OSA
- Severe OSA in patients who do not respond to, or are unable or unwilling to tolerate PAP therapies

Function:

- Protrude (advance) and help stabilize the mandible in order to maintain a patent upper airway during sleep

Requirements:

- mechanism that advances the mandible in increments of 1 mm or less
- protrusive adjustment range of at least 5 mm.
- reversal of the advancement must be possible
- maintains a stable retentive relationship to the teeth, implants, or edentulous ridge

Contraindications for oral appliance therapy

- Uncontrolled periodontal disease.
- Fewer than 8 teeth in an arch (maybe)
- Acute TMD (maybe)
- In patients with severe OSA currently using PAP therapy successfully

Best candidates for OAT

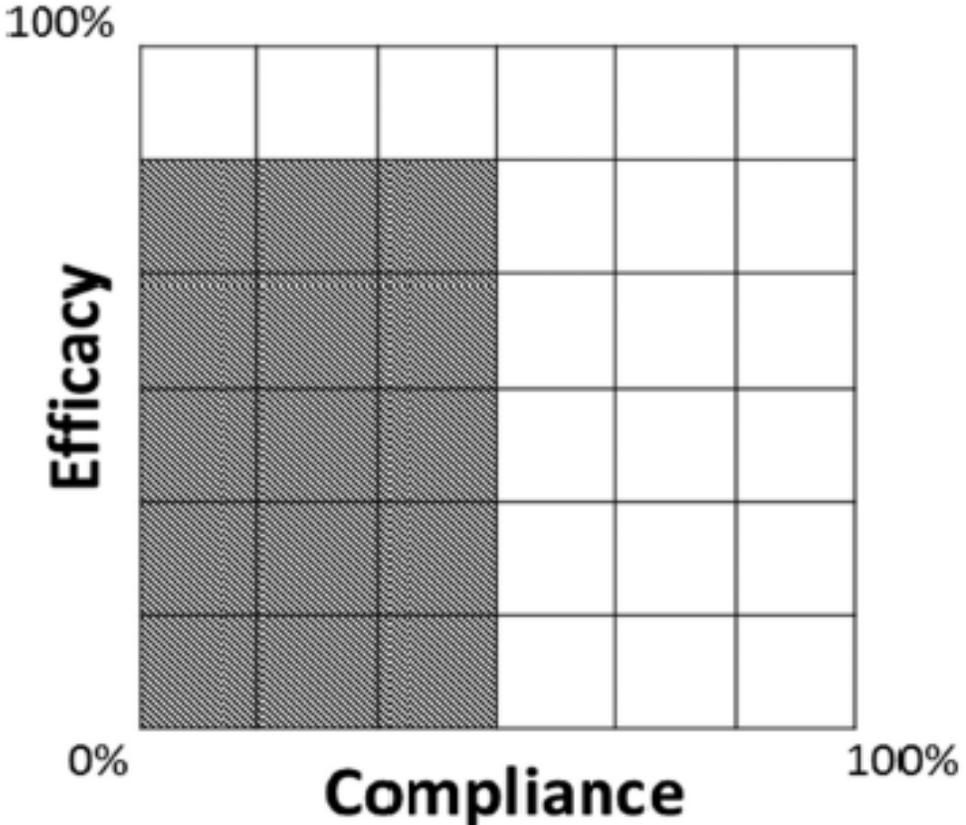
- Younger
- Milder disease
- Non-obese

Benefits of Oral Appliance Therapy

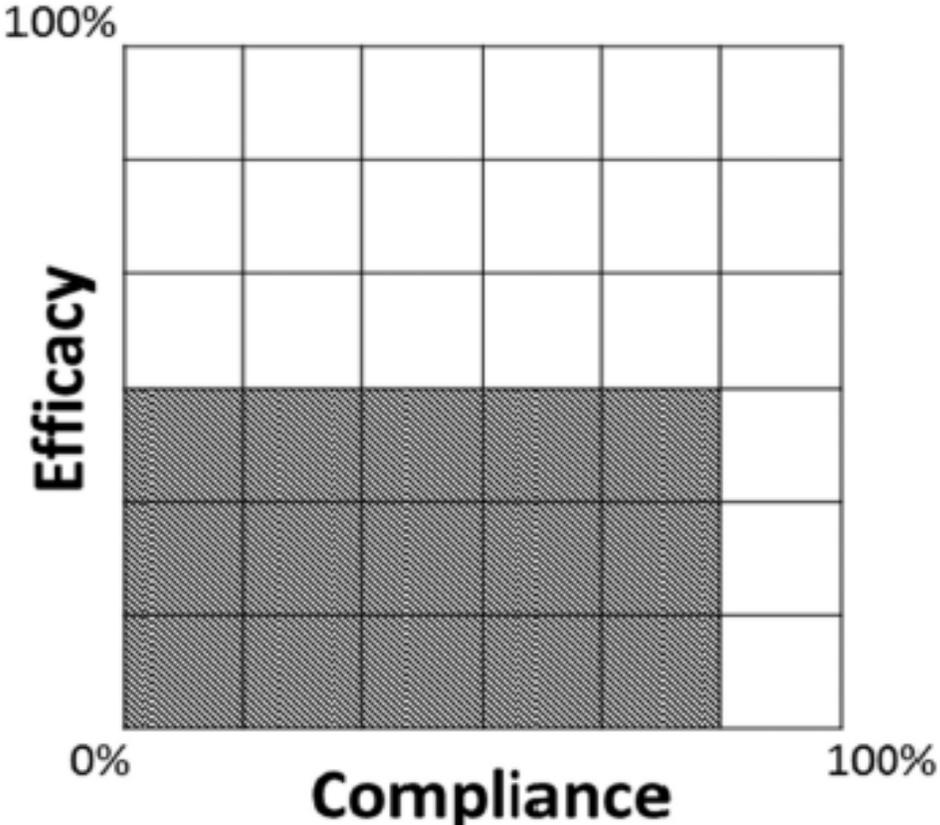
- Easier to adapt to than CPAP
- Much more portable than CPAP
- No electrical outlet required
- Nothing to replace on regular basis
- Easy maintenance
- Less bothersome to bed partner
- *Similar medical and quality of life outcomes to CPAP*

□ Sleep time vulnerable to disease ■ Effective treatment

CPAP



Oral Appliance



Sutherland et al. JDSM 2015

Benefits of Oral Appliance Therapy

Improvement in:

- objective sleepiness
- objective fatigue
- driving simulator performance
- 24-hour blood pressure
- endothelial function
- oxidative stress
- quality of life

Possible side effects of oral appliance therapy

- Altered morning bite
- Tender teeth or gums
- Dry mouth
- Drooling
- Tender jaw muscles or jaw joint

All of the above are usually short-term and pass with time or require some additional management.

- Permanent bite changes are common and very seldom severe enough to cause patient to stop therapy.
- Decrease in OB and OJ and expansion of mandibular arch

Tooth movement.

This may be **permanent bite changes** which are common, but typically not a concern for the patient. This may result in the back teeth touch less and the front teeth overlap reduces. This could also mean slight spacing between the back teeth.

Absolutely needs to be discuss with the patient prior to treatment. Post-treatment letter sent to patients general dentist explains this, and the patient's understanding of it.

“Effective treatment of OSA , a serious and potentially life-threatening condition, supersedes maintenance of a stable baseline occlusion.”

Almeida, Sutherland, Cistulli in *“Sleep Medicine for Dentists” 2nd ed. Quintessence*

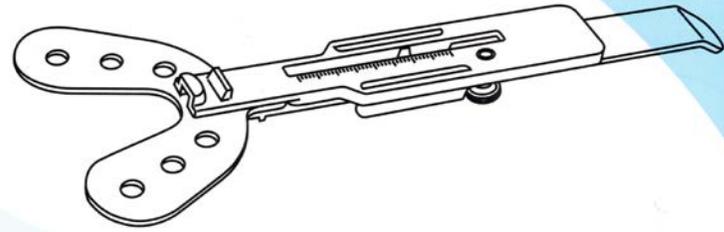
Mandibular Advancement Device Challenges

- 66% of patients are “responders”, the rest are not.
- Not possible to reliably predict who is a responder.
- Sleep MDs seldom think of OAT as first line Tx.
- Dental plans don’t cover Tx, however some medical insurance does.
- Family physicians don’t refer. (I get more referrals from observant dentists)
- Ont. Assistive Devices Program offsets CPAP fee, not OAT.
- Many pts. Have already failed CPAP (maybe lower adherence with OAT?).
- Many have already claimed portion of CPAP on insurance.
- Sleep MDs believe that because OAT less efficacious than CPAP “it doesn’t work”.
- Sometimes symptomatic patients are not offered CPAP because they are too mild.
- Sometimes Sleep MDs don’t mention treatment alternatives.



ProGauge™

User Manual



SOMGauge

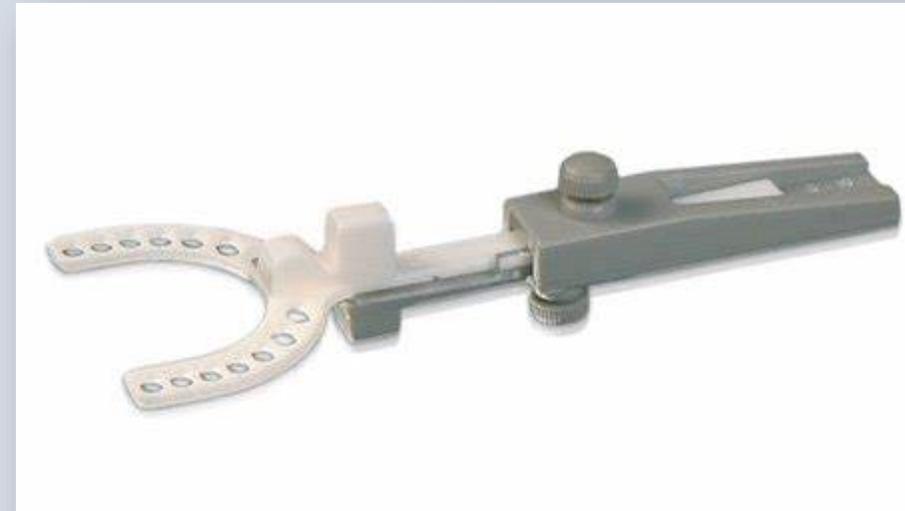
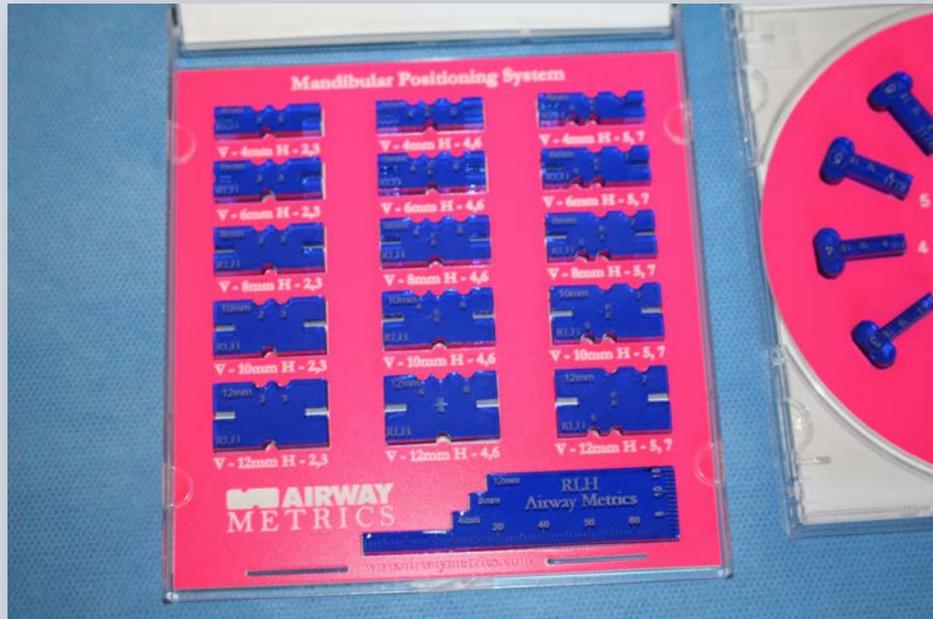
Preformed Impression Tray

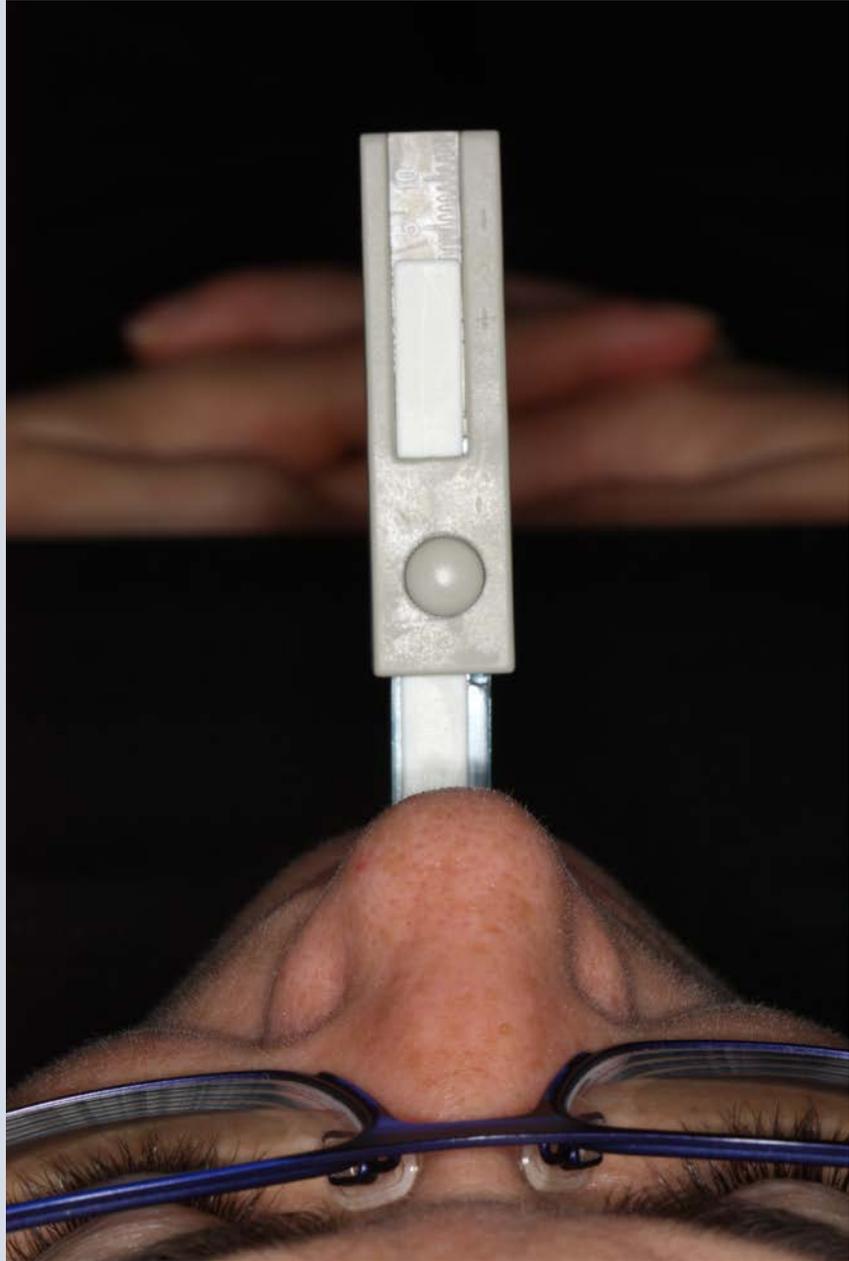


CE

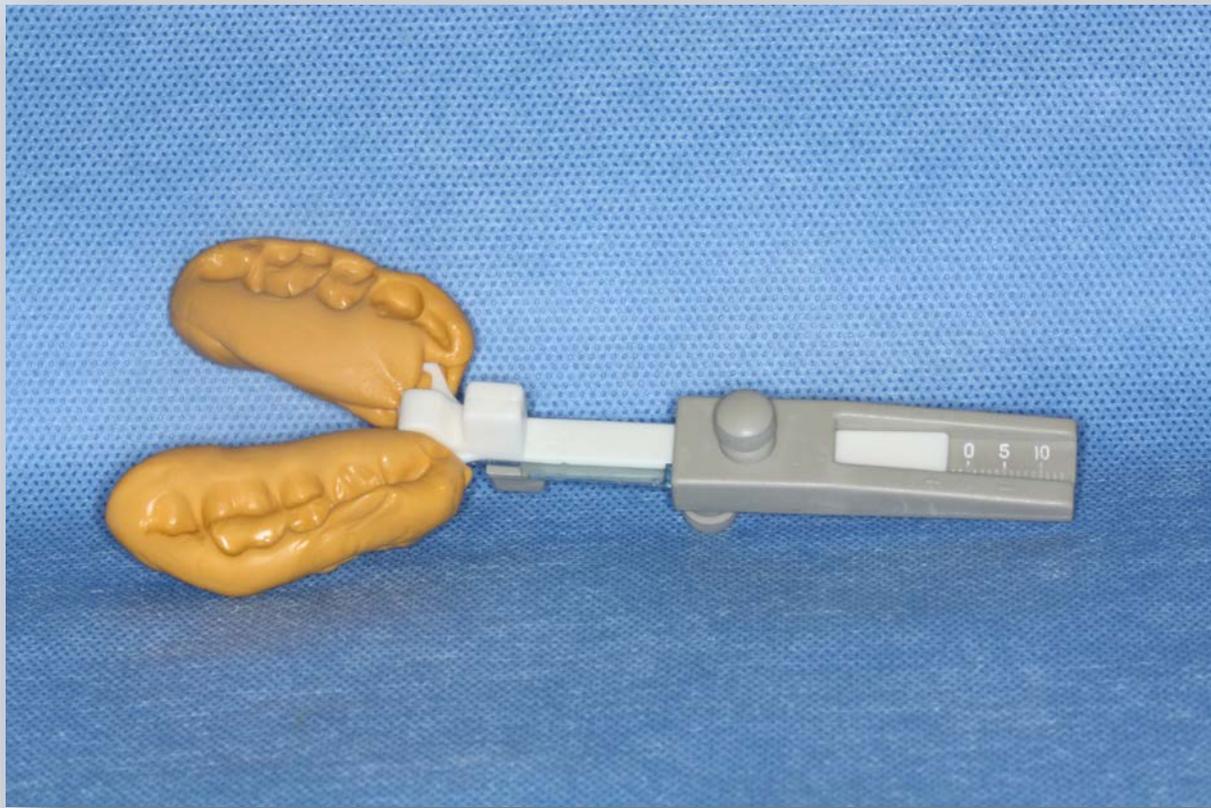
For dental professional use only

SomnoMed
The Leader In COAT™
(Continuous Open Airway Therapy)

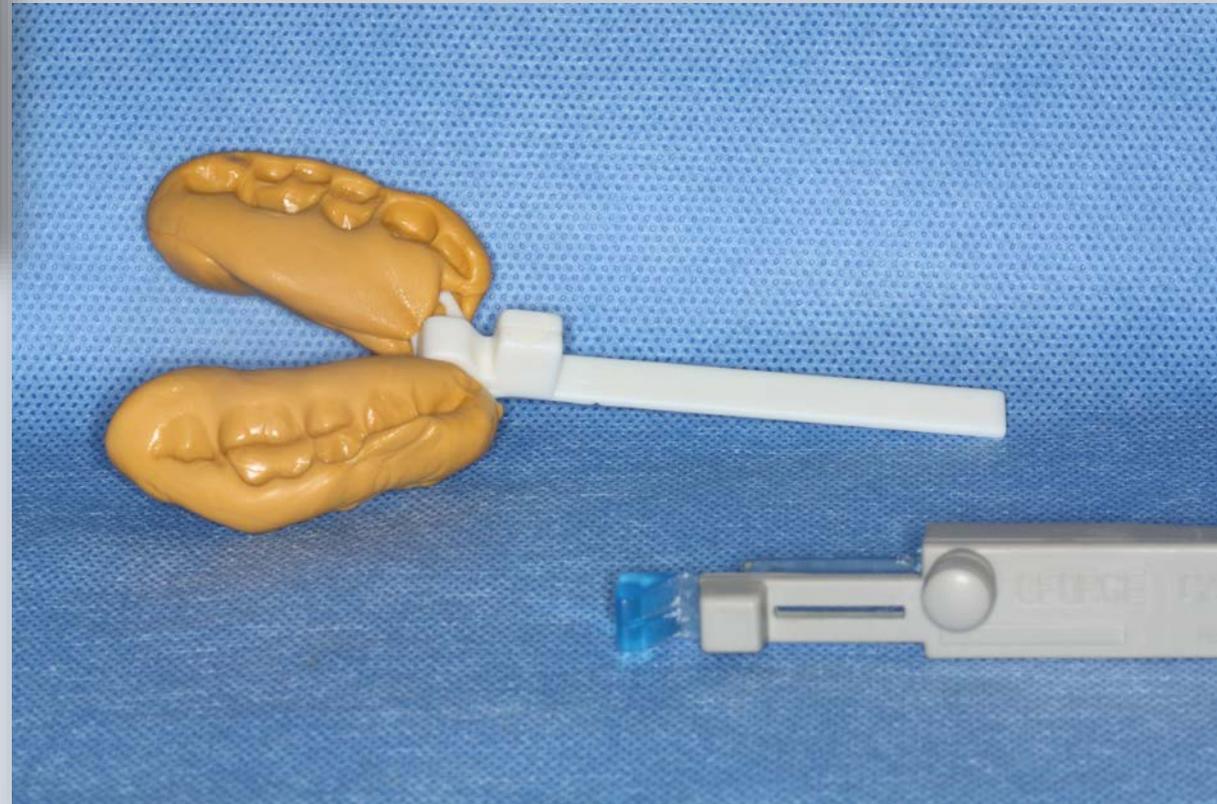








Just the bite fork goes
to the lab!



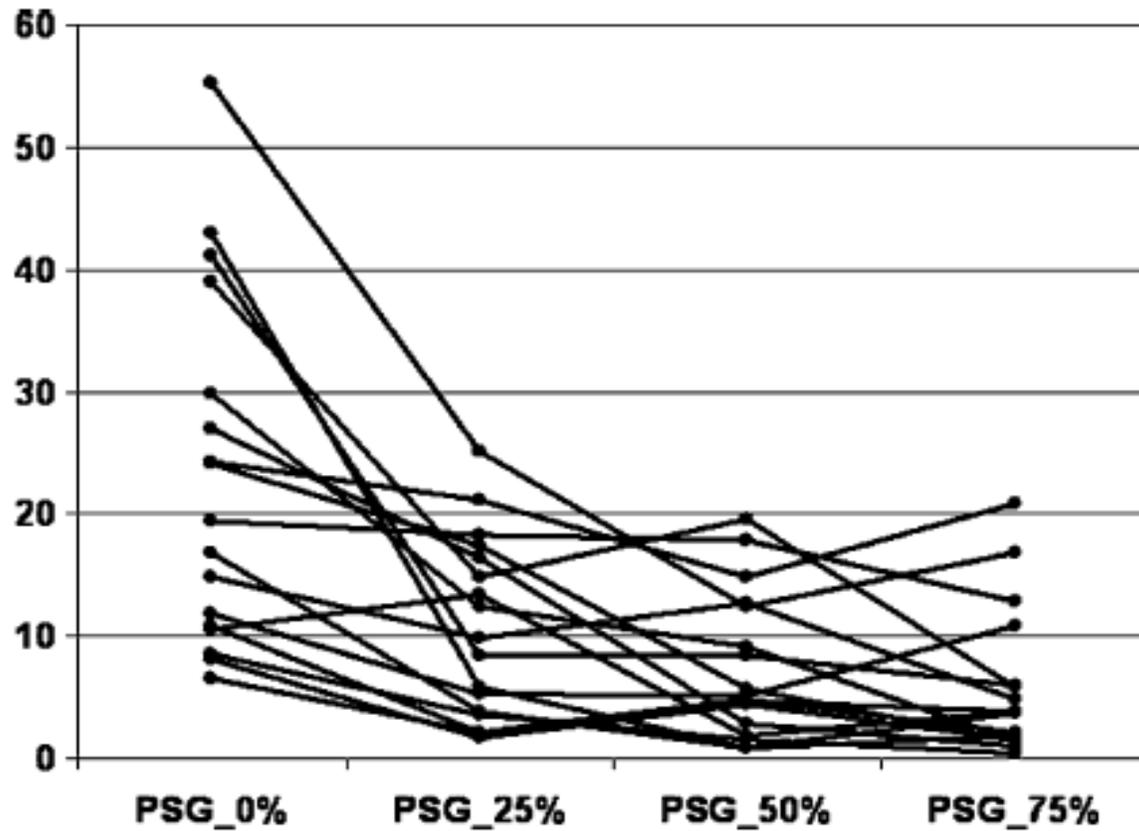


Fig. 2 Individual values of the apnea–hypopnea index (*AHI*) from the ambulatory polysomnographic recordings with the MAD set at 0%, 25, 50%, and 75% of the maximum protrusion of the mandible (PSG_0%–PSG_75%) in 17 OSA patients

Aarab et al. Effects of an oral appliance with different mandibular protrusion positions at a constant vertical dimension on obstructive sleep apnea. *Clin Oral Invest* (2010)

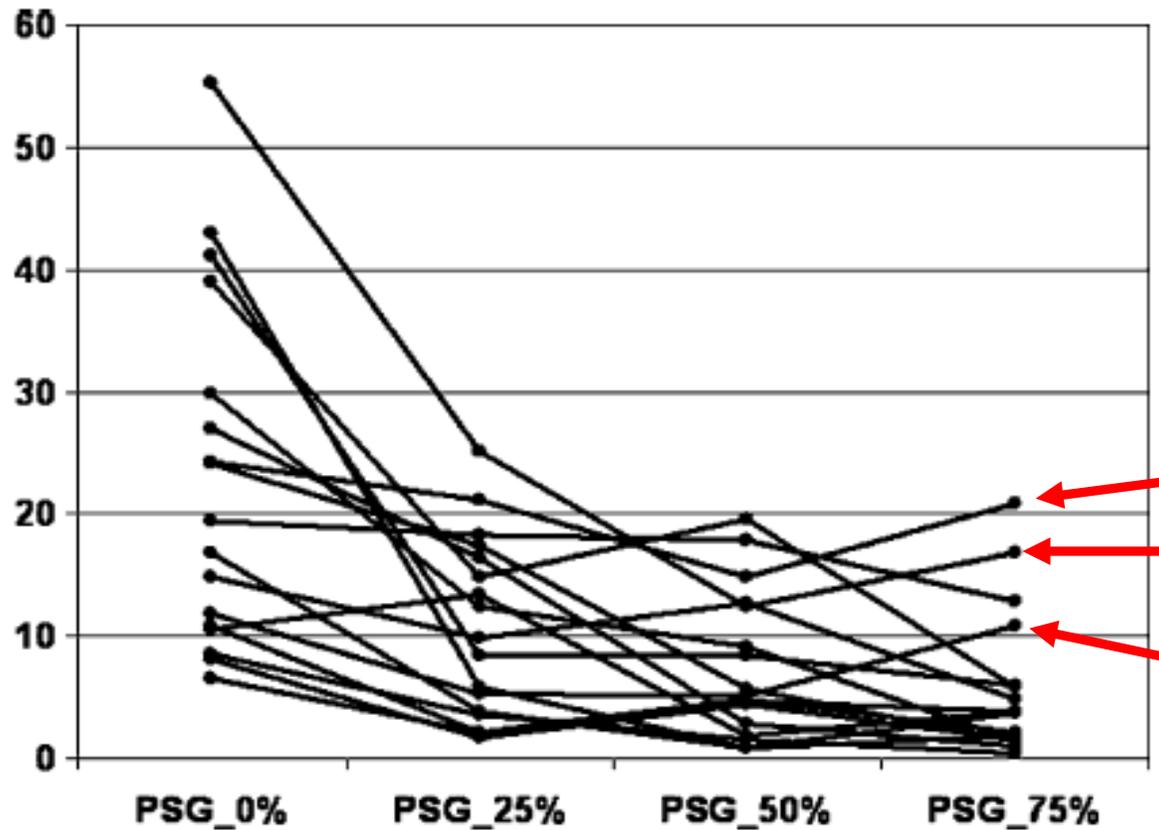
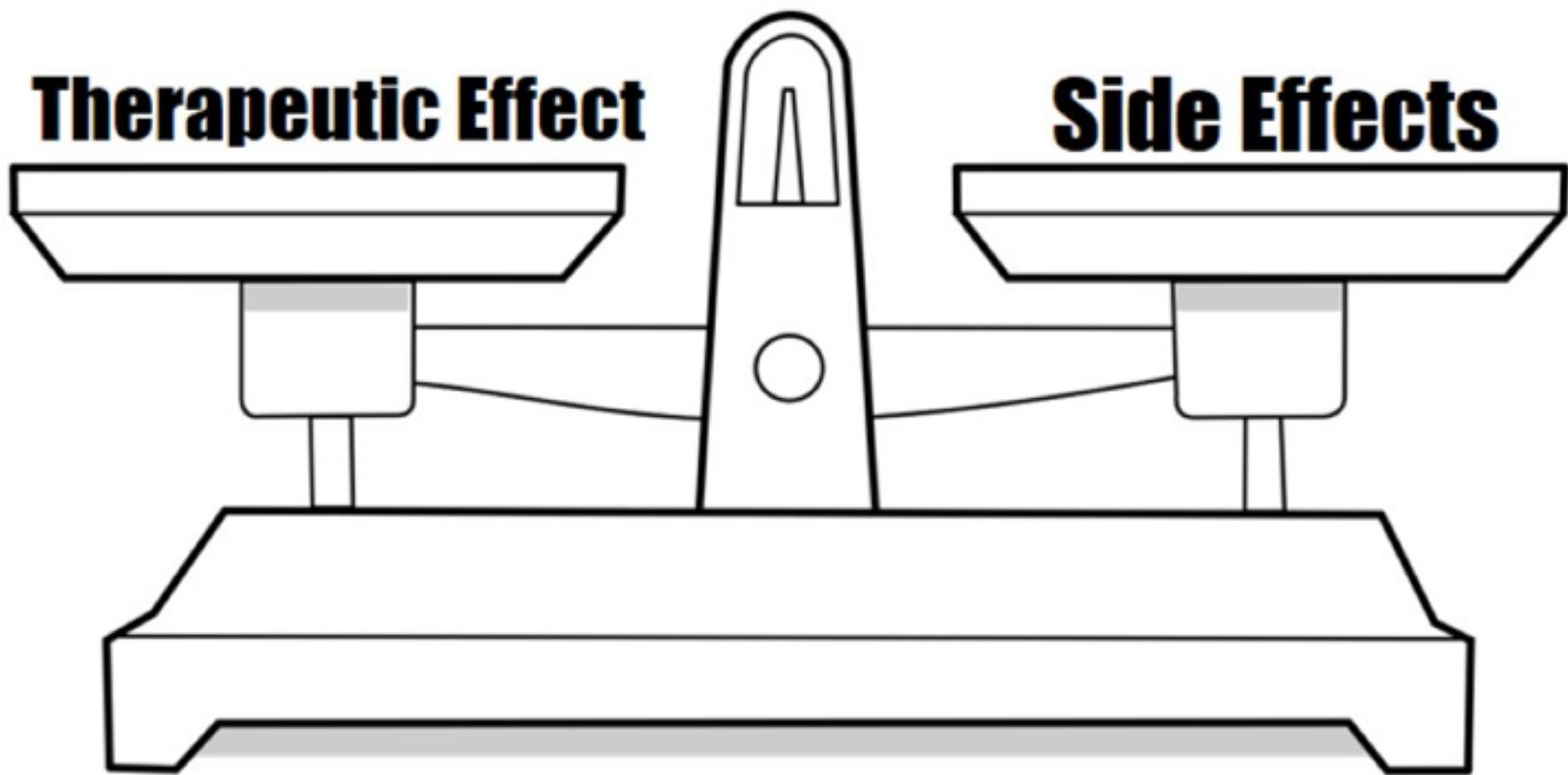


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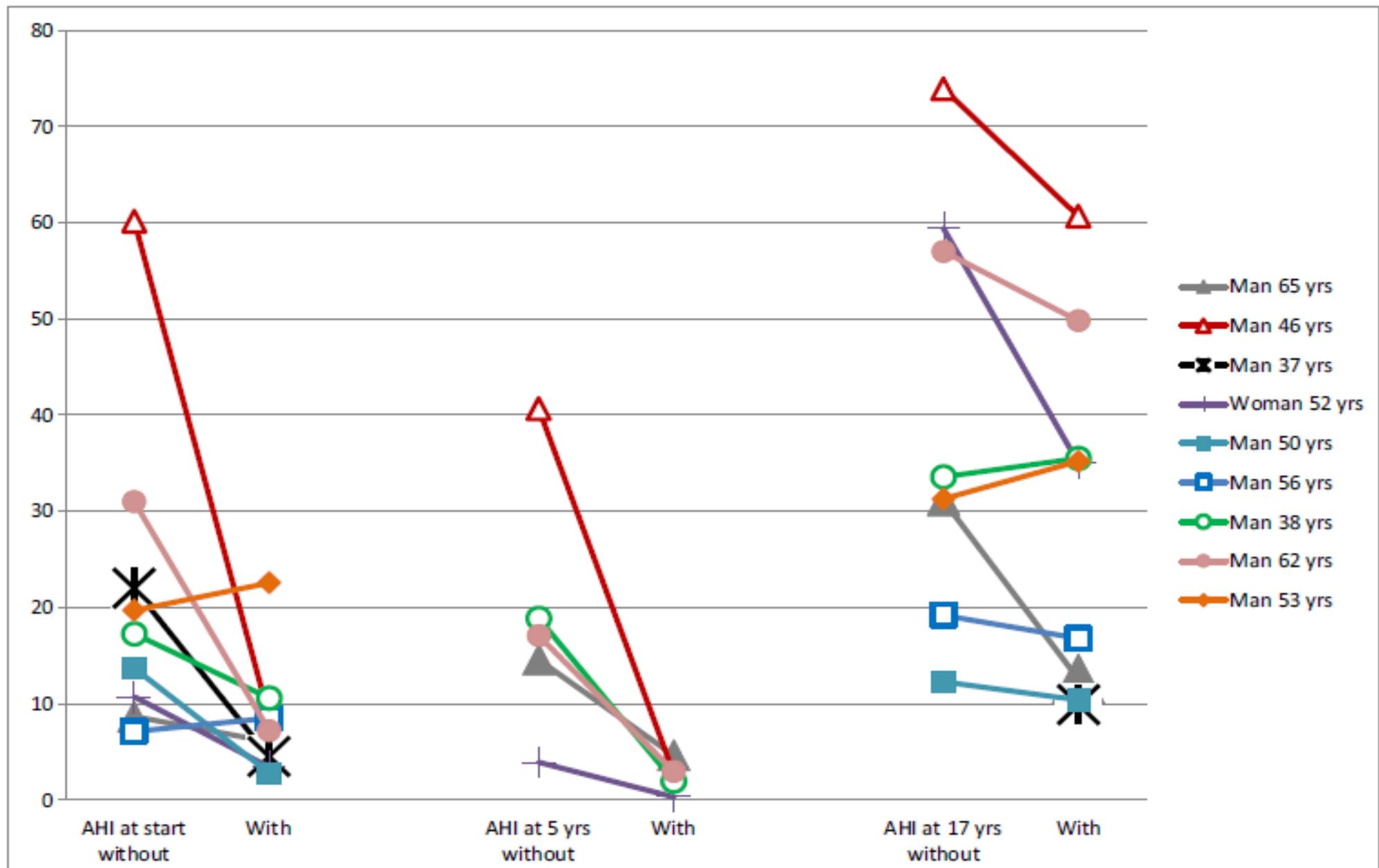
When do you (or the patient) bring their mandible further forward?

- Subjective titration (symptoms)
- Objective titration (Snore Lab, oximetry or HSAT)

In practice we use a combination of the above.

Patients diagnosed with OSA must be referred back to sleep physician for objective testing (titration PSG)

- DDS suspects OSA and **refers patient** to sleep MD prior to initiating therapy
- OR Sleep MD refers patient to dentist with training in OAT
- “Following diagnosis, the dentist may provide OAT as appropriate with a **prescription provided by a physician** that has had a face-to-face evaluation.” (AADSM)
- Patient history and exam
- Determination of suitability for OAT
- Discussion/ consent (treatment expectations, risks, alternatives etc.)
- Records and treatment plan
- Adjustment and titration of appliance
- **Referral for follow-up assessment by sleep MD (PSG)**
- **Long-term follow-up**



General considerations

- Get educated
- Work with a dental lab that is familiar with multiple appliances
- Get to know a few appliances well
- Talk to colleagues and visit online forums
- There is no “one appliance fits all”, but some appliances with minor modifications can treat most of your patients

- Normal sleep
- Sleep disordered breathing
 - Obstructive Sleep Apnea (OSA)
 - Pathophysiology and co-morbidities
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- Treatment options
- Oral appliance therapy
- **Bruxism and OSA**
- TMD and OSA
- Paediatric OSA

Bruxism and OSA

Defined as repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or bracing or thrusting of the mandible.

Diagnostic Criteria for Sleep Bruxism:

A. tooth grinding sounds

B. 1. Abnormal tooth wear consistent with A

2. Transient morning jaw muscle pain, and/or temporal headache; and/or jaw locking upon awakening consistent with reports of tooth grinding during sleep.

Sleep Bruxism different than Awake Bruxism

International Classification of Sleep Disorders 3rd ed.

Bruxism and OSA

(1) *primary or idiopathic SB*, which is without an identifiable cause or any associated sociopsychological or medical problem.

(2) *secondary SB*, which is related to sociopsychological and/or medical conditions (e.g., movement or sleep disorder, neurologic or psychiatric condition, drug/ chemical related).

Sleep Bruxism may occur concomitantly with many other sleep disorders such as insomnia, sleep epilepsy, REM behavior disorder (RBD), and SDB.

Table 3—Common clinical features between sleep bruxism and sleep disordered breathing

Clinical Features	Comment
Both SB and SDB more common in supine sleep position	Studies required to assess influence of postural modification on SB (e.g., sleep positioned benefit not tested yet in a control design for SB)
Oropharyngeal and masticatory muscles activation and tonicity occurs during SB and SDB	Studies required to confirm if masticatory muscle activation during apneic events results in SB plus if it is more the tonic (e.g., clenching type) that is observed or the phasic RMMA
Sleep arousal	Typically in SDB, arousal is observed after airway obstruction; in contrast, SB occurs within a sleep arousal
Gastroesophageal reflux	Conceptually, acid reflux that occurs with SDB, results in a protective response (arousal and swallowing) to prevent mucosal injury and aspiration—indirect clinical evidence and one experimental study
Temporomandibular disorders	Perhaps SB is associated with underlying SDB and consequently the etiology of TMD. Alternatively, SDB may be risk factor for TMD—vulnerability to be proven
Headache	Both tension-type headache and migraine are associated with SB and SDB—based on population survey
Successful treatment with mandibular advancement appliance (MAA)	Further studies investigating the use of MAA in SB is warranted—experimental short term evidence at this stage and large studies required for replication
Successful treatment with CPAP	Further studies required—only one case report
Successful treatment with upper airway surgery	Missing evidence for link between SDB and SB

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Bruxism and OSA

“Dentists need to be aware that current standard maxillary oral appliances (occlusal splints) to protect teeth from attrition may not be appropriate treatment in the presence of SDB. That is, in some cases, occlusal splints may aggravate the underlying SDB.”

Balasubramanian et al. 2014

- Normal sleep
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- Paediatric OSA

TMD and OSA

TMD as defined by the American Academy of Orofacial Pain encompass a group of musculoskeletal and neuro-muscular conditions that involve the TMJs, the masticatory muscles, and all associated tissues.

Research Diagnostic Criteria for TMD

Prevalence of TMD in the general population is
6-13% for muscle pain,
9-16% for disk derangement,
9% for joint pain.

Manfredini et al. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011

TMD and OSA

Chronic TMD cases had 3X greater odds of high likelihood for OSA (based on STOP questionnaire) (1,700 pts)

Men and women with high likelihood of OSA (STOP questionnaire) had 73% greater incidence of first-onset TMD. (Over 3,000 pts)

Sanders et al. 2013 *JDR Clinical Research Supplement*

Taiwan National Health Insurance (NHI) Research Database
Identified 10,408 suspected SA patients (no previous TMD Hx)
Matched “10 controls” to each of the above (104,080)
Those with SA had a 2.5 times greater rate of new onset TMD

Wu et al. International Journal of *Environmental Research and Public Health* 2020

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- Bruxism and OSA
- TMD and OSA
- **Treatment guidelines**
- Paediatric OSA

Guidelines outlining DDS role in treatment of SDB CSS and CADSM

Gauthier et al. *Can Respir J*. 2012 Sep-Oct; 19(5): 307–309.

In 2014 PEAK article RCDSO states:

- “dentists must ensure affected patients undergo a **medical assessment** to determine the nature of their SDB (sleep disordered breathing), including the presence or absence of OSA, before initiating treatment with oral appliances.”
- “The use of an oral appliance for sleep-related therapy should be initiated only by a dentist, whose main roles are to screen for SDB, **but not to diagnose it**, and to provide therapy.” (*when indicated*)

Position paper by Canadian dental sleep medicine professionals regarding the role of different health care professionals in managing obstructive sleep apnea and snoring with oral appliances.

Gauthier et al. Can Respir J Vol 19 No 5 September/October 2012

- Recognize the symptoms of SDB.
- As appropriate, refer the patient to a sleep physician
- Assess oral health especially as it pertains to consequences of OSA
- Manage, within his or her expertise, SDB, sleep bruxism, and the dental consequences of GERD and orofacial pain
- Propose various oral appliances, as appropriate to the patient.
- With a sleep physician, jointly monitor changes in sleep disorders and mental as well as physical health.
- Monitor the efficacy and safety of the treatment
- Manage side effects of oral appliance therapy as they develop.

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PAEDIATRIC OSA

- Definition AHI ≥ 1
- Risk factors
 - adenotonsillar hypertrophy
 - obesity, craniofacial anomalies
 - neuromuscular disorders
- Prevalence of snoring and OSA
 - Children 3-27%
 - OSA alone 1-5%
 - Adolescents 1-10%

Marcus et al. *Pediatrics*. 2012 Sep;130(3)

PAEDIATRIC OSA

Symptoms

- Sleepiness (not commonly)
- Aggressive behavior
- Attention deficit/hyperactivity disorder (ADHD)
- Poor school performance
- Delays in development
- Poor quality of life
- Metabolic Syndrome

National Sleep Foundation recommendations for sleep time duration

Age	Hours of Sleep
Newborn	14-17
Infant	12-15
Toddler	11-14
Pre-Schooler	10-13
School-aged Children	9-11
Teenagers	8-10
Adult	7-9
Older Adult	7-8

PAEDIATRIC OSA

Treatment Options

- Primary treatment option is AT (adenoidectomy/ tonsillectomy)
- 13-29% have residual OSA and up to 73% amongst obese children
- Weight loss, if obese
- CPAP has poor adherence; AT done first if an option
- Intranasal steroids or oral leukotriene modifier if mild OSA
- Orthodontic treatment options as adjunctive therapy

(Marcus et al. *Paediatrics* 2012)

PAEDIATRIC OSA

Treatment Options

Orthodontic/ Orthopedic

Orthopedic mandibular advancement (OMA)
could potentially increase the opening of the
oropharyngeal airway

Rapid maxillary expansion (RME)
in those with a narrow maxilla may decrease nasal
resistance and allow tongue repositioning

PAEDIATRIC OSA

Orthodontic/ Orthopedic

- “Since there is extremely little evidence supporting these treatments(RME OMA), care must be taken regarding the interpretation of orthodontic treatment results in pediatric OSA.”

Huynh et al. Orthodontics treatments for managing obstructive sleep apnea syndrome in children: A systematic review and meta-analysis. *Sleep Med Rev*(2016)

PAEDIATRIC OSA Treatment Options

Orthodontic/ Orthopedic

Rapid maxillary expansion versus watchful waiting in pediatric OSA: a **systematic review**

Fernández-Barriales, et al. *Sleep Med. Rev.* Feb 4, 2022

“We could not find convincing evidence of the benefit of RME over watchful waiting in patients with pediatric OSA.”

“Unlike adult OSA, in which a relentless disease progression is expected, pediatric OSA often spontaneously remits (69-100%).”

PAEDIATRIC OSA

Premolar extractions

Review of electronic health records of 5,584 subjects

One half had 4 premolar extractions

The other half, matched for age range, gender, and BMI

2792 in each group	No premolar extractions	Premolar extractions
Number with OSA (%)	267 (9.56%)	299 (10.71%)

“The prevalence of OSA was not significantly different between the groups

(OR = 1.14, **p = 0.144**).” i.e. no significant difference.”

Larsen et. al.. Evidence Supports No Relationship between Obstructive Sleep Apnea and Premolar Extraction: An Electronic Health Records Review. *J Clin Sleep Med*. 2015 Dec 15;11(12):1443-8.

PAEDIATRIC OSA

Premolar extractions

“There is no strong evidence to support the concept that premolar extractions in bimaxillary protrusion or crowded growing and adult patients reduce either pharyngeal airway volume or minimal cross-sectional area.”

Orabi et al. “Pharyngeal airway dimensional changes after orthodontic treatment with premolar extractions: A **systematic review with meta-analysis.**”
Am J Orthod Dentofacial Orthop 2021;160:503-15)

PAEDIATRIC OSA

Orthodontic/ Orthopedic Treatment

• Practice Points

- Orthodontic treatments to correct craniofacial morphology, such as orthopedic mandibular advancement or rapid maxillary expansion, can be useful to:
 - 1) correct craniofacial morphology, such as a smaller maxilla and/or mandible, which can be a risk factor of sleep-disordered breathing in children
 - 2) reduce pediatric snoring and obstructive sleep apnea, considering the paucity in quantity and in quality of studies.
 - 3) ...one should be careful when interpreting orthodontic treatment results in pediatric obstructive sleep apnea, due to limited number of included studies.

(Huynh et al. Orthodontics treatments for managing obstructive sleep apnea syndrome in children: A systematic review and meta-analysis. *Sleep Med Rev* 2016)

Want to learn more?

- AADSM.org
- Tufts University Dental Sleep Medicine Fellowship
- SDDacademy.com

Contact me if you'd like a pdf version of this presentation and/or STOP questionnaire for waiting, or treatment rooms.

dr.don@huronidental.ca

Thanks!

Questions?



bettersleepdental.ca

Don Farquhar DDS D-ABDSM

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Office phone: 705-721-0426

Member of American Academy of Dental Sleep Medicine and

Diplomate of the American Board of Dental Sleep Medicine

Member of the Board of Directors of the ABDSM