

Greater Kansas City Dental Society
Blue Springs , Missouri
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Introduction to Dental Sleep Medicine:
The Role of Dentistry in the Treatment of Sleep Disordered Breathing

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Dentistry is neither an allied health profession nor a paramedical profession. It is the only anatomically focused health care profession that is university-based and for which primary care responsibility is maintained by the profession.

Dentists must have a reliable knowledge of basic clinical medicine for safely and effectively treating individuals with chronic and other diseases, which make them biologically and pharmacologically compromised.

Gambhir RS. Primary care in dentistry – an untapped potential. *J Family Med Prim Care* 2015;4:13-8.

The United States is currently experiencing a primary care shortage. One solution to improving health care is to increase the utilization of existing health care providers, **particularly dentists**, an opportunity that has been largely ignored.

By employing mid-level providers for less complex procedures to deliver more accessible dental care at lower cost, dentists can redistribute tasks to their office workforce. They can then serve as **oral physicians** who can provide limited preventive primary care, including **screening for chronic diseases**, while continuing to oversee all dental care, whether provided by dentists or non-dentists.

Giddon DB, Swann B, Donoff RB, Hertzman-Miller R. Dentists as oral physicians: the overlooked primary health care resource. *J Prim Prev*2013;**34**:279-91

“Dentists may be helpful as screeners for related medical problems. Every dentist should have some kind of oral cancer screening device (BP monitors, etc) in the office. But I don’t want to be just a screener. I want to provide care. Orofacial pain treatment and dental sleep medicine are two expanded areas where, as a dentist, I can really render a useful and successful therapeutic service.”

Louis Malcmacher, DDS, AGD Impact, March, 2014, vol. 42, no. 3

SCREENING

Facial Lesions

Hypertension

Child Abuse & Neglect

SCREENING FOR DISORDERS

GERD

Pediatric Airway / Tonsils

Sleep Apnea
Orofacial Pain
TMD

Obesity

Oral Cancer / STDs

SCREENING

Dermatologist

Cardiologist
Internist

Protective
Services

SCREENING
FOR
DISORDERS

G I
Doc

ENT

Sleep
Physician

PCP

Pathologist

Objectives this morning

- Normal sleep and the pathophysiology of abnormal sleep.
- Sleep disorders concentrating on sleep disordered breathing conditions especially disruptive snoring, sleep-related bruxism and obstructive sleep apnea.
- How dentist are in the optimum position to identify patients with possible sleep disordered breathing conditions.
- Screening for sleep disordered breathing patient in the dental practice and the dental, head and neck examination prior to treatment using oral appliance therapy.
- Compare Oral Appliance therapy to Positive Airway Pressure (PAP) therapy and discuss benefits and contraindications of both.

Disclosures

I have no conflicts of interest.

I declare that neither I nor any member of my family has a financial arrangement or affiliation with any corporate organization offering financial support or grant monies for this continuing dental education program, nor do I have a financial interest in any commercial product(s) I will discuss in the presentation.

“Dental educational institutions have an obligation to disseminate new knowledge related to dental practice. In so doing, some presentations may include controversial materials or commercial references.

Sponsorship of a continuing dental education course by The University of Tennessee Health Science Center UT College of Dentistry does not necessarily imply endorsement of a particular philosophy, views expressed, procedure, or product by this institution.”

A little about me

- Graduated from the University of Tennessee Health Science Center College of Dentistry in 1983 (at the age of 12)
- Practiced general dentistry in Collierville, TN for 35 years.
- Last 2 years have been full time Associate Professor and Director of the Dental Sleep Medicine and Orofacial Pain Program at UT CoD.
- Recently went part time at UT in order to cover my practice due to an unfortunate issue with my former associate.
- Have been fortunate to establish professional and personal relationships with many of the very respected leaders in both fields of Dental Sleep Medicine and Orofacial Pain.

A little about me

- My core foundation of practice for Orofacial Pain comes from my studies with Jeff Okeson of the University of Kentucky
- I currently am a member of the Board of Directors for the American Academy of Dental Sleep Medicine (AADSM).
- I obtained my Board certification with The American Board of Dental Sleep Medicine (ABDSM) in 2014.
- I am a member of the AADSM, the American Academy of Sleep Medicine, the American Academy of Orofacial Pain and the ADA, the Tennessee Dental Association and the Memphis Dental Society.

SLEEP

There is no single activity that humans do more: if you live to be 90, you will probably spend just over 32 years asleep !

SLEEP

- Sleep is essential for a person's health and well-being.
- ~60 million Americans suffer from over 70 different sleep disorders. (some sources as high as 80 million)
- 60 percent of adults report having problems sleeping a few nights a week or more.
- Most of these individuals go undiagnosed and untreated.
- When I began in sleep 13 years ago it was estimated that 18 million Americans suffered from Obstructive Sleep Apnea (OSA).
- Today, the American Academy of Sleep Medicine (AASM) estimates between 25 – 30 million Americans suffer from OSA.

SLEEP

- Excessive daytime sleepiness affects approximately 25% of the general population (children and adults)
- And up to 40% of adults experience daytime sleepiness (enough to interfere with their daily activities)
- 69% of children experience one or more sleep problems a few nights or more during the week.
- In children, sleepiness is often expressed as inattentiveness, hyperactivity and decreasing school performance.
- 48% of adults report snoring.

Sleep – Why it's Important

- Healthy Brain Function and Emotional Well-Being
- Healing damaged cells (Growth Hormone in Children)
- Boosting your immune system
- Recovering from the day's activities
- Safety – Prevents microsleep
- Recharging your heart and cardiovascular system for the next day

National Institutes of Health

Morselli L et al. Role of sleep duration in the regulation of glucose metabolism and appetite. *Best Pract Res Clin Endocrinol Metab* 2010;24(5):687–702.

Sleep – Why it's Important



Sleep – Why it's Important

The National Highway Traffic Safety Administration conservatively estimates that **100,000** police-reported crashes are the direct result of driver fatigue each year. This results in an estimated **1,550** deaths, **71,000** injuries, and **\$12.5** billion in monetary losses. These figures may be the tip of the iceberg, since currently it is difficult to attribute crashes to sleepiness.

**I WANT TO DIE PEACEFULLY IN
MY SLEEP, LIKE MY GRANDFATHER**



**NOT SCREAMING AND YELLING
LIKE THE PASSENGERS IN HIS CAR**

The Depression Treatment Device



- Home
- Overview & Facts
- Causes
- Diagnosis
- Treatment
- Support
- Health Impact
- Performance
- Safety

Excessive Sleepiness

Ask a Research Question | A-Z Index

Bureau of Transportation Statistics

- Explore Topics and Geography
- Browse Statistical Products and Data
- Learn About BTS and Our Work
- Newsroom

Table 2-21: Passenger Car Occupant Safety Data

Excel | CSV

	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fatalities	25,929	27,449	23,212	24,092	22,385	21,387	21,566	21,997	22,423	22,505	22,199	21,194	20,862	20,699
Injured persons	N	N	N	2,376,000	2,235,000	2,232,000	2,265,000	2,364,000	2,469,000	2,458,000	2,341,000	2,201,000	2,138,000	2,052,000
Vehicles involved in crashes	N	N	N	8,357,652	7,730,251	7,521,838	7,450,134	7,928,000	8,165,000	8,284,000	8,050,000	7,470,000	6,935,000	6,891,000
Vehicle-miles (millions)	1,030,376	1,107,056	1,248,980	1,427,178	1,411,655	1,436,035	1,445,106	1,459,208	1,478,352	1,499,139	1,528,399	1,555,901	1,569,455	1,583,127
Rates per 100 million vehicle-miles														
Fatalities	2.52	2.48	1.86	1.69	1.59	1.49	1.49	1.51	1.52	1.50	1.45	1.36	1.33	1.31
Injured persons	N	N	N	166	158	155	157	162	167	164	153	141	136	130
Vehicles involved in crashes	N	N	N	586	548	524	516	543	552	553	527	480	442	435

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Fatalities	20,320	20,569	19,725	19,192	18,512	17,925	16,614	14,646	13,135	12,491	12,014	12,361	12,037	11,926
Injured persons	1,927,000	1,805,000	1,756,000	1,643,000	1,573,000	1,475,000	1,379,000	1,304,000	1,216,000	1,253,000	1,240,000	1,328,000	1,296,000	1,292,000
Vehicles involved in crashes	6,705,000	6,606,000	6,511,000	6,232,000	6,087,000	5,864,000	5,745,000	5,575,000	5,211,000	5,350,000	5,328,000	5,577,000	5,669,000	5,982,000
Vehicle-miles (millions)	1,596,579	1,613,749	1,613,543	1,629,955	1,616,908	1,616,328	1,554,673	1,524,331	1,510,339	1,507,716	1,369,810	1,377,486	1,384,194	1,396,098
Rates per 100 million vehicle-miles														
Fatalities	1.27	1.27	1.22	1.18	1.14	1.11	1.07	0.96	0.87	0.83	0.88	0.90	0.87	0.85
Injured persons	121	112	109	101	97	91	89	86	81	83	91	96	94	93
Vehicles involved in crashes	420	409	404	382	376	363	370	366	345	355	389	405	410	428

KEY: N = data do not exist

NOTES



HHS Public Access

Author manuscript
J Sch Health. Author manuscript; available in PMC 2017 May 01.

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J Sch Health. 2016 May ; 86(5): 363-381. doi:10.1111/josh.12388.

School Start Times, Sleep, Behavioral, Health, and Academic Outcomes: a Review of the Literature

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...sleep in adolescents has been shown to be associated with a wide range of poor mental and physical health to behavioral problems and, in turn, most high school students do not get sufficient sleep. Delaying school start times has been proposed as a policy change to address insufficient sleep. This review initially to improve students' academic performance, reduce stress, and improve health.

...es 38 reports examining the association between school start times, sleep, and adolescent students.

...reviewed provide evidence that delaying school start time increases sleep duration in adolescents, primarily by delaying rise times. Most of the studies reviewed provide evidence that delaying school start time increases sleep duration even with relatively small delays in start times of half an hour. These findings also generally correspond to improved attendance, less tardiness, higher grades, and fewer motor vehicle crashes.

...additional research is necessary, research results that are already available should be shared with stakeholders to enable the development of evidence-based policies.

This report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Sleep Statistics – Sleep Deprivation

Number of people in the U.S. who have a chronic sleep disorder	60 Million
Estimated cost to U.S. employers in lost productivity due to sleep loss issues	\$18 Billion
Percent of people who suffer from sleep apnea	8 %
Percent of American adults experience a sleep problem a few nights per week	62 %
Percent of all adults have insomnia in the course of any year	30 %

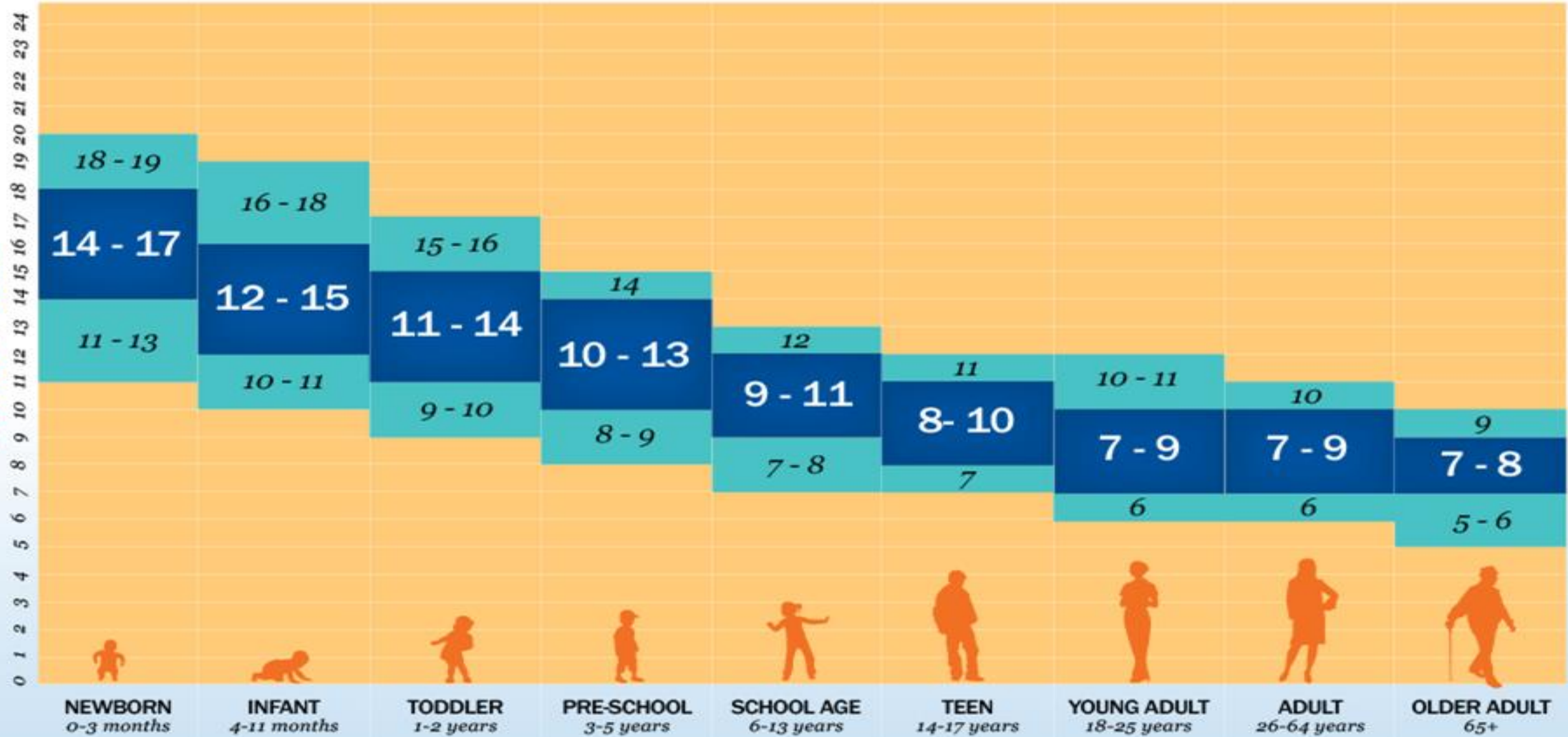
Sources: National Sleep Foundation, National Department of Transportation, Centers for Disease Control and Prevention

Sleep Statistics – Average Hours Needed

Ages 5 – 10	11 hours
Ages 10 – 17	9 hours
Adults	8 hours
Percent of adults who reported getting an average of 6 hours or less	29 %
Percent of high school students who reported getting an average of at least 8 hours	31 %

Sources: National Sleep Foundation, National Department of Transportation, Centers for Disease Control and Prevention

HOURS OF SLEEP



Recommended **Maybe Appropriate** **Not Recommended**

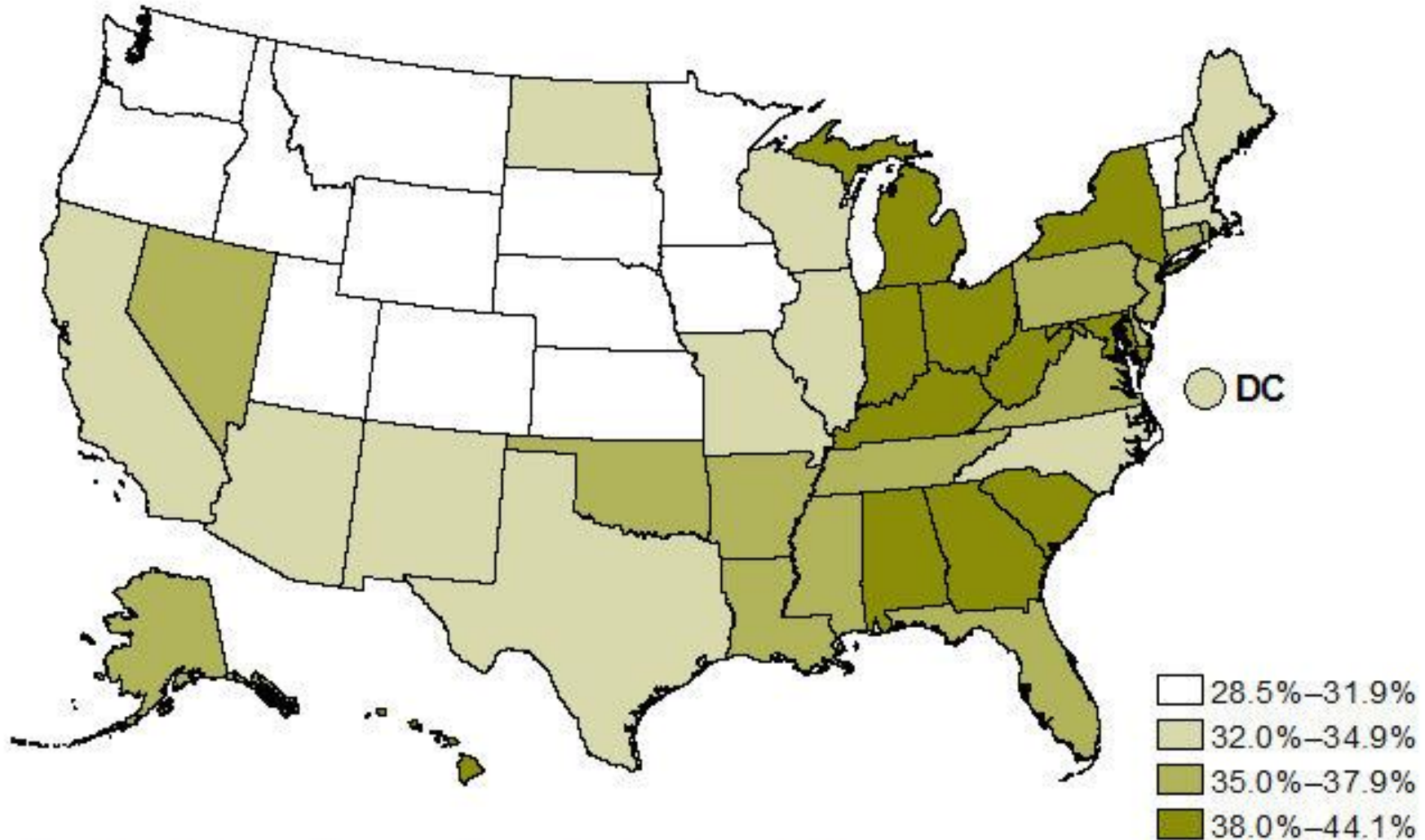
CDC - Sleep and Sleep Disorders

The screenshot shows a web browser window with the following elements:

- Browser Tabs:** "Learning Stream ..." and "CDC - Data and Statistics - Sleep".
- Address Bar:** "https://www.cdc.gov/sleep/data_statistics.html".
- Header:** CDC logo and "Centers for Disease Control and Prevention CDC 24/7: Saving Lives, Protecting People™". A search bar with the text "SEARCH" and a magnifying glass icon is on the right. A "CDC A-Z INDEX" dropdown menu is also present.
- Main Content Area:**
 - Section Header:** "Sleep and Sleep Disorders" (on a dark green background).
 - Left Sidebar:** A vertical menu with items: "Sleep" (highlighted), "About Our Program", "Basics About Sleep" (with a plus icon), "Data & Statistics", "Surveillance", "Fact Sheets", "Media Products", "More Online Media Resources", "Publications" (with a plus icon), "Projects and Partners", and "Resources".
 - Breadcrumbs:** "CDC > Sleep".
 - Section Header:** "Data and Statistics" (with Facebook, Twitter, and a plus icon).
 - Section Header:** "Short Sleep Duration Among US Adults".
 - Text:** "Adults need 7 or more hours of sleep per night for the best health and wellbeing.¹ Short sleep duration is defined as less than 7 hours of sleep per 24-hour period."
 - Section Header:** "Geographic Variation in Short Sleep Duration".
 - Text:** "Figure 1 shows the age-adjusted percentage of adults who reported short sleep duration (less than 7 hours of sleep per 24-hour period), by state in the United States in 2014. The percentage varies considerably by state, from <30% in Colorado, South Dakota, and Minnesota to ≥40% in Kentucky and Hawaii. The highest percentages were in the southeastern United States and in states along the Appalachian Mountains. The lowest percentages were in the Great Plains states."

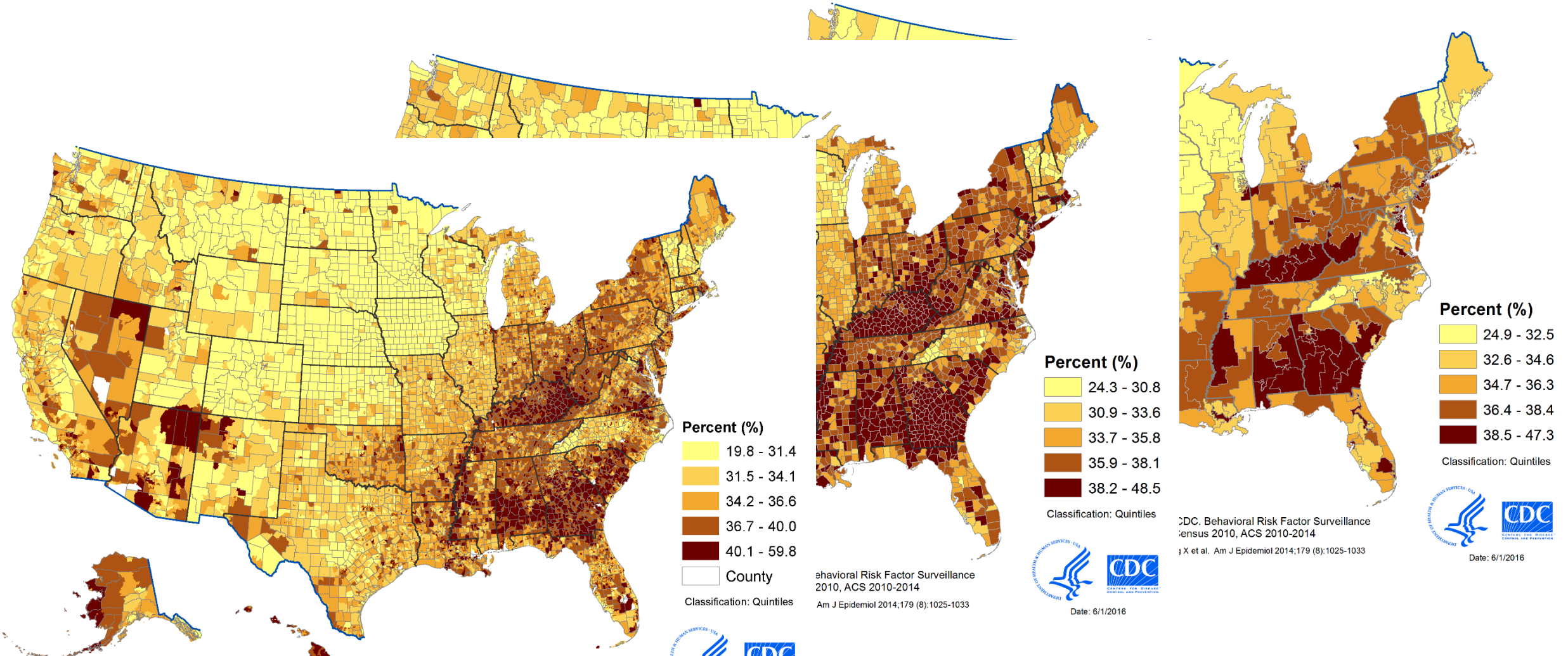
The Windows taskbar at the bottom shows the search bar, task view, and various application icons (Edge, File Explorer, Mail, PowerPoint, Chrome). The system tray on the right shows the time "7:51 PM" and date "11/7/2018".

Sleep Statistics – <7 hours by State



Source: CDC. Behavioral Risk Factor Surveillance System 2014.

Sleep Statistics – <7 hours by Census



Percent (%)

19.8 - 31.4
31.5 - 34.1
34.2 - 36.6
36.7 - 40.0
40.1 - 59.8

County
Classification: Quintiles

Percent (%)

24.3 - 30.8
30.9 - 33.6
33.7 - 35.8
35.9 - 38.1
38.2 - 48.5

Classification: Quintiles

Percent (%)

24.9 - 32.5
32.6 - 34.6
34.7 - 36.3
36.4 - 38.4
38.5 - 47.3

Classification: Quintiles

Data Sources: CDC, Behavioral Risk Factor Surveillance System 2010, Census 2010, ACS 2010-2014
Method from Zhang X et al. Am J Epidemiol 2014;179 (8):1025-1033

Behavioral Risk Factor Surveillance System 2010, ACS 2010-2014
Am J Epidemiol 2014;179 (8):1025-1033

CDC, Behavioral Risk Factor Surveillance System 2010, ACS 2010-2014
Zhang X et al. Am J Epidemiol 2014;179 (8):1025-1033



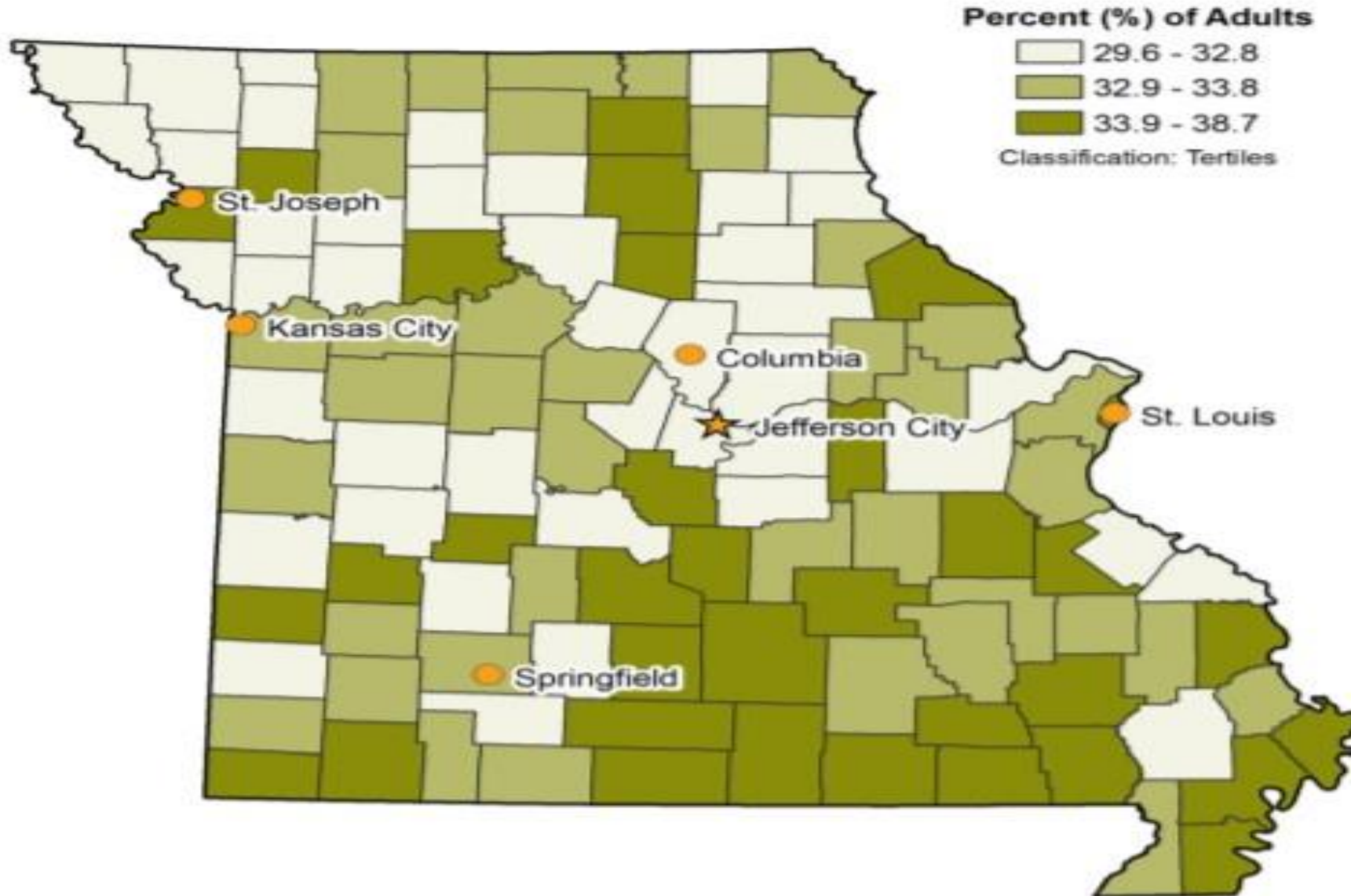
Date: 6/2/2016

Date: 6/1/2016

Date: 6/1/2016

Sleep Statistics – Missouri

Model-based



* Method from
2010, Americ
Percentage c

14, Census
d population.

Sleep Statistics – Sleep Behavior

Unintentionally fell asleep during the day at least once in the past month	37.9 %
Nodded off or fell asleep while driving in the past month	4.5 %
Annual number of car crash fatalities attributed to falling asleep	1,550
Annual number of nonfatal car crash injuries attributed to falling asleep	40,000

Sources: National Sleep Foundation, National Department of Transportation, Centers for Disease Control and Prevention

Sleep Statistics – Sleep Related Difficulties

DIFFICULTY	PERCENT AFFECTED	NUMBERS
Concentrating on things	23.2 %	49.2 Million
Remembering things	18.2 %	38.8
Working on hobbies	13.3 %	28.2
Driving or taking public transportation	11.3 %	24
Taking care of financial affairs	10.5 %	22.3
Performing employed or volunteer work	8.6 %	18.3

Sources: National Sleep Foundation, National Department of Transportation, Centers for Disease Control and Prevention

Sleep Statistics – Sleep Disorders

Number of people who suffer from insomnia	70 Million
Number of people who suffer from sleep apnea	20 - 25 Million
Number of people who suffer from narcolepsy	200,000 +
Number of people who suffer from restless leg syndrome	30 Million

Sources: National Sleep Foundation, National Department of Transportation, Centers for Disease Control and Prevention

- Every member of the animal kingdom is forced to spend perhaps a third of its life unconscious and vulnerable: unable to feed, unable to watch for predators, unable to protect its offspring.



“If sleep doesn’t serve some vital function, it is the biggest mistake evolution ever made.”

Allan Rechtschaffen

Pioneer sleep researcher, Mt. Sinai Hospital, New York

Three States of Consciousness

- **Awake**

- **nREM sleep**

- **REM sleep**

Sleep Stages

- **NREM sleep** typically occupies 75–80% of total sleep each night. Many of the health benefits of sleep take place during NREM sleep – tissue growth and repair occurs, energy is restored and hormones that are essential for growth and development are released.

Sleep Stages

- **REM sleep** typically occupies 20–25% of total sleep each night. REM sleep, when dreaming occurs, is essential to our minds for processing and consolidating emotions, memories and stress. It is also thought to be vital for learning, stimulating the brain regions used in learning and developing new skills.

Polysomnography - PSG

Polysomnography (PSG) is a study or test done while you're fully asleep.

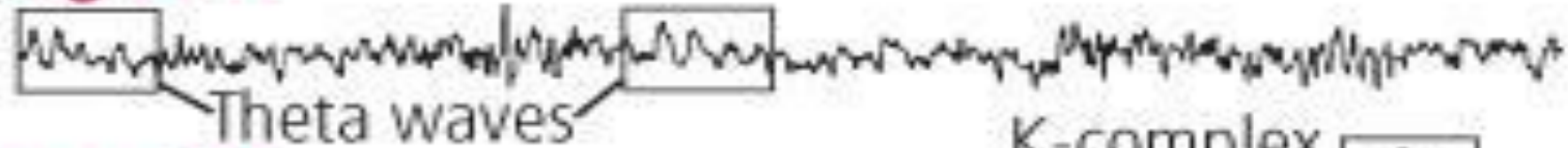
PSG registers your body's shifts between the two stages of sleep, which are rapid eye movement (REM) sleep, and non-rapid eye movement (non-REM) sleep. Non-REM sleep is divided into "light sleep" and "deep sleep" phases. (N1, N2, N3 sleep)

Relaxed wakefulness

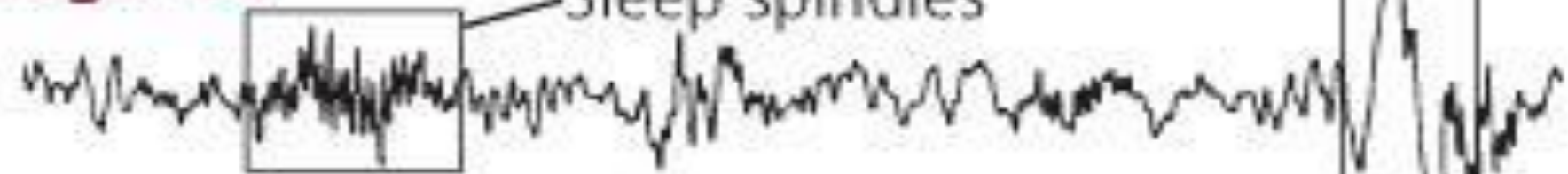
Alpha waves



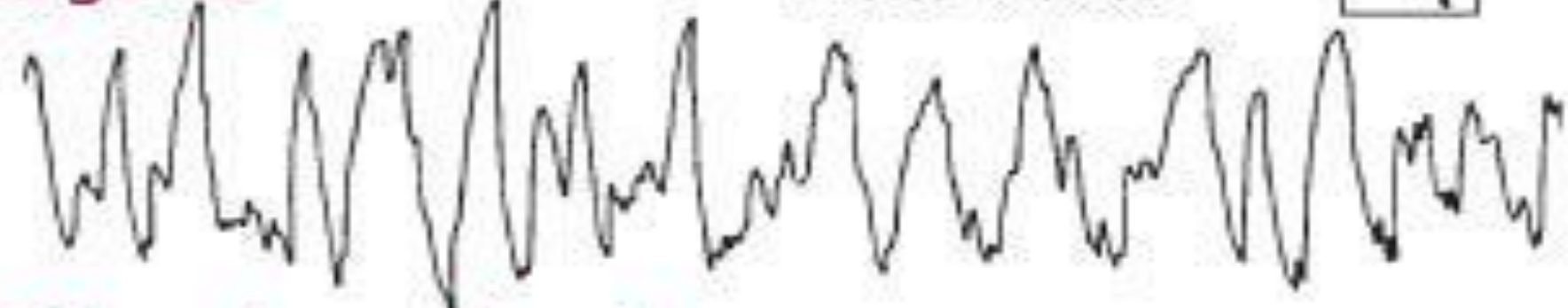
Stage N1



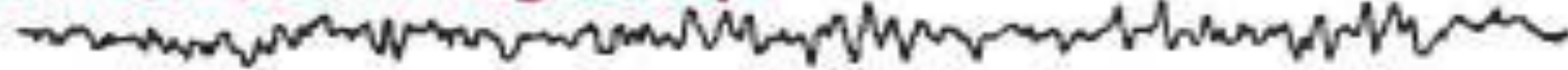
Stage N2



Stage N3



REM or dreaming sleep

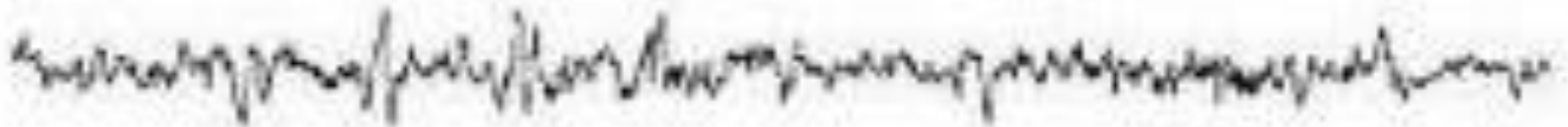


N1 Sleep

“Light sleep”

4% - 5 % of total sleep time is
considered normal

Increases to 15% by age 70



N2 Sleep

“Restful Sleep”

45% - 50% of total sleep time is considered normal

“Junk” sleep (Coined by Jamison Spencer)



N3 Sleep

“Deep Sleep”

Delta wave or Slow wave sleep

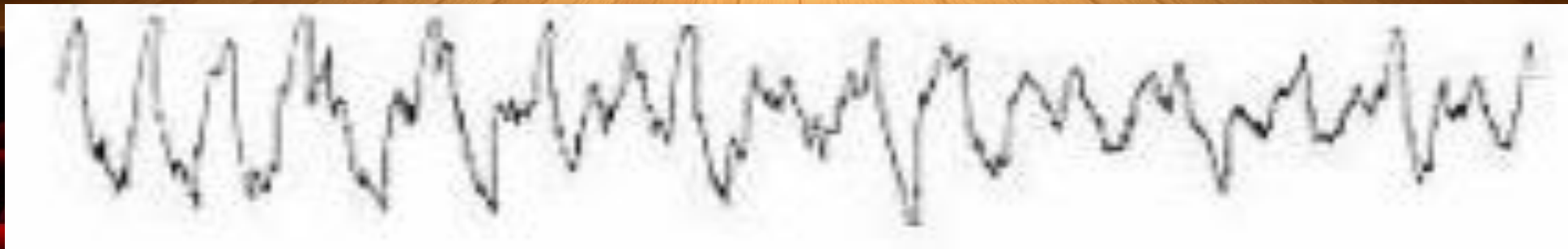
10% - 20% of total sleep time is considered normal

% decreases with age

Above 40 – 50% in children: to total absence by age 40 – 60

Usually appears only in the first 1/3 of the sleep episode

Growth hormone usually released during N3 sleep



REM Sleep

Rapid eye movement sleep

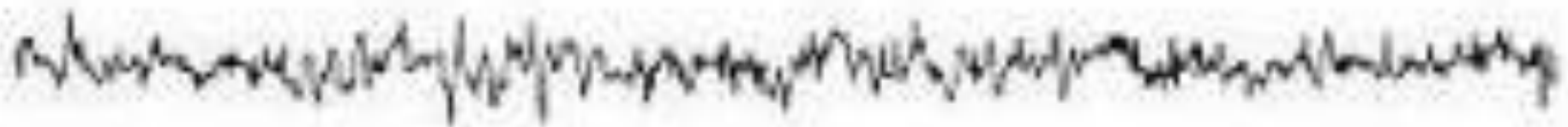
20% - 25% of total sleep time is considered normal

Body paralysis – atonia

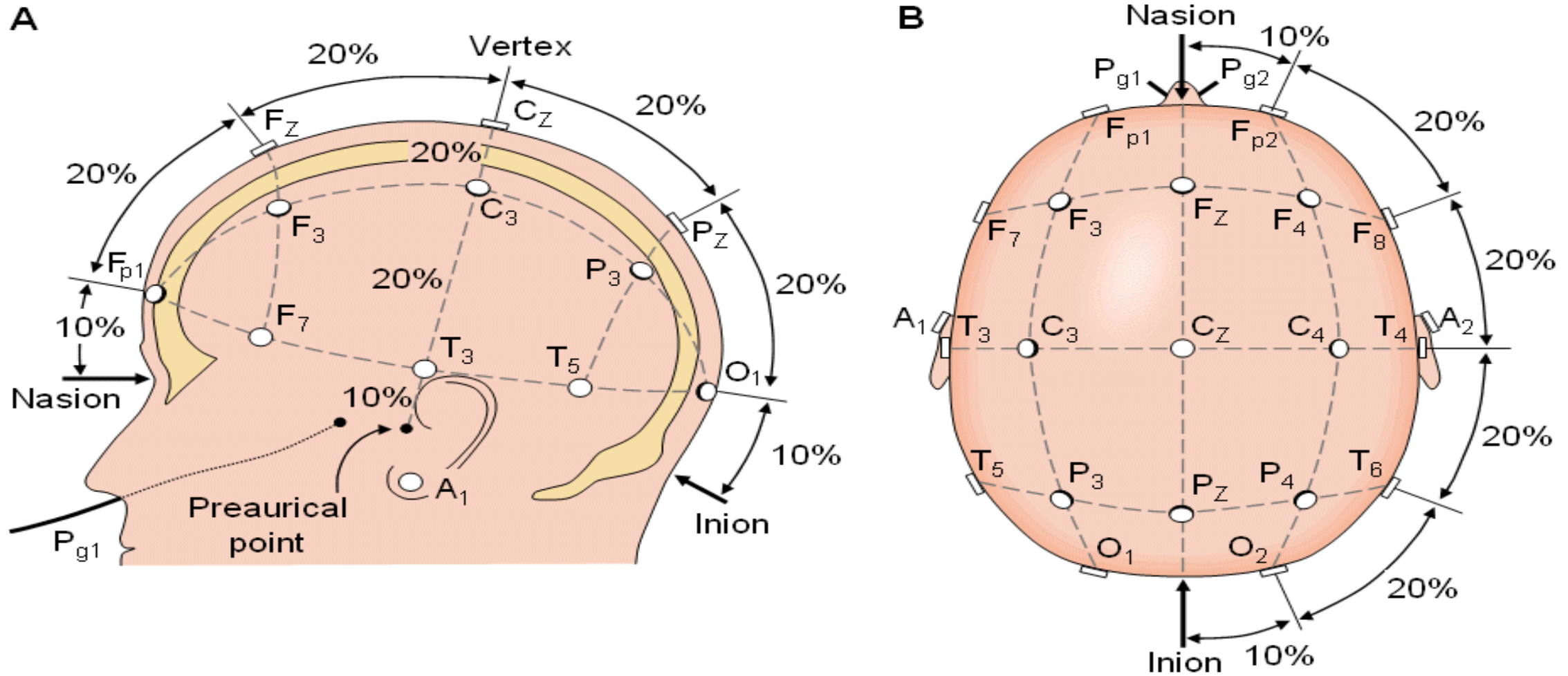
Mind is very active

Vivid hallucinatory imagery or dreaming

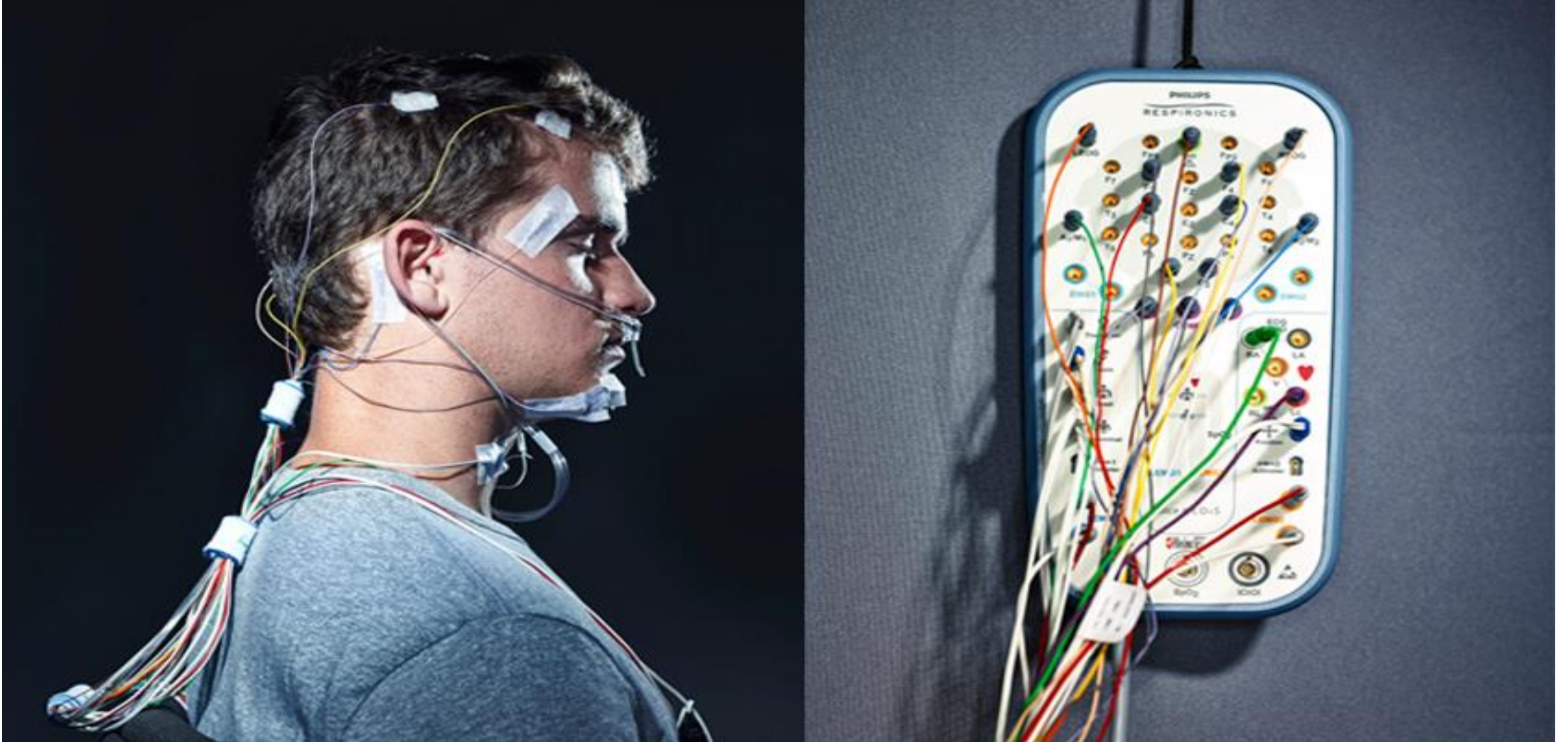
Do problem solving – thought consolidation

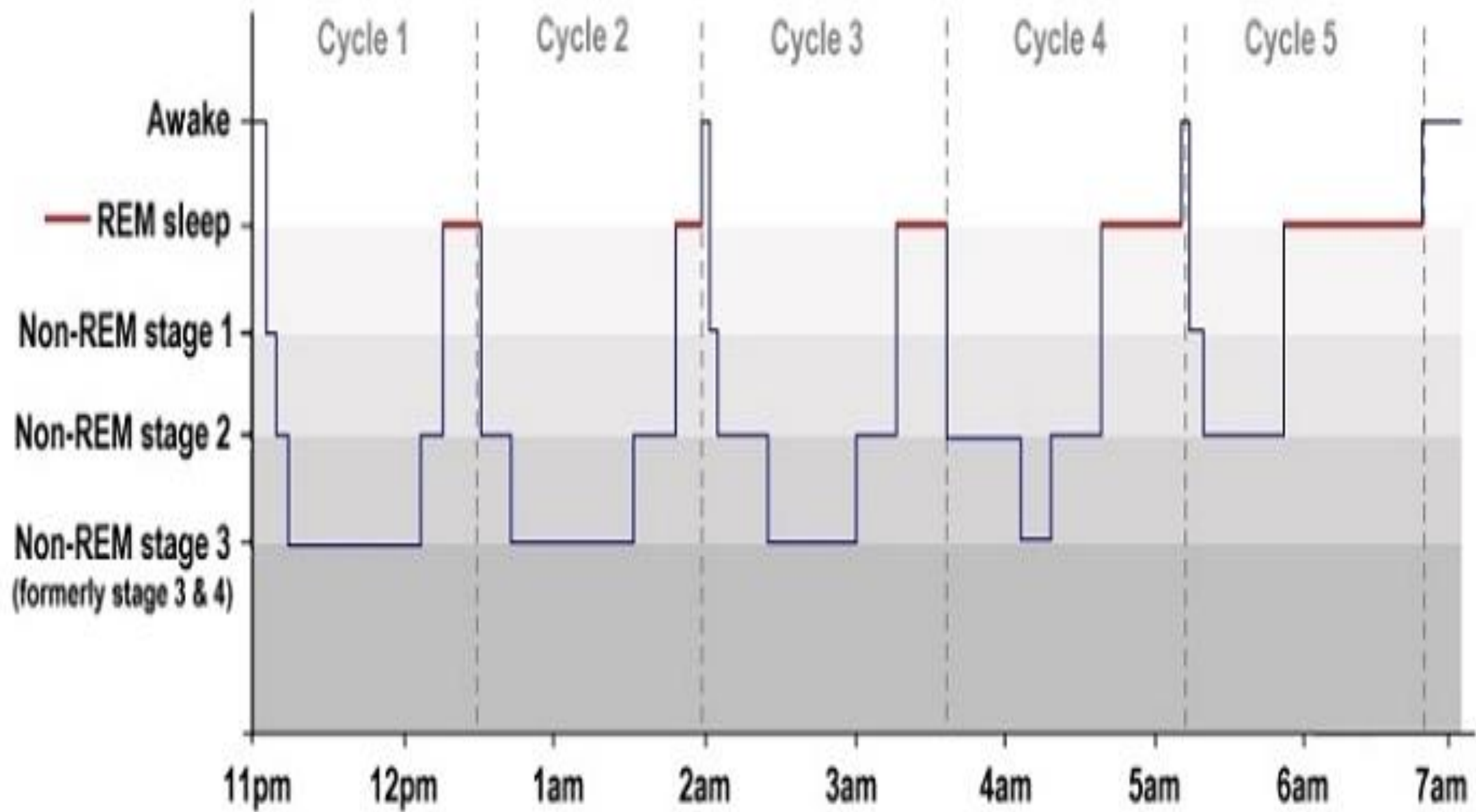


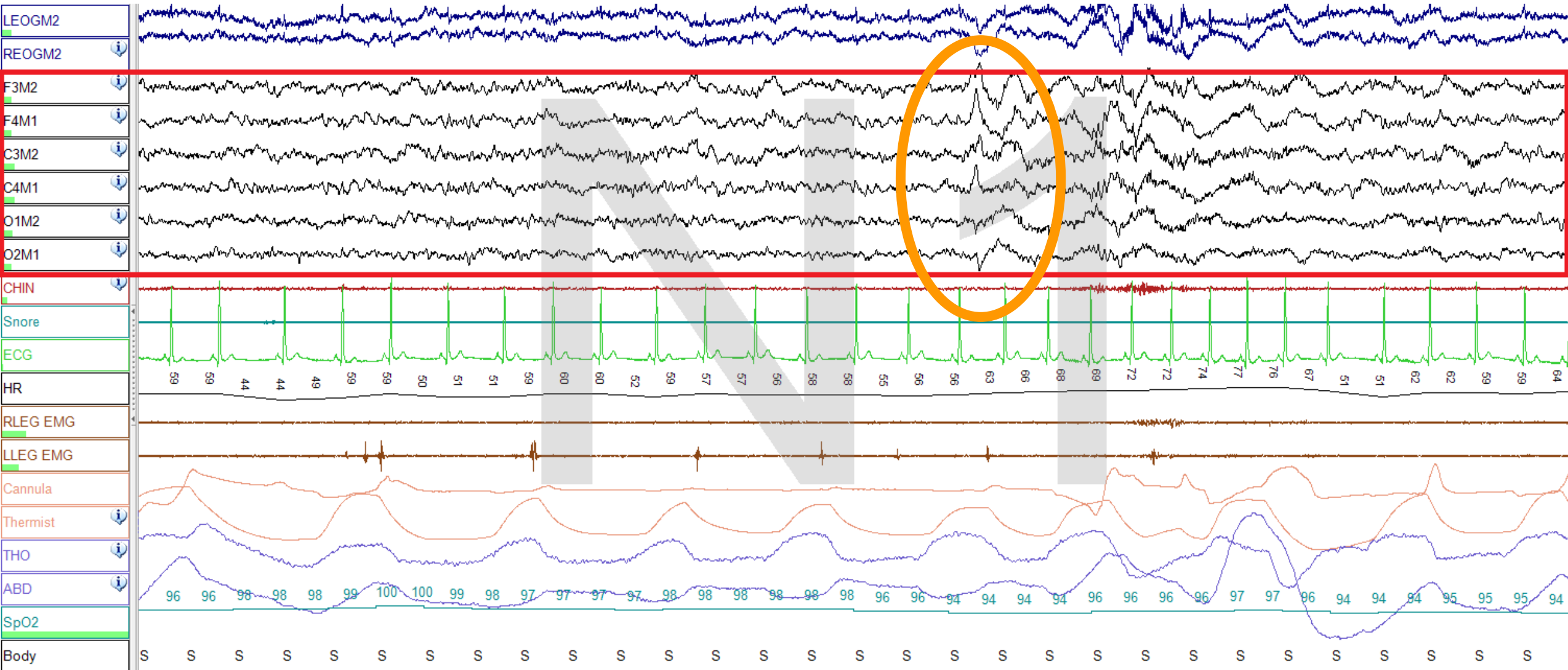
EEG Sensor Placement - PSG

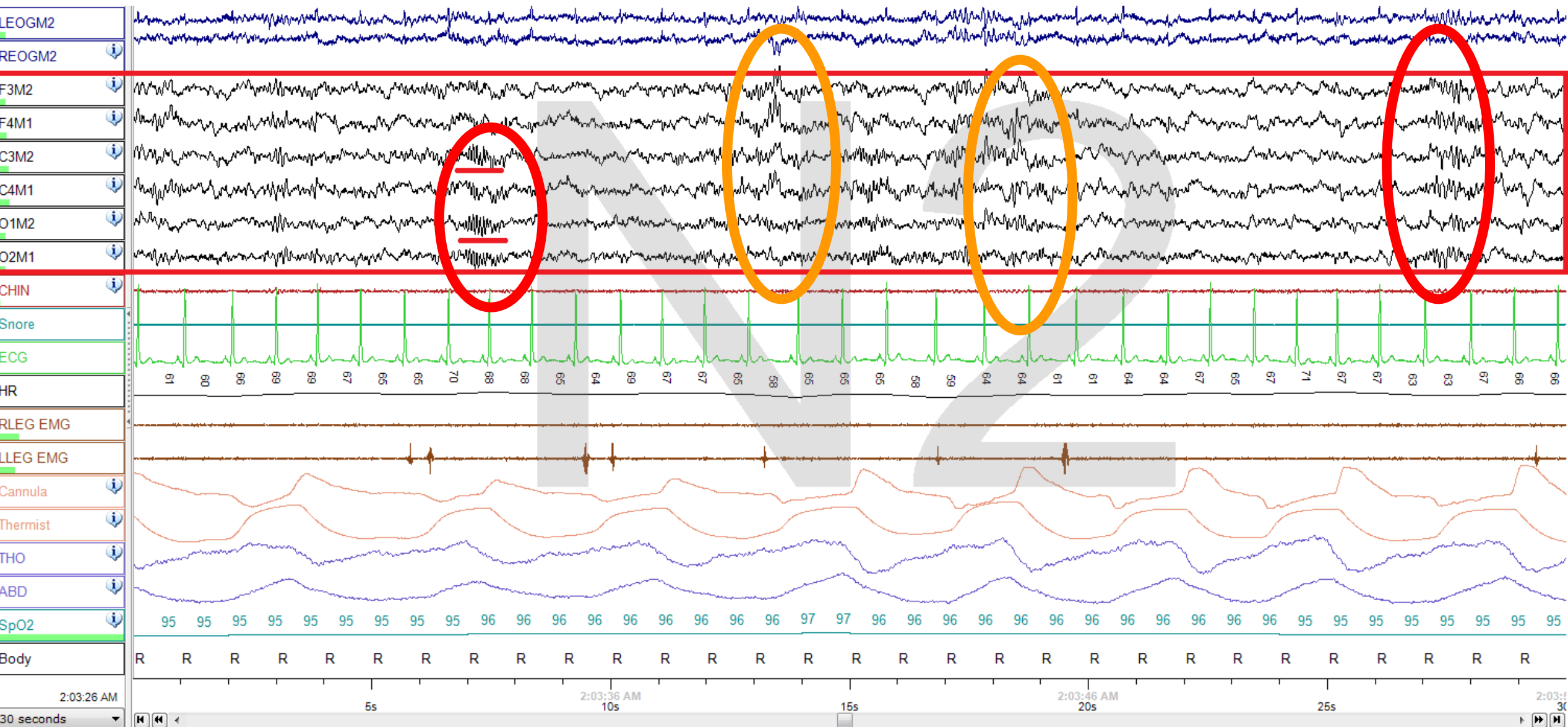


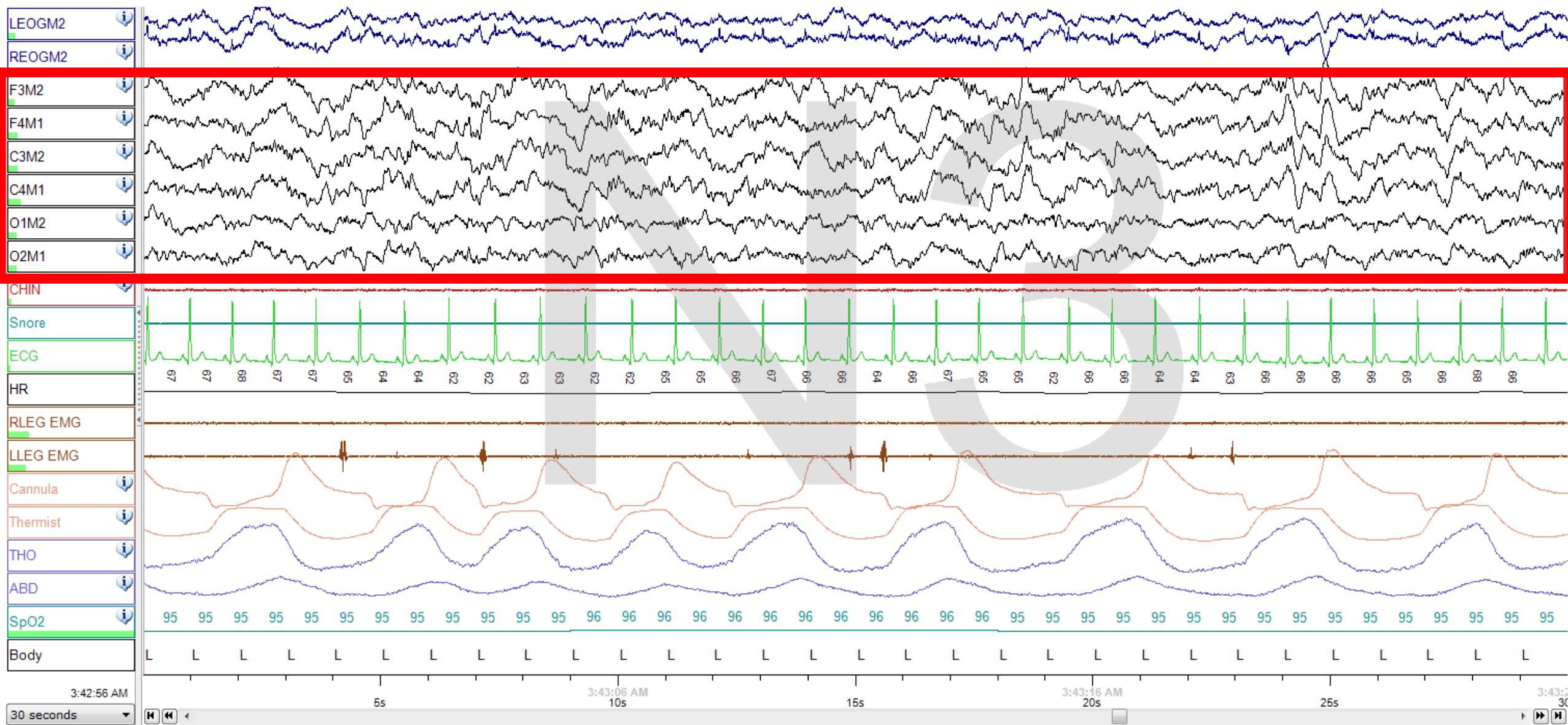
EEG Sensor Placement - PSG

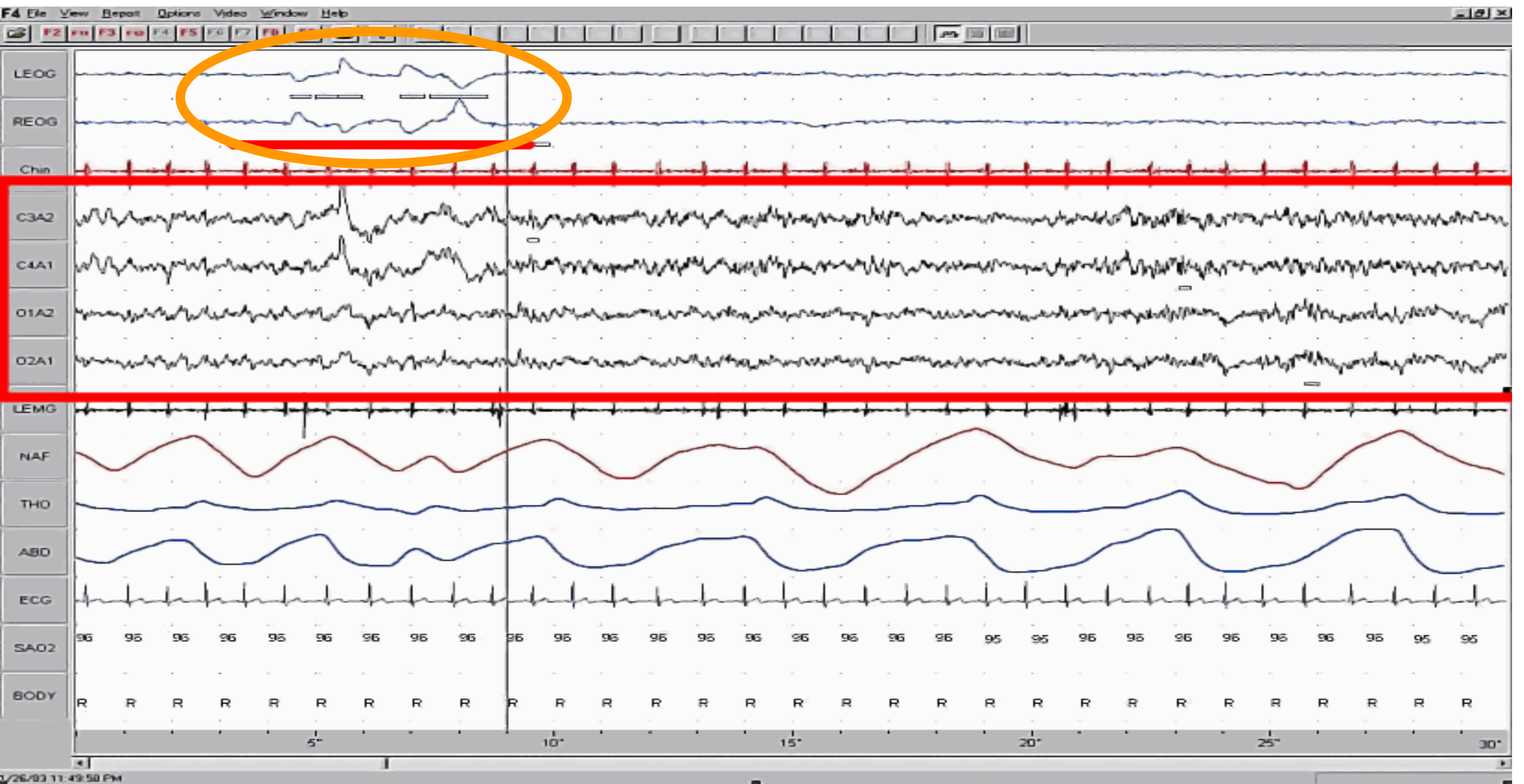












SLEEP DISORDERS

- Insomnia (affects nearly 60% of adults at least one night / week)
- Sleep Apnea (affects 25 - 30 million Americans) (> 90% undiagnosed)
- Narcolepsy (affecting as many as 250,000 Americans)
- Sleepwalking (somnambulism)
- Periodic Limb Movement Disorder (PLMD)
- Restless Leg Syndrome
- Sleep-Related Bruxism
- Night Terrors

Where does Dentistry Fit In ?

- **Dentistry's role is in the area of treatment of SDB conditions**
 - **such as;**

Where does Dentistry Fit In ?

- Obstructive Sleep Apnea**
- Primary Disruptive Snoring (benign?)**
- Nocturnal (Sleep-related) Bruxism**

Sleep Related Bruxism

- As the name implies, not all Bruxism is sleep related
- However, when we see Bruxism we need to remember that much is sleep related
- Parafunction or a protective function?

Overview on Sleep

ation Splints on



Indication and safety of oral appliance use should be attentively evaluated on a patient-by-patient basis. For example, the use of single upper arch oral appliance customized for SB was shown to exacerbate obstructive respiratory events in patients with SDB (ie, rise in the apnea-hypopnea index).^{60,61} In case of a patient with SB at risk of SDB (eg, obstructive sleep apnea), we recommended a mandibular occlusal splint (made for the lower jaw) or a mandibular advancement appliance.

dentist dental practice to utilize oral appliance therapy when treating SB; however, its effect on SDB remains an enigma.

The Link between Sle
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This review will examine the relationship between sleep bruxism (SB), sleep disordered breathing (SDB), and temporomandibular disorders (TMD), with the aim of defining clinical disorders are concomitant, the nature of any causal relationships, with the ultimate advice to clinicians about what to do when a patient presents with a clinical cluster in a given patient.

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Disclosure of Financial and Conflicts of Interest: G. Lavigne is a Canada Research Chair. Our group also receives—free or at reduced cost—oral appliances for research purposes (ORM-Narval, USA-Canada; Silencer, Canada; Klearway, Canada; Somnomed, USA) with no obligation attached. M.C. Carra, N. Huynh, and B. Fleury have no financial conflict of interest to disclose.

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* Corresponding author.

both wear and to protect dental restorations. The use of a stabilization splint alters airway patency during sleep in patients with obstructive sleep apnea (OSA); a condition characterized by repetitive complete or partial obstruction of the upper airway (during sleep)³ has been investigated in two previous studies. One study found that the use of stabilization splints may be associated with a risk of aggravating these respiratory disturbances. In the other study, a mandibular

occlusal stabilization splints on patients (47.3 ± 11.7 years of age) received a maxilla. All patients underwent polysomnography with their splint in situ, and polysomnography without the splint in situ, using a randomized controlled-measures ANOVAs did not show differences in the Apnea-Hypopnea Index (AHI), Epworth Sleepiness Scale (ESS), neither between polysomnography with the splint in situ (AHI: F = 2.757, P = .10) nor between the nights with the splint in situ (ESS: F = 0.231, P = .796). The results revealed that the mean AHI of the nights with the splint in situ (17.4 ± 7.0 events/hour) was not significantly different from that of the nights without the splint in situ (17.4 ± 7.0 events/hour) (F = 7.203, P = .025). The

SDB has
serves as a
airway
is common

Indication and safety of oral appliance use should be attentively evaluated on a patient-by-patient basis. For example, the use of single upper arch oral appliance customized for SB was shown to exacerbate obstructive respiratory events in patients with SDB (ie, rise in the apnea-hypopnea index).^{60,61} In case of a patient with SB at risk of SDB (eg, obstructive sleep apnea), we recommended a mandibular occlusal splint (made for the lower jaw) or a mandibular advancement appliance.



ELSEVIER

Original Article
Prospective study
changes in
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ARTICLE

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Snoring

ORIGINAL ARTICLE
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Impact
on Carotid
Artery

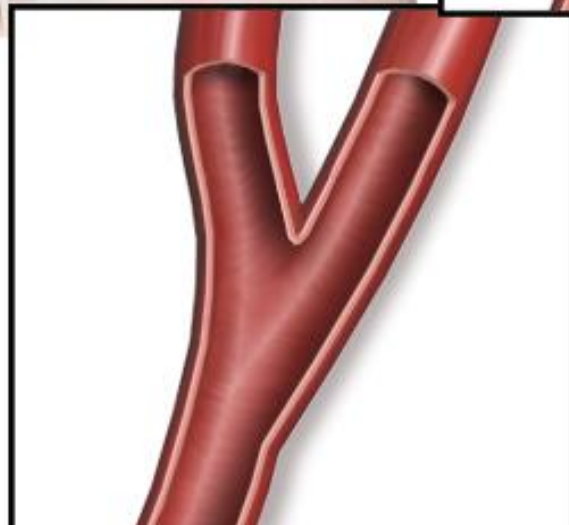
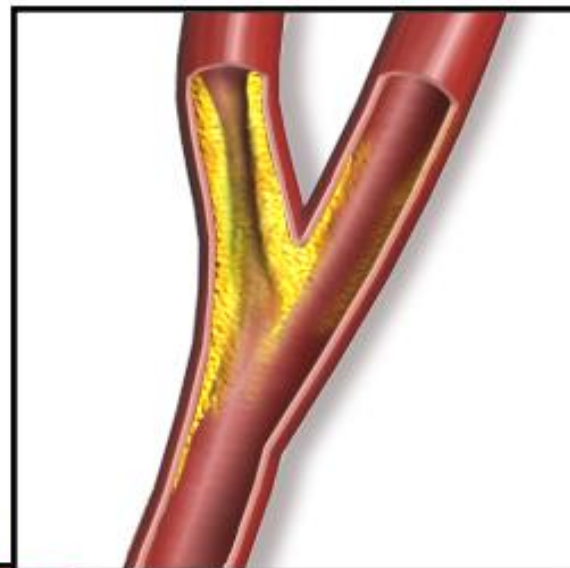
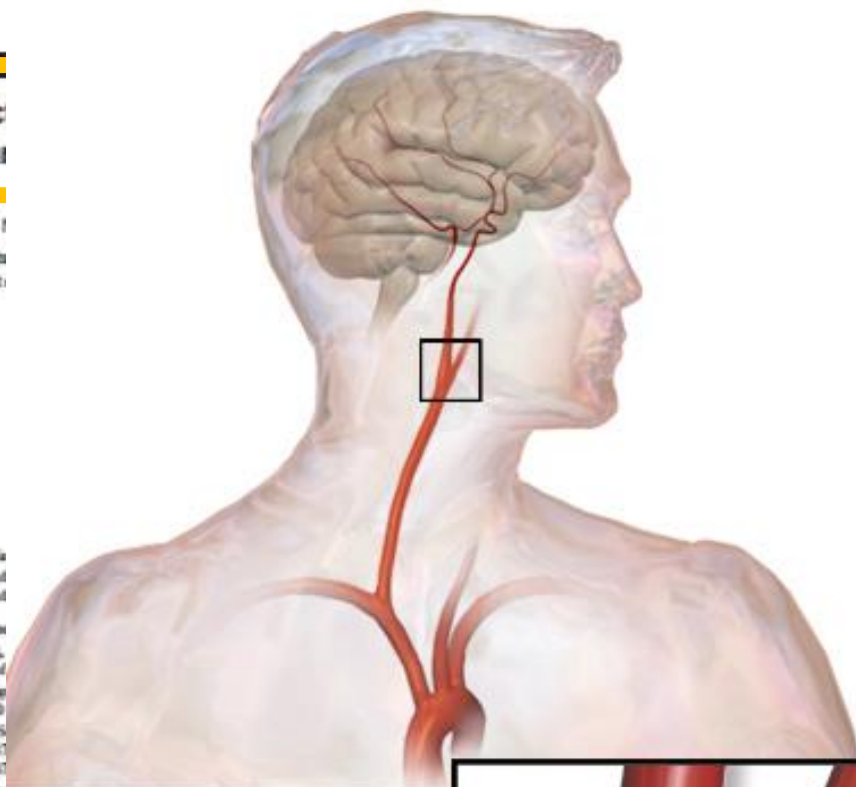
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Atherosclerosis is a major cause of cardiovascular disease. It is characterized by the accumulation of lipids, inflammatory cells, and fibrous tissue in the arterial wall. Snoring is a common symptom of obstructive sleep apnea (OSA), which is associated with atherosclerosis. We investigated the relationship between snoring and carotid artery atherosclerosis in a prospective study.

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Snoring

which is an early finding of atherosclerosis highly correlated with OSAS

carotid artery atherosclerosis - Snoring - obstructive sleep apnea syndrome

Obstructive sleep apnea syndrome (OSAS) is a common respiratory disorder characterized by repetitive episodes of upper airway collapse during sleep, leading to intermittent hypoxemia and hypercapnia. OSAS is associated with atherosclerosis and cardiovascular disease. Carotid artery atherosclerosis is a common finding in OSAS patients. Snoring is a common symptom of OSAS. We investigated the relationship between snoring and carotid artery atherosclerosis in a prospective study.

Snoring in females

Carotid artery thickness in

Julio A. Choe, MD, PhD

Department of Neurobiology, Perelman School of Medicine, University of Pennsylvania, University of Pennsylvania, College of Arts and Sciences, Department of Internal Medicine

Obstructive sleep apnea (OSA) is a common respiratory disorder characterized by repetitive episodes of upper airway collapse during sleep, leading to intermittent hypoxemia and hypercapnia. OSA is associated with atherosclerosis and cardiovascular disease. Carotid artery atherosclerosis is a common finding in OSA patients. Snoring is a common symptom of OSA. We investigated the relationship between snoring and carotid artery atherosclerosis in a prospective study.

Obstructive sleep apnea (OSA) is a common respiratory disorder characterized by repetitive episodes of upper airway collapse during sleep, leading to intermittent hypoxemia and hypercapnia. OSA is associated with atherosclerosis and cardiovascular disease. Carotid artery atherosclerosis is a common finding in OSA patients. Snoring is a common symptom of OSA. We investigated the relationship between snoring and carotid artery atherosclerosis in a prospective study.

Study conducted in the Korean Genome and Epidemiology cohort study of Korean

1. Introduction

There is a growing concern about the development of atherosclerosis associated with cardiovascular disease [1,2], stroke [3,4], and hypertension [5]. It is well known that snoring is associated with obstructive sleep apnea (OSA), which is a risk factor for atherosclerosis.

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The Effect of Snoring and OSA on the Sleep Quality of Bed Partners



The Effect of Snoring and OSA on the Sleep Quality of Bed Partners



*Mayo Clinic
Proceedings*

October 1999

Volume 74
Number 10

The Effect of Snoring and Obstructive Sleep Apnea on the Sleep Quality of Bed Partners

WILLIAM BENINATI, MD; CAMERON D. HARRIS, BS; DANIEL L. HEROLD; AND JOHN W. SHEPARD, JR, MD

• *Objective:* To measure the effect of snoring and obstructive sleep apnea (OSA) on the sleep of snorers' bed partners and to determine whether a bed partner's sleep improves when snoring and OSA are treated.

• *Materials and Methods:* We studied 10 married couples in which 1 member was undergoing polysomnography to evaluate suspected OSA. The patients and their spouses underwent simultaneous polysomnography. Midway through the 1-night study, the patients received nasal continuous positive airway pressure (CPAP) with the pressure adjusted to eliminate snoring and obstructive breathing events. Apnea-hypopnea index (episodes/hours of sleep time), arousal index (arousals/hours of sleep time), and sleep efficiency (percent time asleep) were calculated to measure sleep quality.

• *Results:* The patients (all male) demonstrated a median (range) apnea-hypopnea index of 26 (3-75) that decreased to 7 (0-34) during the trial of nasal CPAP therapy ($P < .05$). During the CPAP trial, the median (range)

arousal index of the spouses decreased from 21 (14-34) to 12 (4-27) ($P < .01$), and the spouses' median (range) sleep efficiency increased from 74% (56%-80%) to 87% (64%-95%) ($P < .01$).

• *Conclusion:* The elimination of snoring and OSA in these patients was associated with an improvement in the quality of their bed partners' sleep, as indicated by improved sleep efficiency and continuity, even when the spouses had been habitually exposed to snoring and OSA. Assuming that 480 minutes were spent in bed for sleep, a 13% improvement in sleep efficiency (ie, from 74% to 87%) translates to an additional 62 minutes of sleep per night for the spouses of snorers with OSA.

Mayo Clin Proc. 1999;74:955-958

AHI = apnea-hypopnea index; Ari = arousal index; CPAP = continuous positive airway pressure; NREM = non-rapid eye movement; OSA = obstructive sleep apnea; St1-2 = stages 1-2

The Mayo Clinic 1999 study

The Effect of Snoring and OSA on the Sleep Quality of Bed Partners

- 10 married couples brought into sleep clinic
- The husbands were all suspected of having sleep apnea
- Split night study
- AHI average was 26 (range 3 – 75)
- AHI decreased to 7 (range 0 – 34) once put on CPAP

The Effect of Snoring and OSA on the Sleep Quality of Bed Partners

- Spouses arousal index was 21 (range 14 – 34)
- Arousal index decreased to 12 (range 4 – 27) after husband was put on CPAP.
- All 10 couples had been married for many years and been habituated to the snoring
- Spouses sleep efficiency increased from 74 % (26 % inefficient sleep) to 87 % - a **13 %** increase

The Effect of Snoring and OSA on the Sleep Quality of Bed Partners

- ***Conclusion:*** The elimination of snoring and OSA in these patients was associated with an improvement in the quality of their bed partners' sleep, as indicated by improved sleep efficiency and continuity, even when the spouses had been habitually exposed to snoring and OSA. Assuming that 480 minutes were spent in bed for sleep, a 13% improvement in sleep efficiency (ie, from 74% to 87%) translates to an additional 62 minutes of sleep per night for the spouses of snorers with OSA.

What if patient doesn't have a bed partner to ask about their snoring?



SnoreLab
The Snoring Management App

Record, measure and track your snoring with the No.1 snoring management app:

- ★ Measures snoring intensity (Snore Score)
- ★ Records sound samples
- ★ Tests the effectiveness of snoring remedies
- ★ Tracks the impact of lifestyle factors
- ★ Millions of nights monitored

SnoreLab has helped change lives for the better.
If snoring impacts your life: *download it today!*

Download on the App Store

The image shows a dark-themed app interface. On the left is a vertical sidebar menu with icons and text for 'iPhone', 'Android', 'DEMO', 'REVIEWS', 'REMEDIES', 'ARTICLES', 'SUPPORT', and 'CONTACT US'. The main content area features the app's title and a list of five bullet points. Below the list is a promotional sentence. At the bottom left is the 'Download on the App Store' logo. On the right, a smartphone displays a 'Snore Report' screen with a graph showing snoring intensity over time, a playback control bar, and a bottom navigation bar with icons for 'Info', 'Record', 'Statistics', and 'Settings'.

Where does Dentistry Fit In ?

- Sleep Apnea**
- Primary Disruptive Snoring (benign?)**
- Nocturnal Bruxism**

Sleep Disordered Breathing and Mortality: Eighteen-Year Follow-up of the Wisconsin Sleep Cohort

Terry Young, PhD¹; Laurel Finn, MS¹; Paul E. Peppard, PhD¹; Mariana Szklo-Coxe, PhD¹; Diane Austin, MS¹; F. Javier Nieto, PhD¹; Robin Stubbs¹, BS; K. Mae Hla, MD²

¹Department of Population Health Sciences and ²Department of Medicine, University of Wisconsin-Madison, Madison, WI

Background: Sleep-disordered breathing (SDB) is a treatable but markedly under-diagnosed condition of frequent breathing pauses during sleep. SDB is linked to incident cardiovascular disease, stroke, and other morbidity. However, the risk of mortality with untreated SDB, determined by polysomnography screening, in the general population has not been established.

Methods: An 18-year mortality follow-up was conducted on the population-based Wisconsin Sleep Cohort sample (n = 1522), assessed at baseline for SDB with polysomnography, the clinical diagnostic standard. SDB was described by the number of apnea and hypopnea episodes/hour of sleep; cutpoints at 5, 15 and 30 identified mild, moderate, and severe SDB, respectively. Cox proportional hazards regression was used to estimate all-cause and cardiovascular mortality risks, adjusted for potential confounding factors, associated with SDB severity levels.

Results: All-cause mortality risk, adjusted for age, sex, BMI, and other
 hazard ratio (HR, 95% CI) for all-cause mortality with severe versus no

SDB was 3.0 (1.4,6.3). After excluding persons who had used CPAP treatment (n = 126), the adjusted HR (95% CI) for all-cause mortality with severe versus no SDB was 3.8 (1.6,9.0); the adjusted HR (95% CI) for cardiovascular mortality was 5.2 (1.4,19.2). Results were unchanged after accounting for daytime sleepiness.

Conclusions: Our findings of a significant, high mortality risk with untreated SDB, independent of age, sex, and BMI underscore the need for heightened clinical recognition and treatment of SDB, indicated by frequent episodes of apnea and hypopnea, irrespective of symptoms of sleepiness.

Keywords: Sleep-disordered breathing, sleep apnea, all-cause mortality, cardiovascular mortality, cohort

Citation: Young T; Finn L; Peppard PE; Szklo-Coxe M; Austin D; Nieto FJ; Stubbs R; Hla KM. Sleep disordered breathing and mortality: eighteen-year follow-up of the wisconsin sleep cohort. *SLEEP* 2008;31(8):1071-1078.

0 Years



*Sleep Disordered Breathing and Mortality:
Eighteen Year Follow-up of the Wisconsin
Sleep Cohort; SLEEP, Vol. 31, No. 8, 2008*

5 Years



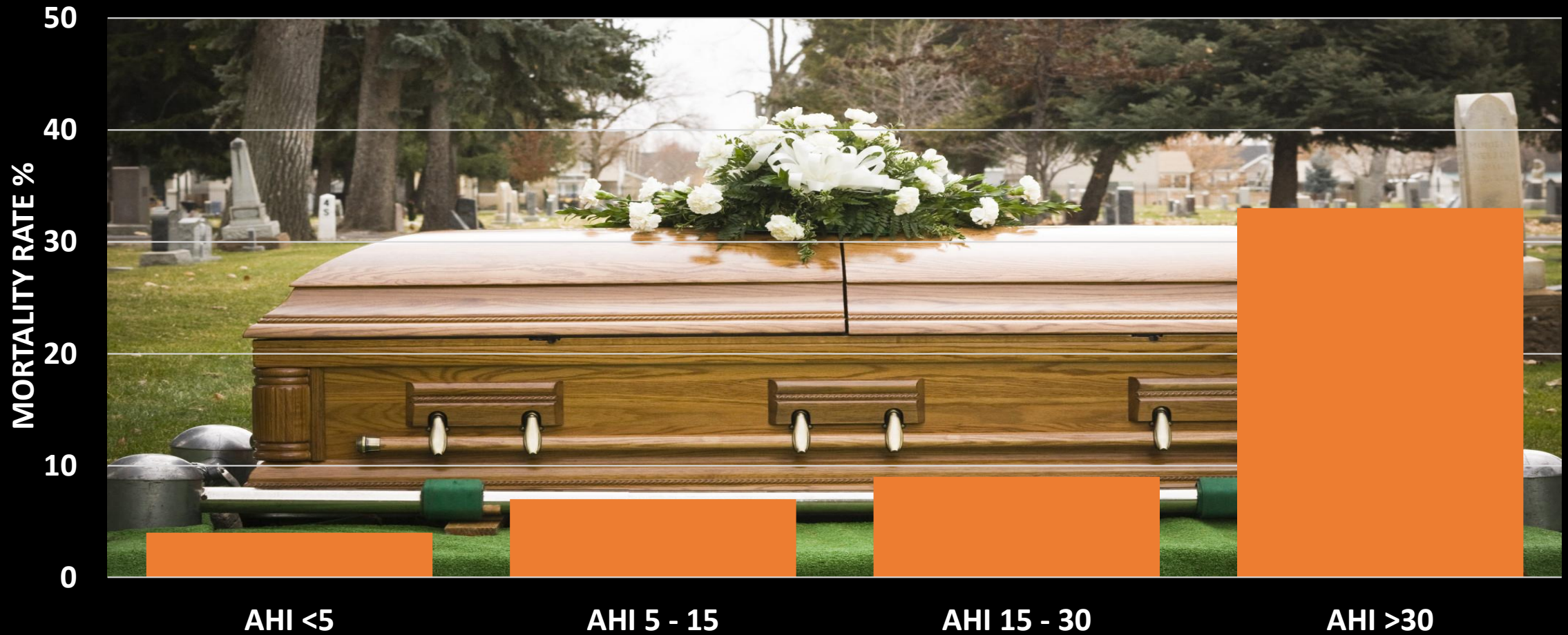
*Sleep Disordered Breathing and Mortality:
Eighteen Year Follow-up of the Wisconsin
Sleep Cohort; SLEEP, Vol. 31, No. 8, 2008*

10 Years



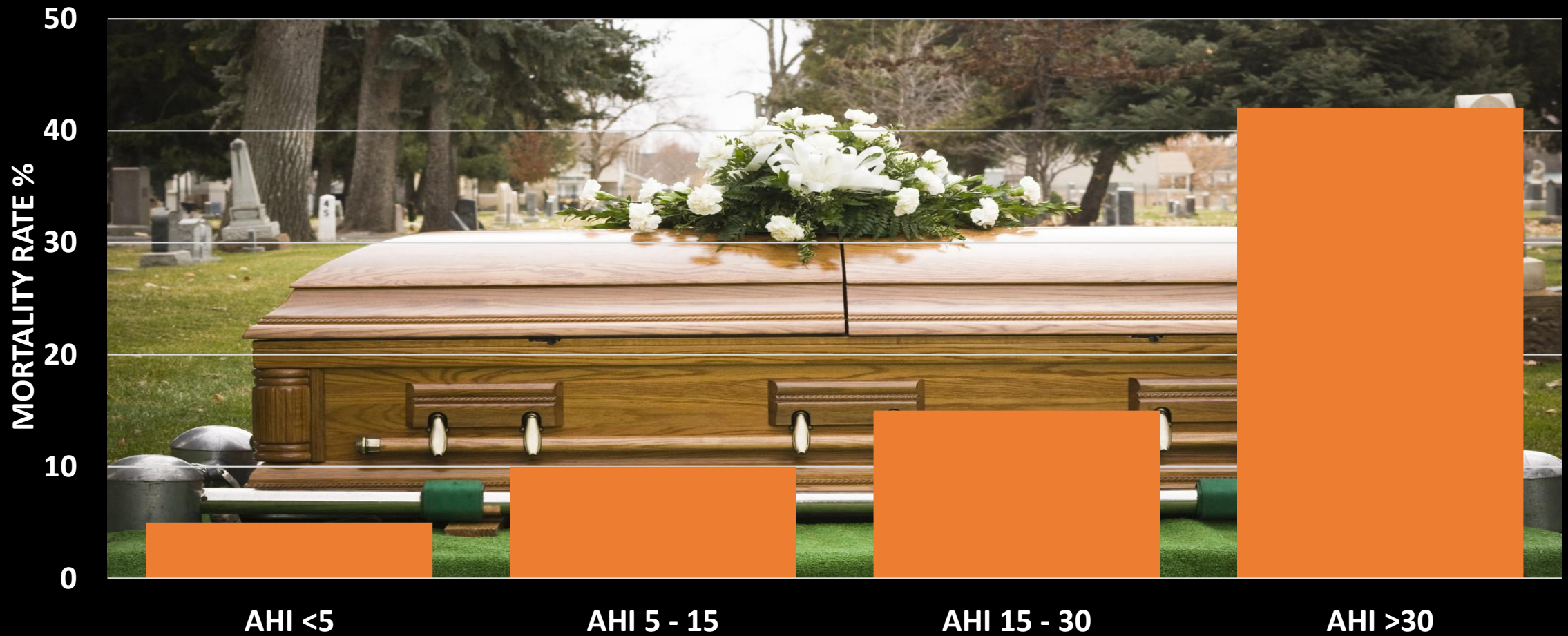
*Sleep Disordered Breathing and Mortality:
Eighteen Year Follow-up of the Wisconsin
Sleep Cohort; SLEEP, Vol. 31, No. 8, 2008*

15 Years



*Sleep Disordered Breathing and Mortality:
Eighteen Year Follow-up of the Wisconsin
Sleep Cohort; SLEEP, Vol. 31, No. 8, 2008*

18 Years



*Sleep Disordered Breathing and Mortality:
Eighteen Year Follow-up of the Wisconsin
Sleep Cohort; SLEEP, Vol. 31, No. 8, 2008*

Who Are These People ?



Your Staff



Their Family, Patients, Your Family and Friends



Their Family, Patients, Your Family and Friends



Sleep-Related Disorders in Children with Attention-Deficit Hyperactivity Disorder: Preliminary Results of a Full Sleep Assessment Study

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Keywords

Attention; Children; Epilepsy; Hyperactivity; Sleep

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doi: 10.1111/ncs.12573

Introduction

SUMMARY

Background and methods: We present the preliminary results of a prospective case-control sleep study in children with a diagnosis of attention-deficit hyperactivity disorder (ADHD). A deep sleep assessment including sleep questionnaires, sleep habits, a video-polysomnographic recording with full high-density electroencephalography (EEG) and cardiorespiratory polygraphy, multiple sleep latency test, and 1-week actigraphic recording were performed to verify whether children with ADHD may be classified into one of the following five phenotypes: (1) hypoarousal state, resembling narcolepsy, which may be considered a "primary" form of ADHD; (2) delayed sleep onset insomnia; (3) sleep-disordered breathing; (4) restless legs syndrome and/or periodic limb movements; and (5) sleep epilepsy and/or EEG interictal epileptiform discharges. **Results:** Fifteen consecutive outpatients with ADHD were recruited (two female, mean age 10.6 ± 2.2 , age range 8–13.7 years) over 6 months. The narcolepsy-like sleep phenotype was observed in three children, the sleep onset insomnia phenotype was observed in one child, mild obstructive sleep apnea was observed in three children, sleep hyperkinesia and/or PLMs were observed in five children, while IEDs and/or nocturnal epilepsy were observed in three children. Depending on the sleep phenotype, children received melatonin, iron supplementation, antiepileptic drugs, or stimulants. **Conclusions:** Our study further highlights the need to design an efficient sleep diagnostic algorithm for children with ADHD, thereby more accurately identifying cases in which a full sleep assessment is indicated.

1

ORIGINAL RESEARCH
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Behavioral and Sleep Problems Mediate the Relationship between Obstructive Breathing Disorders and Cognitive Deficits in Children

J. Hunter^{2,4} and Leila Kheirandish-Goza³

¹ Biological Sciences Division, The University of Chicago, Chicago, IL, United States, ² Department of Pediatrics, Pritzker School of Medicine, The University of Chicago, Chicago, IL, United States, ³ Department of Psychiatry, The University of Chicago, Chicago, IL, United States, ⁴ Department of Psychology, The University of Chicago, Chicago, IL, United States

Over the past several decades have illustrated that obstructive breathing (SDB) are at greater risk for cognitive problems. Although behavioral problems have been associated with SDB and cognitive functioning, these relationships have not been fully elucidated.

In a community-based cohort of 1,115 children who were screened for SDB, we examined the relationships between SDB, behavior, and cognition, and two pathways based on propensity score weighting and mediation analysis to test the mediational role of parent-reported behavior and cognitive functioning in the relationship between SDB and cognitive functioning. Multiple

well as dopamine transporter genes appear to be implicated [2,6]. Brain imaging studies have demonstrated a dysfunction of the

Attention Deficit Hyperactivity Disorder and Sleep

John H. Herman, PhD

KEYWORDS

- Attention deficit/hyperactivity disorder
- Periodic limb movement disorder

KEY POINTS

- ADHD is well known to be associated with sleep problems and these associations are known manifestations of the disorder.
- ADHD may be associated with obstructive sleep apnea (OSA).
- ADHD may be associated with periodic limb movement disorder (PLMD).
- ADHD is frequently associated with sleep problems and this condition is associated with disordered breathing.
- Obstructive sleep apnea, snoring, and PLMD are common in children with ADHD.
- Stimulant medication in children with ADHD may improve sleep.
- Melatonin, and not zolpidem, is effective for improving sleep in children with ADHD.
- ADHD often appears comorbid with sleep problems.
- Children with ADHD frequently have sleep problems and a sleep study or surgery alleviates the symptoms and improves cognitive effects.

ADHD and Sleep Disordered Breathing in Children

- Children do not react to sleepiness the same way as adults
- Have you ever wondered why they give hyperactive, inattentive children “Speed” as a treatment for their ADHD?
- Ritalin, Focalin and Adderall are all amphetamines - stimulants

ADHD and Sleep Disordered Breathing in Children

- Problems are not just OSA in children
- There is a big problem with the advent of electronics (in our house we call them “screens”)
- Improper sleep hygiene – worse over the last 50 years
- School start times

Sleep Apnea – What is it ?





Sleep Apnea Severity

- **AHI - Apnea/Hypopnea Index**
- **Apneas – Cessation of Breath**
 - **No airflow for at least 10 seconds**
- **Hypopneas – Shallow Breathing**
 - **>30% reduction in airflow**

Sleep Apnea Severity

Mild Sleep Apnea – 5 – 14.9 events per hour

Moderate Sleep Apnea – 15 – 29.9 events per hour

Severe Sleep Apnea – over 30 events per hour



Mild



Moderate



Severe

DEFINITIONS

Dental Sleep Medicine –

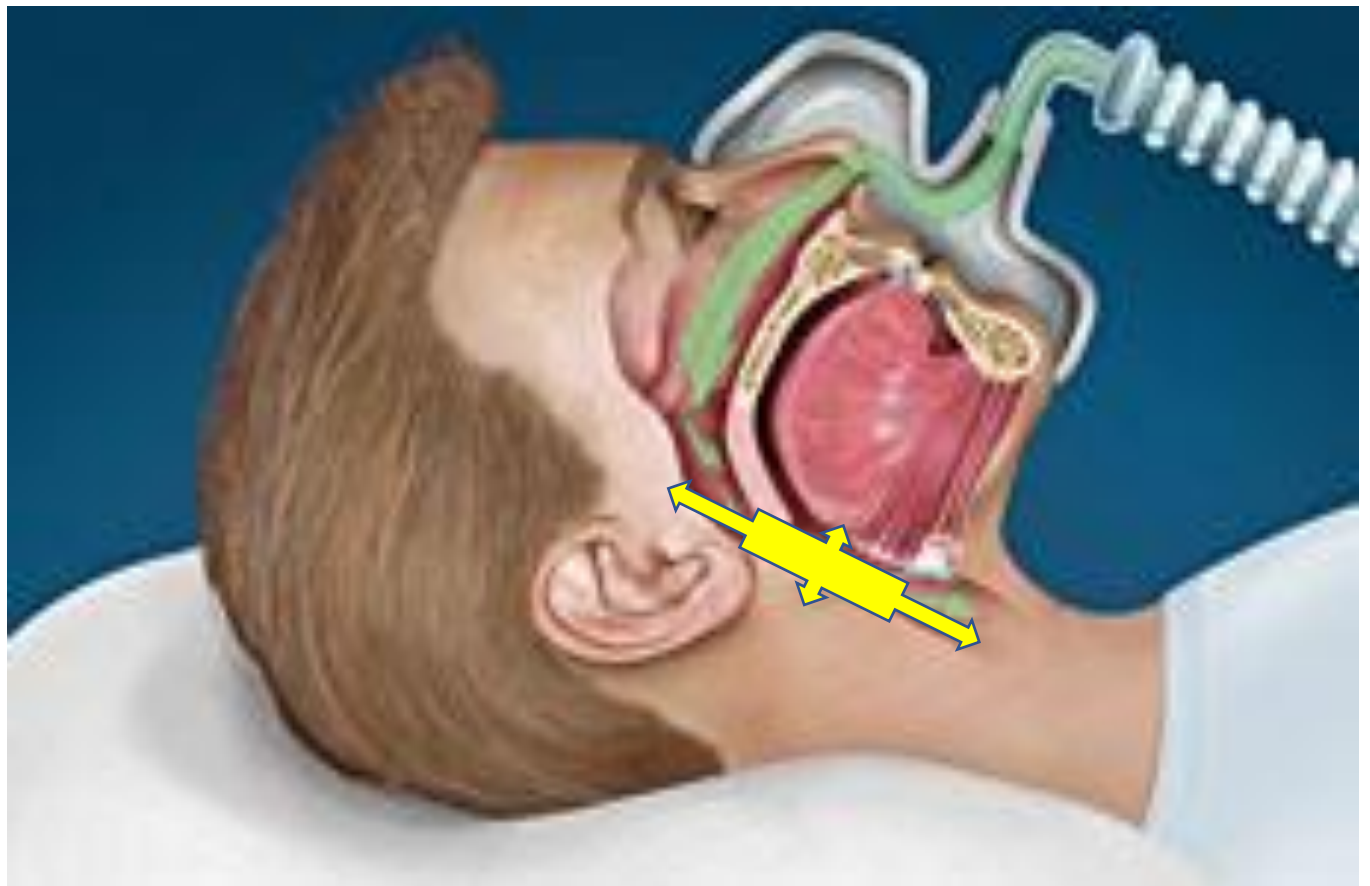
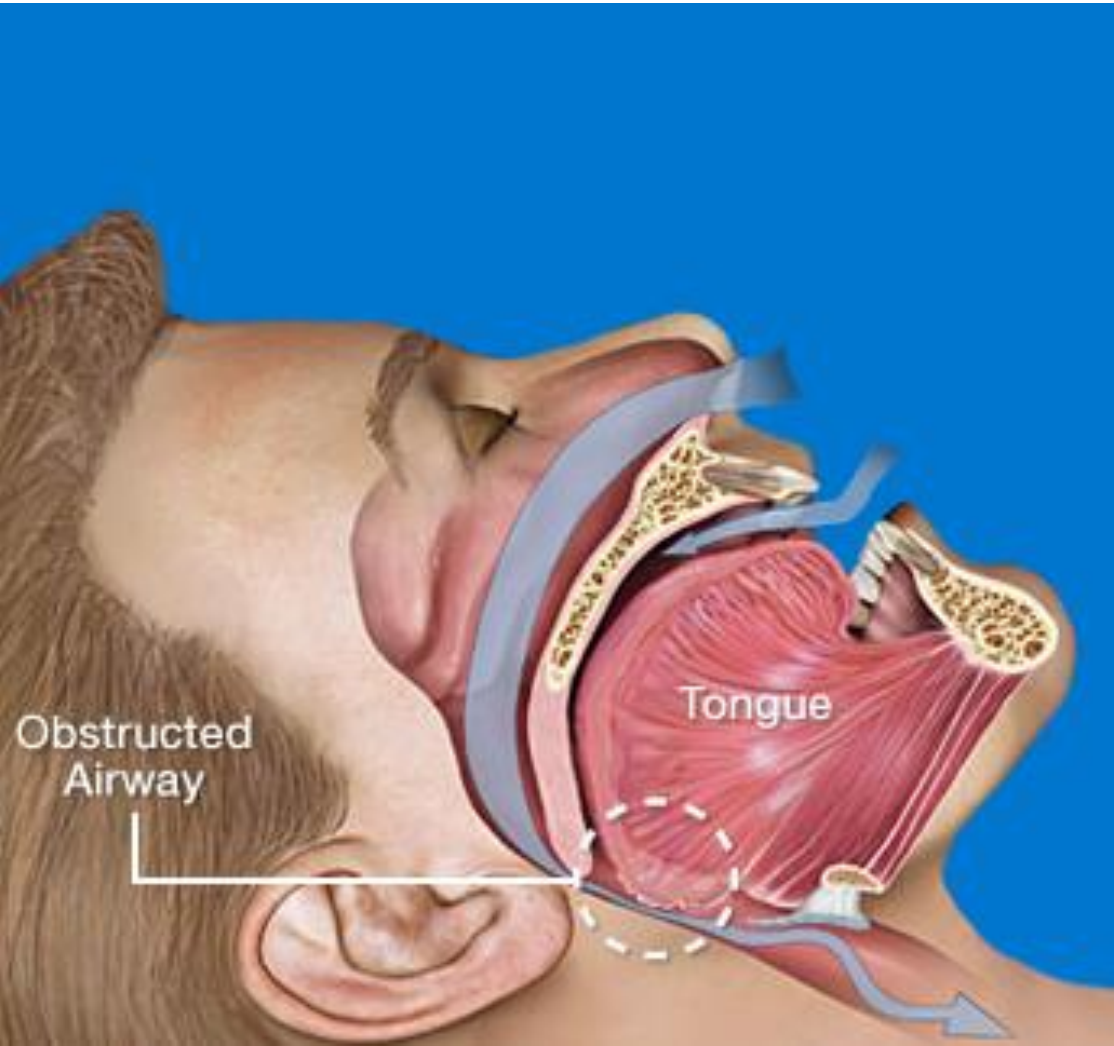
Dental Sleep Medicine (DSM) is the area of dentistry involved in the use of Oral Appliance Therapy (OAT) and Oral Surgery procedures for the treatment of Sleep Related Disordered Breathing (SRDB), especially in the form of Obstructive Sleep Apnea (OSA), Upper Airway Resistance Syndrome (UARS) and Primary Disruptive Snoring.

DEFINITIONS

Oral Appliance Therapy –

Oral Appliance Therapy (OAT) involves the selection, design, fitting and follow-up care of specially designed Oral Appliances that, when worn during sleep, maintain an open and unobstructed airway in the throat.



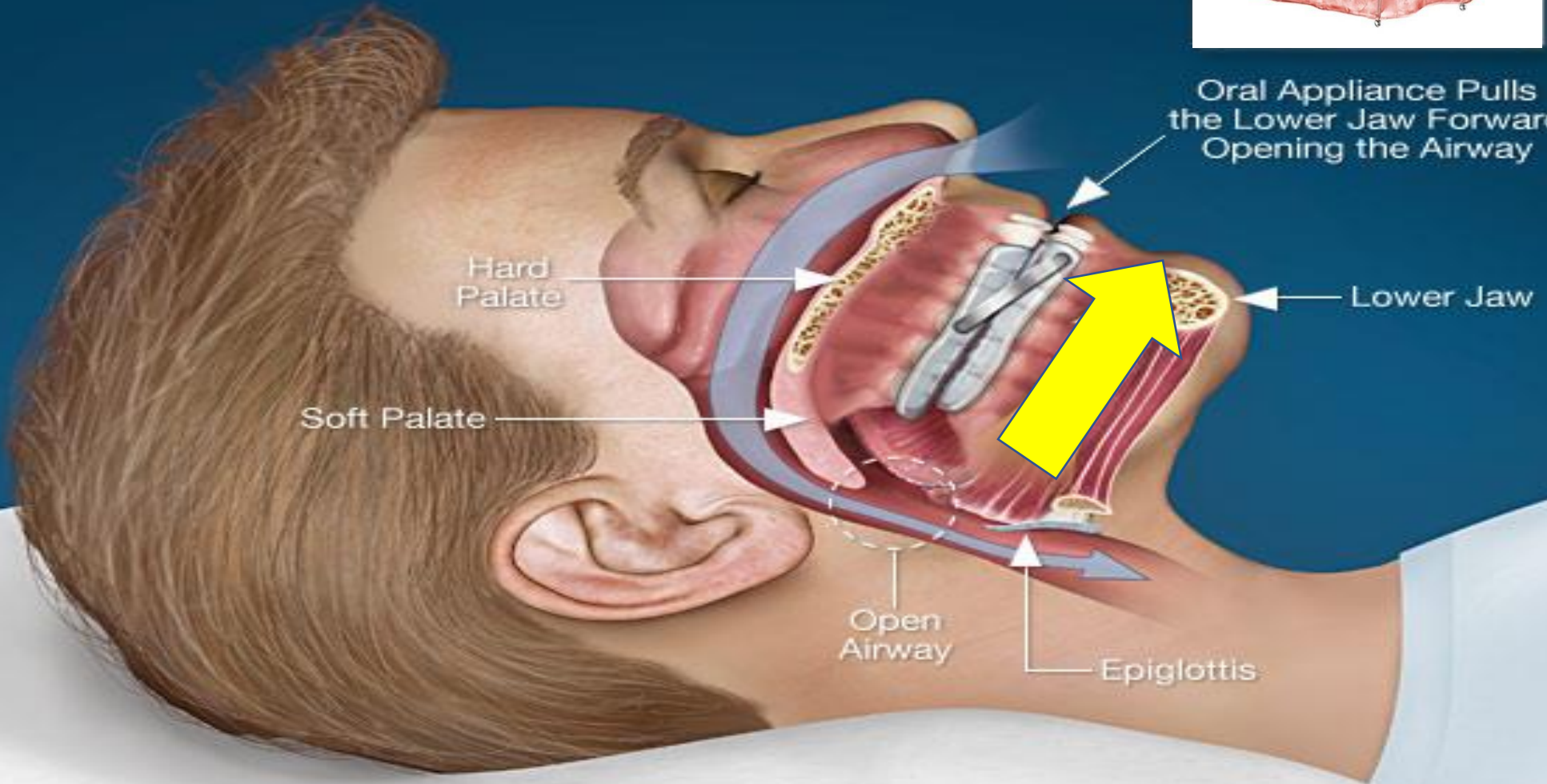


Oral Appliance Therapy

The first and most comfortable option to CPAP for the treatment of obstructive sleep apnea.



Oral Appliance Pulls the Lower Jaw Forward Opening the Airway



SLEEP APNEA?

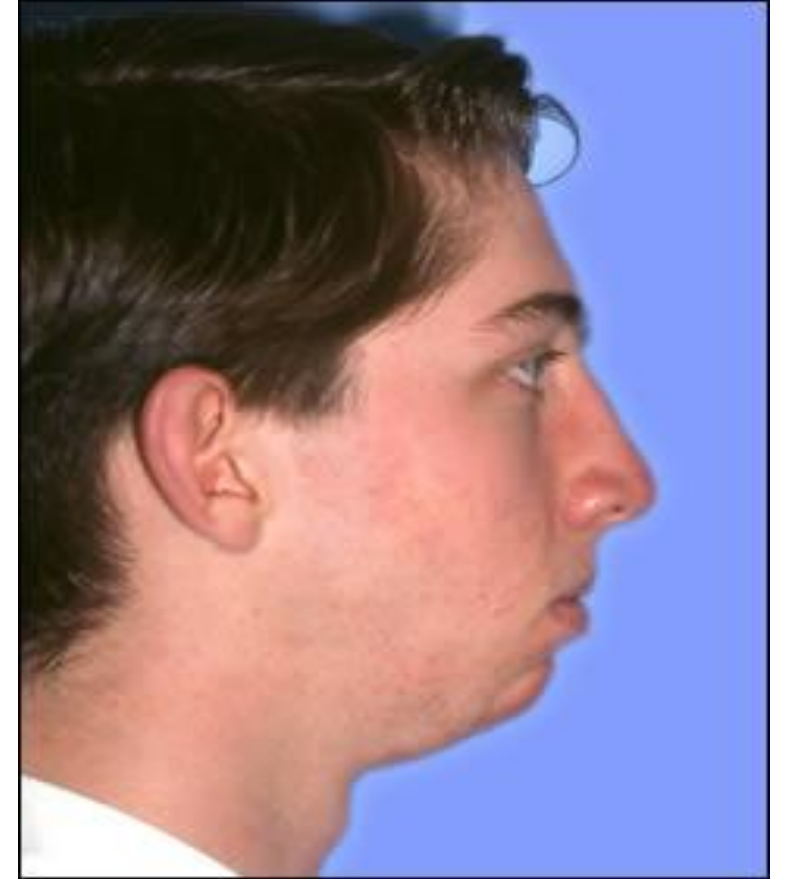


Dental Risk Factors – What You May Observe

- Retrognathia
- Tongue size
- Tongue scalloping
- Large uvula
- Tonsils
- signs of GERD
- Signs of Bruxism
- Sleepiness during dental appointment

Dental Risk Factors – What You May Observe

- **Retrognathia**
- Tongue size
- Tongue scalloping
- Large uvula
- Tonsils
- signs of GERD
- Signs of Bruxism
- Sleepiness during dental appointment



Dental Risk Factors – What You May Observe

- Retrognathia
- **Tongue size (macroglossia)**
- **Tongue scalloping**
- Large uvula
- Tonsils
- signs of GERD
- Signs of Bruxism
- Sleepiness during dental appointment





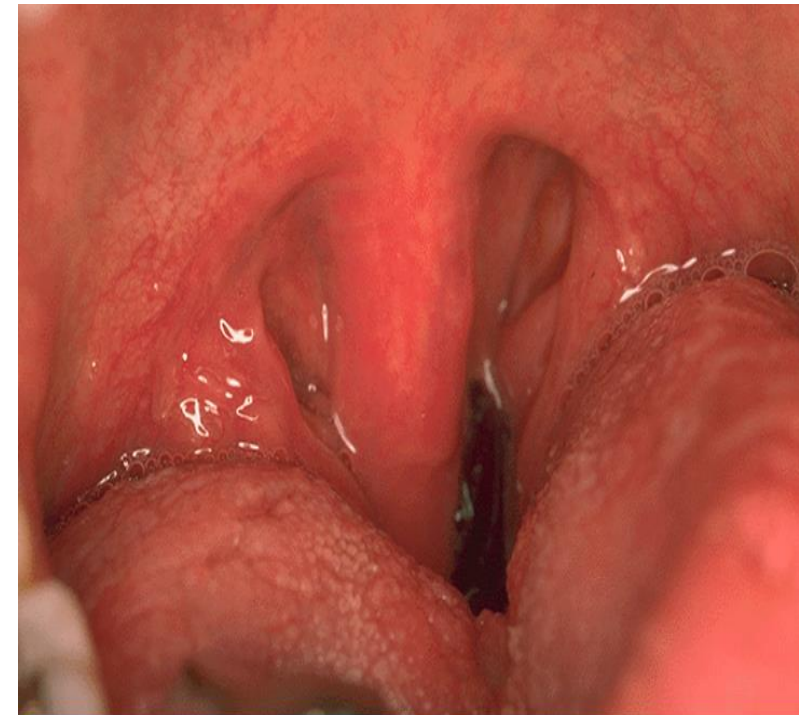
Dental Risk Factors – What You May Observe

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Dental Risk Factors – What You May Observe

- Retrognathia
- Tongue size
- Tongue scalloping
- Large uvula
- **Tonsils**
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- Signs of Bruxism
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Dental Risk Factors – What You May Observe

- Retrognathia
- Tongue size
- Tongue scalloping
- Large uvula
- Tonsils
- **signs of GERD**
- Signs of Bruxism
- Sleepiness during dental appointment



Dental Risk Factors – What You May Observe

- Retrognathia
- Tongue size
- Tongue scalloping
- Large uvula
- Tonsils
- signs of GERD
- **Signs of Bruxism**
- Sleepiness during dental appointment





Custom mouth guards are the **best solution** for nightly teeth grinding



Dental Risk Factors – What You May Observe

- Retrognathia
- Tongue size
- Tongue scalloping
- Large uvula
- Tonsils
- signs of GERD
- Signs of Bruxism
- **Sleepiness during dental appointment**



Other Risk Factors

OBESITY

OBESITY in the United States



Obesity Trends Among U.S. Adults between 1985 and 2015

Definitions:

- Obesity: Body Mass Index (BMI) of 30 or higher.
- Body Mass Index (BMI): A measure of an adult's weight in relation to his or her height, specifically the adult's weight in kilograms divided by the square of his or her height in meters.

BODY MASS INDEX

Weight (pounds)

Height (ft/in)

	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330
4'5"	30	33	35	38	40	43	45	48	50	53	55	58	60	63	65	68	70	73	75	78	80	83
4'6"	29	31	34	36	39	41	43	46	48	51	53	56	58	60	63	65	68	70	72	75	77	80
4'7"	28	30	33	35	37	40	42	44	47	49	51	54	56	58	61	63	65	68	70	72	75	77
4'8"	27	29	31	34	36	38	40	43	45	47	49	52	54	56	58	61	63	65	67	70	72	74
4'9"	26	28	30	33	35	37	39	41	43	46	48	50	52	54	56	59	61	63	65	67	69	72
4'10"	25	27	29	31	34	36	38	40	42	44	46	48	50	52	54	57	59	61	63	65	67	69
4'11"	24	26	28	30	32	34	36	38	40	43	45	47	49	51	53	55	57	59	61	63	65	67
5'0"	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
5'1"	23	25	27	28	30	32	34	36	38	40	42	44	45	47	49	51	53	55	57	59	61	62
5'2"	22	24	26	27	29	31	33	35	37	38	40	42	44	46	48	49	51	53	55	57	59	60
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5'4"	21	22	24	26	28	29	31	33	34	36	38	40	41	43	45	46	48	50	52	53	55	57
5'5"	20	22	23	25	27	28	30	32	33	35	37	38	40	42	43	45	47	48	50	52	53	55
5'6"	19	21	23	24	26	27	29	31	32	34	36	37	39	40	42	44	45	47	49	50	52	53
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5'8"	18	20	21	23	24	26	27	29	30	32	34	35	37	38	40	41	43	44	46	47	49	50
5'9"	18	19	21	22	24	25	27	28	30	31	33	34	36	37	38	40	41	43	44	46	47	49
5'10"	17	19	20	22	23	24	26	27	29	30	32	33	35	36	37	39	40	42	43	45	46	47
5'11"	17	18	20	21	22	24	25	27	28	29	31	32	34	35	36	38	39	41	42	43	45	46
6'0"	16	18	19	20	22	23	24	26	27	29	30	31	33	34	35	37	38	39	41	42	43	45
6'1"	16	17	19	20	21	22	24	25	26	28	29	30	32	33	34	36	37	38	40	41	42	44
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6'9"	13	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	31	32	33	34	35
6'10"	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35

www.graceandstrengthlifestyle.com

*data source - National Obesity Education Initiative



Under Weight
BMI = under 18.5



Normal Weight
BMI = 18.5 - 24.9



Over Weight
BMI = 25 - 29.9



Obesity
BMI = 30 - 39.9

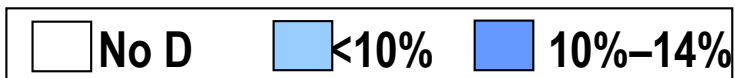
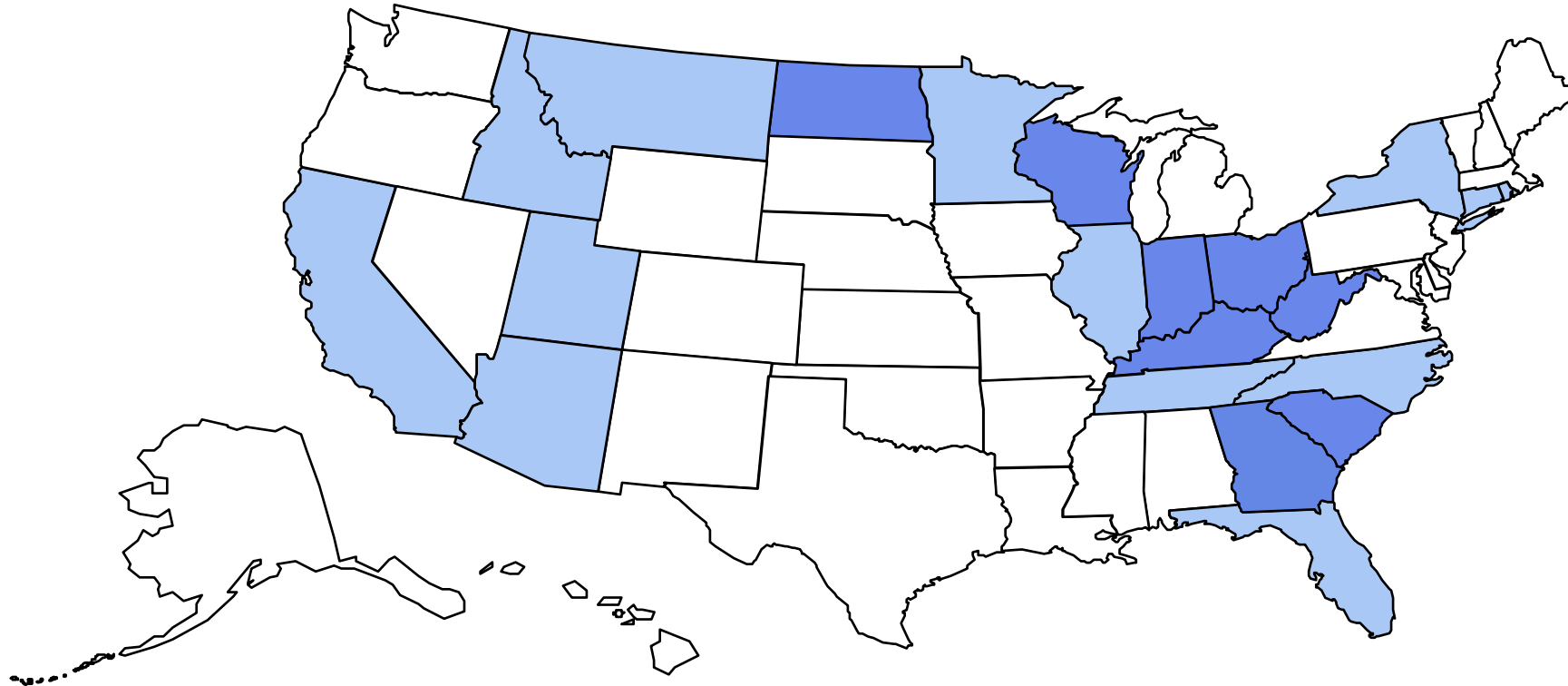


Extreme Obesity
BMI = 40 and over

Obesity Trends* Among U.S. Adults

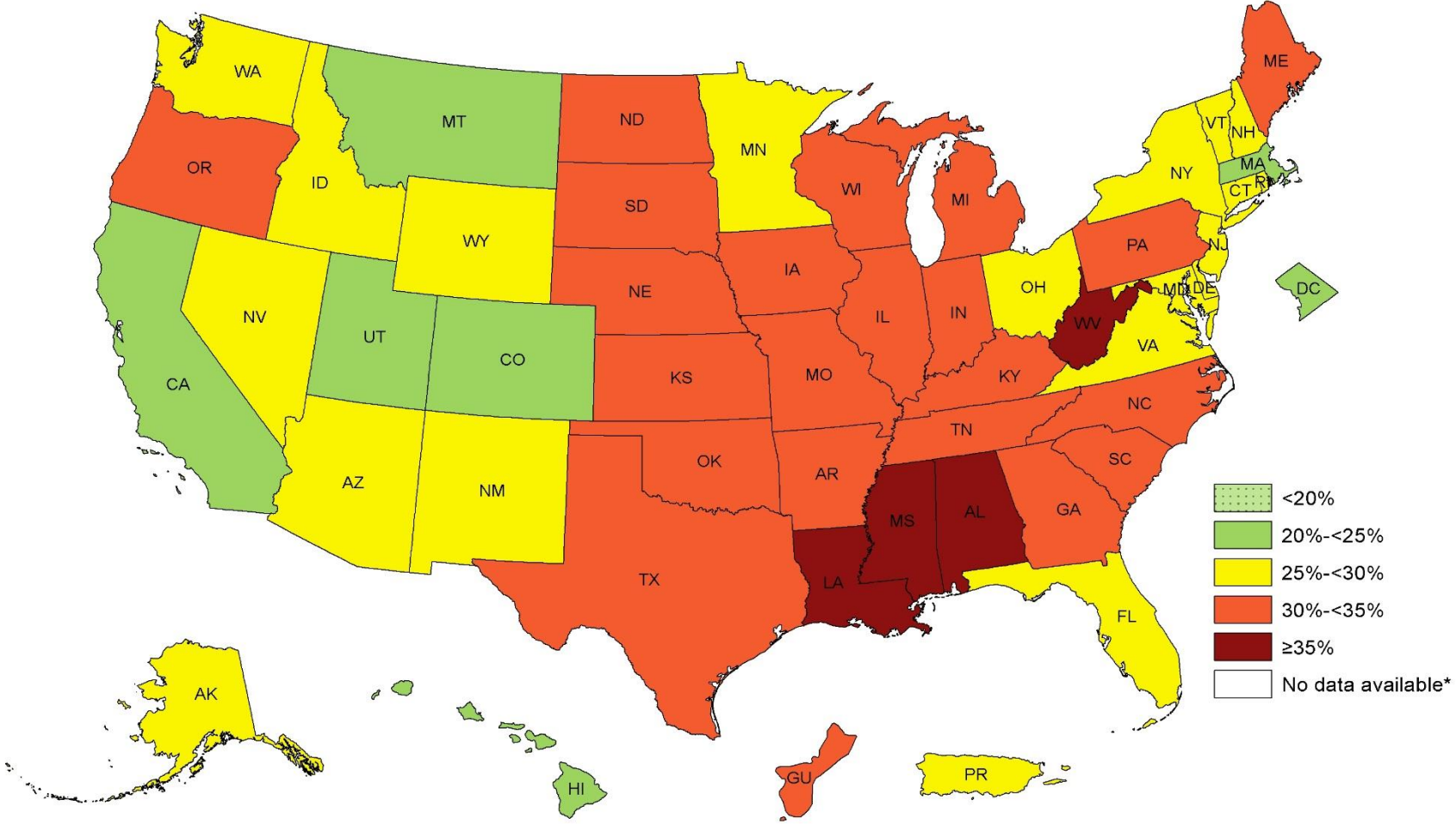
BRFSS, 1985

(*BMI ≥ 30 , or ~ 30 lbs. overweight for 5' 4" person)



Obesity Trends Among U.S. Adults

BRFSS, 2015



*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.



ADA Policy Statement

The Role of Dentistry in the Treatment of Sleep Related Breathing Disorders

Adopted by ADA's 2017 House of Delegates

Sleep related breathing disorders (SRBD) are disorders characterized by disruptions in normal breathing patterns. SRBDs are potentially serious medical conditions caused by anatomical airway collapse and altered respiratory control mechanisms. Common SRBDs include snoring, upper airway resistance syndrome (UARS) and obstructive sleep apnea (OSA). OSA has been associated with metabolic,

The dentist's role in the treatment of SRBD includes the following:

- Dentists are encouraged to screen patients for SRBD as part of a comprehensive medical and dental history to recognize symptoms such as daytime sleepiness, choking, snoring or witnessed apneas and an evaluation for risk factors such as obesity, retrognathia, or hypertension. If risk for SRBD is determined, these patients should be referred, as needed, to the appropriate physicians for proper diagnosis.
- In children, screening through history and clinical examination may identify signs and symptoms of deficient growth and development, or other risk factors that may lead to airway issues. If risk for SRBD is determined, intervention through medical/dental referral or evidenced based treatment may be appropriate to help treat the SRBD and/or develop an optimal physiologic airway and breathing pattern.

for an adult patient with obstructive sleep apnea, a dentist should evaluate the patient for the appropriateness of fabricating a suitable oral appliance. If deemed appropriate, a dentist should fabricate an oral appliance.

- Dentists should obtain appropriate patient consent for treatment that reviews the proposed treatment plan, all available options and any potential side effects of using OAT and expected appliance longevity.
- Dentists treating SRBD with OAT should be capable of recognizing and managing the potential side effects through treatment or proper referral.

Who should be screened for OSA?



A large, diverse group of smiling people of various ages and ethnicities, including men and women of different backgrounds, all looking towards the camera. The group is densely packed and fills the entire frame. At the top center, there is a white rectangular box with an orange border containing the text "EVERYONE?".

EVERYONE ?

Screening Patients for SDB

Clinical Exam Sleep Apnea Screening/Referral Form

Name: _____

Age: _____ Height: _____ Weight: _____ Neck size: _____ BMI: _____

STOP - BANG

Do you **Snore** loudly (loud enough to be heard through a closed door)? _____ Yes _____ No
 Do you often feel **Tired**, fatigued, or sleepy during the daytime? _____ Yes _____ No
 Has anyone **Observed** you stop breathing during your sleep? _____ Yes _____ No
 Do you have/are you treated for high blood pressure? _____ Yes _____ No
BMI more than 35? _____ Yes _____ No
Age over 50 years old? _____ Yes _____ No
Neck circumference > 15.75 inches? _____ Yes _____ No
Male Gender? _____ Male _____ Female _____ Yes _____ No

(≥ 3 yes answers: High Risk for OSA; < 3 yes answers: Low risk for OSA)

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 haven't 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

It is important that you answer each question as best you can.

Situation	Chance of Dozing (0-3)
Sitting and reading _____	_____
Watching TV _____	_____
Sitting, inactive in a public place (e.g. a 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	_____

DO NOT Write below this line

CLINICAL EXAM NOTES

Screening Patients for SDB



Center for Dental Sleep Medicine and Orofacial Pain
Alan O. Blanton, DDS, MS, D. ABDSM

Clinical Exam Sleep Apnea Screening/Referral Form

Name: _____

Age: _____ Height: _____ Weight: _____ Neck size: _____ BMI: _____

STOP - BANG

Do you Snore loudly (loud enough to be heard through a closed door)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you often feel Tired , fatigued, or sleepy during the daytime?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has anyone Observed you stop breathing during your sleep?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you have/are you treated for high blood Pressure ?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
BMI more than 35?	BMI _____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Age over 50 years old?	Age _____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Neck circumference > 15.75 inches?	_____ inches	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Male Gender ?	<input type="checkbox"/> Male <input type="checkbox"/> Female	<input type="checkbox"/> Yes	<input type="checkbox"/> No

(≥ 3 yes answers: High Risk for OSA; < 3 yes answers: Low risk for OSA)

Screening Patients for SDB

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 haven't 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

It is important that you answer each question as best you can.

Situation	Chance of Dozing (0-3)
Sitting and reading _____	___
Watching TV _____	___
Sitting, inactive in a public place (e.g. a 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 _____

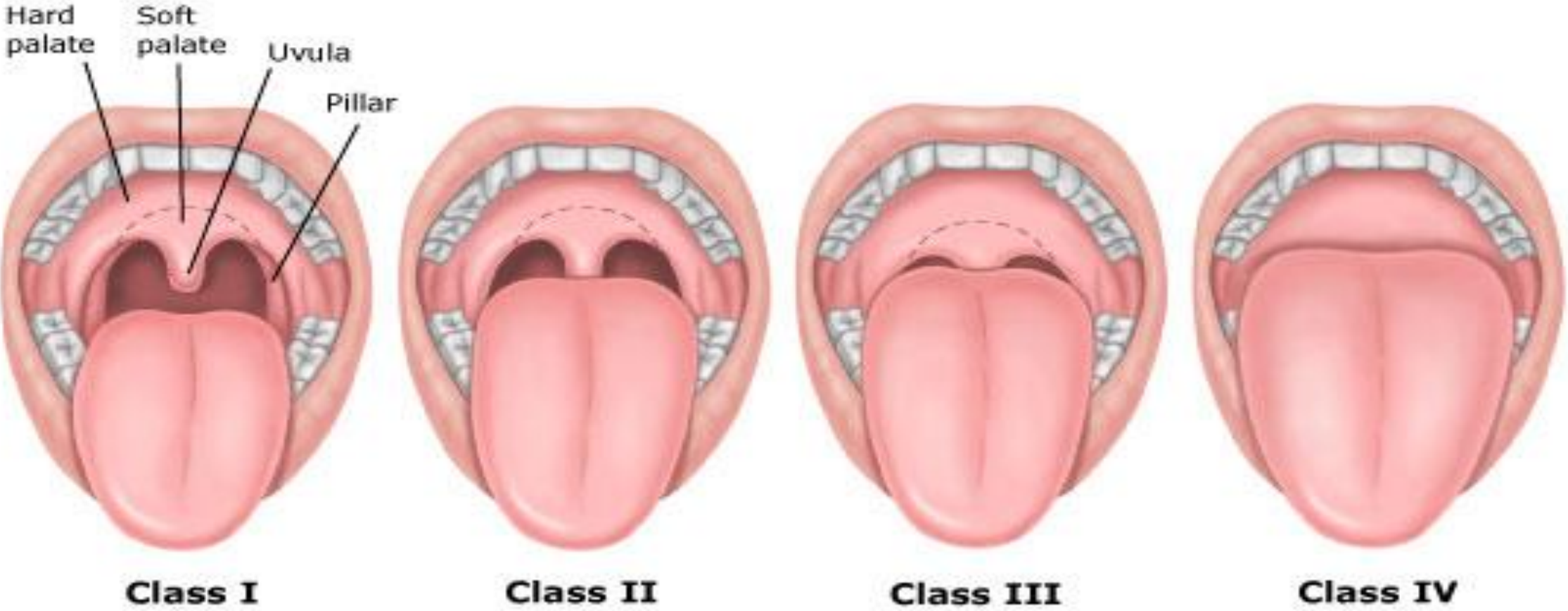
Screening Patients for SDB

DO NOT Write below this line

CLINICAL EXAM NOTES

Mallampati Score	1	2	3	4	Redundant pharyngeal tissue	Yes	No
Tonsil Grade	1	2	3	4	Tongue Size	Large	Normal Small
Tongue Level	1	2	3		Retrognathic mandible	Yes	No
Uvula Form		Large	Normal	Small			
Parafunctional signs		<input type="checkbox"/> Wear (Facets)	<input type="checkbox"/> Exostosis	<input type="checkbox"/> Abfractions	<input type="checkbox"/> Antigonial notching		

Malampati Classification



Class I



Class II



Class III



Class IV



Screening Patients for SDB

- **What not to do for screening**
- Do not use HSAT or oximetry to screen the general public

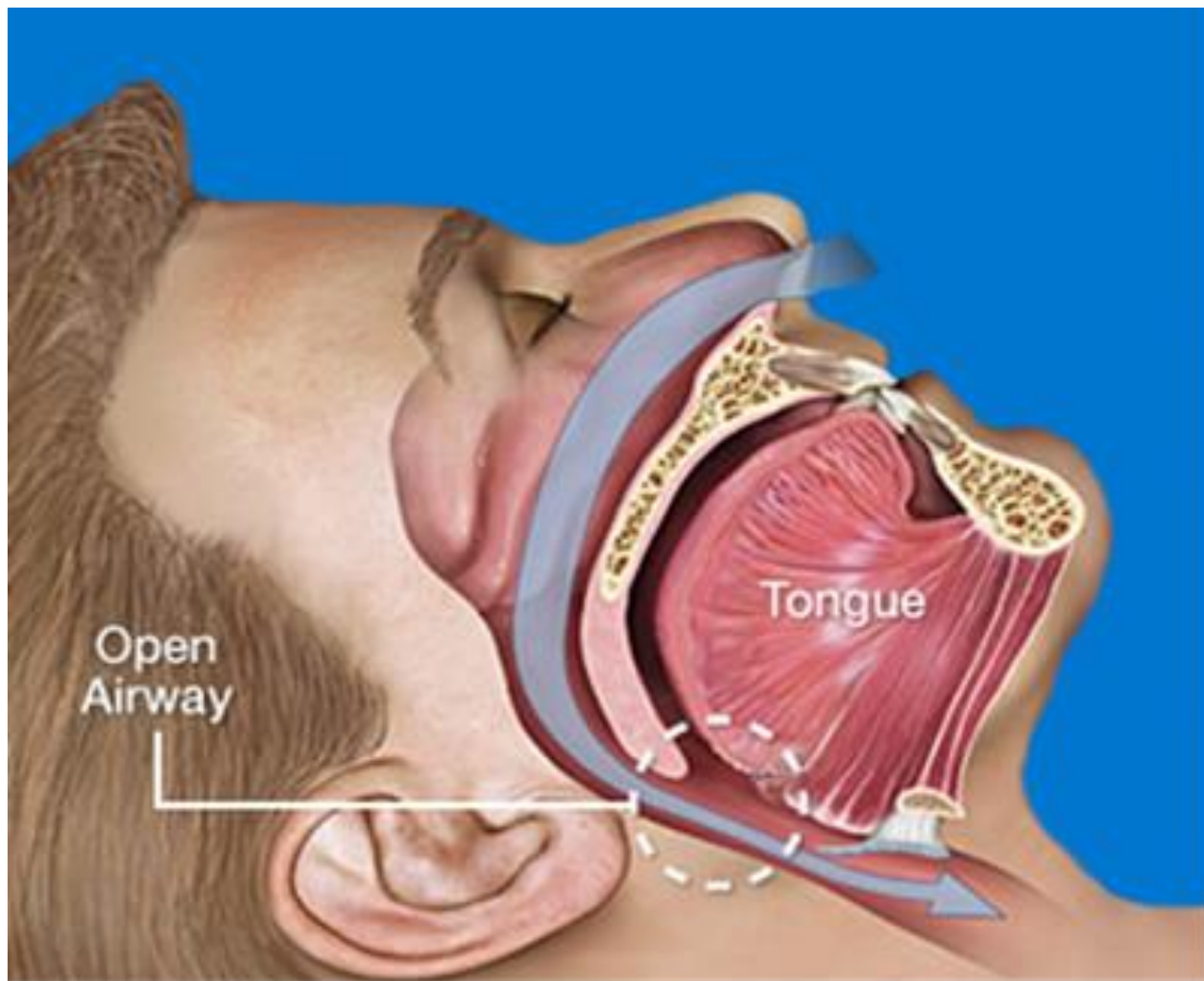
Screening Patients for SDB

JCSM
Journal of Clinical
Sleep Medicine

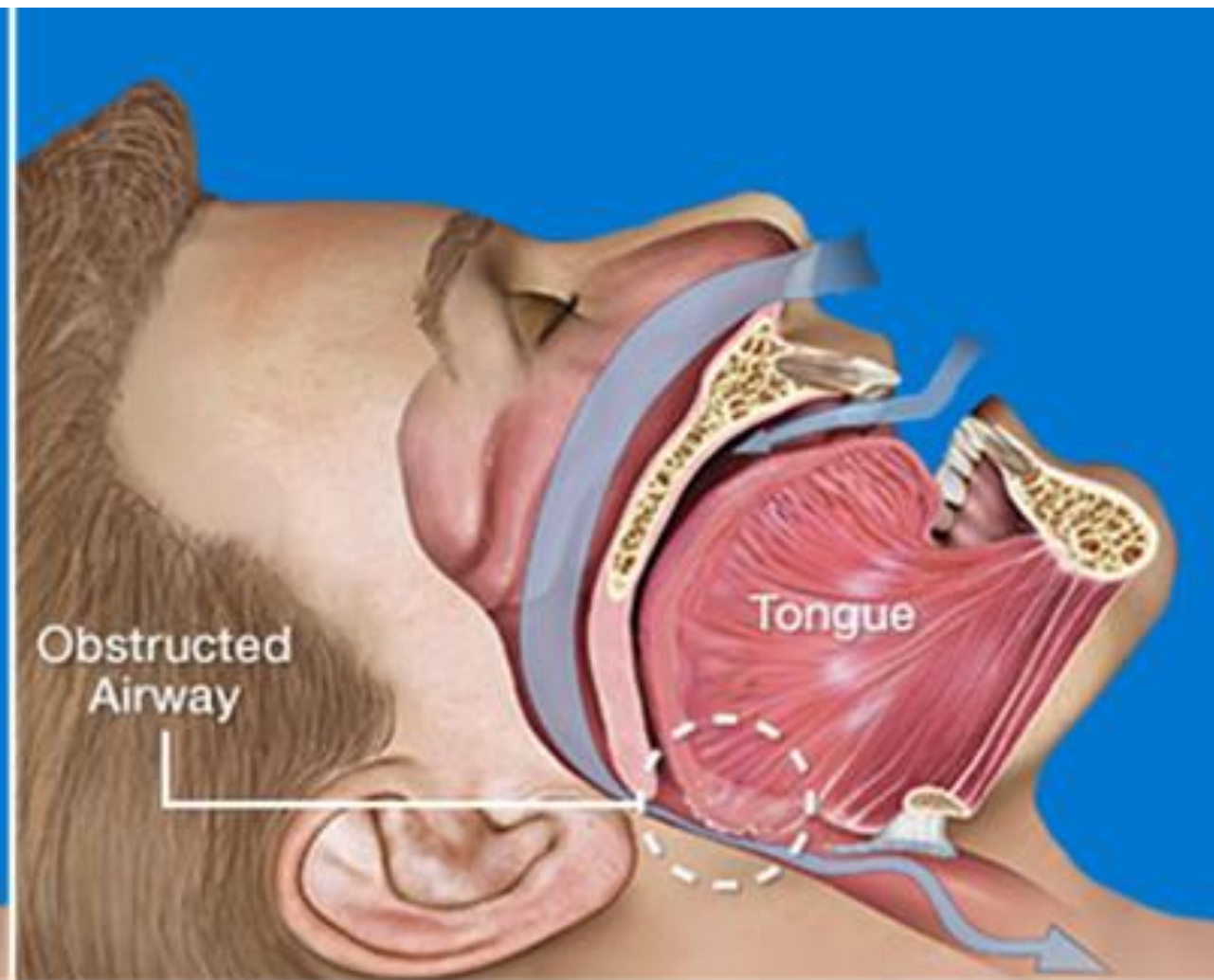
1.2. Provided that the recommendations of 1.1 have been satisfied, PM may be used as an alternative to polysomnography (PSG) for the diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA. PM should not be used in the patient groups described in 1.2.1, 1.2.2, and 1.2.3 (those with comorbidities, other sleep disorders, or for screening).

Center with board certification in sleep medicine or an individual who fulfills the eligibility criteria for the sleep medicine certification examination. PM may be used as an alternative to polysomnography (PSG) for the diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA. PM is not appropriate for the diagnosis of OSA in patients with significant comorbid medical conditions that may degrade the accuracy of PM. PM is not appropriate for the diagnostic evaluation of patients suspected of having comorbid sleep disorders. PM is not appropriate for general screening of asymptomatic populations. PM may be indicated for the diagnosis of OSA in patients for whom in-laboratory PSG is not possible by virtue of immobility, safety, or critical illness. PM may also be indicated to monitor the response to

qualified sleep technician/technologist. A board-certified sleep specialist, or an individual who fulfills the eligibility criteria for the sleep medicine certification examination, must review the raw data from PM using scoring criteria consistent with current published AASM standards. Under the conditions specified above, PM may be used for unattended studies in the patient's home. A follow-up visit to review test results should be performed for all patients undergoing PM. Negative or technically inadequate PM tests in patients with a high pretest probability of moderate to severe OSA should prompt in-laboratory polysomnography.
Keywords: Clinical guidelines, portable monitoring, home study, obstructive sleep apnea, comprehensive evaluation
Citation: Collop NA; Anderson WM; Boehlecke B; Claman D; Goldberg



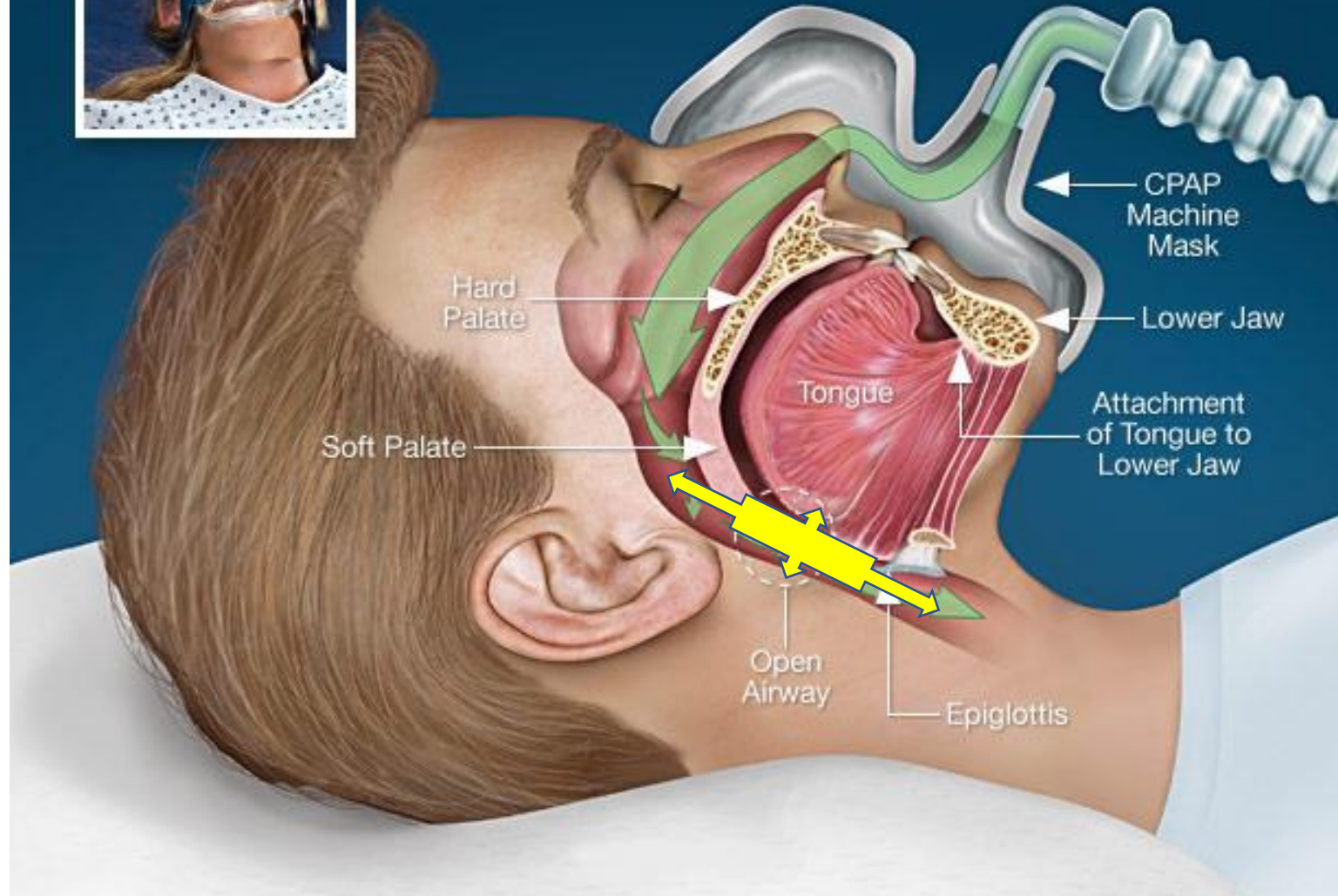
Non-Obstructed Airway



Obstructed Airway

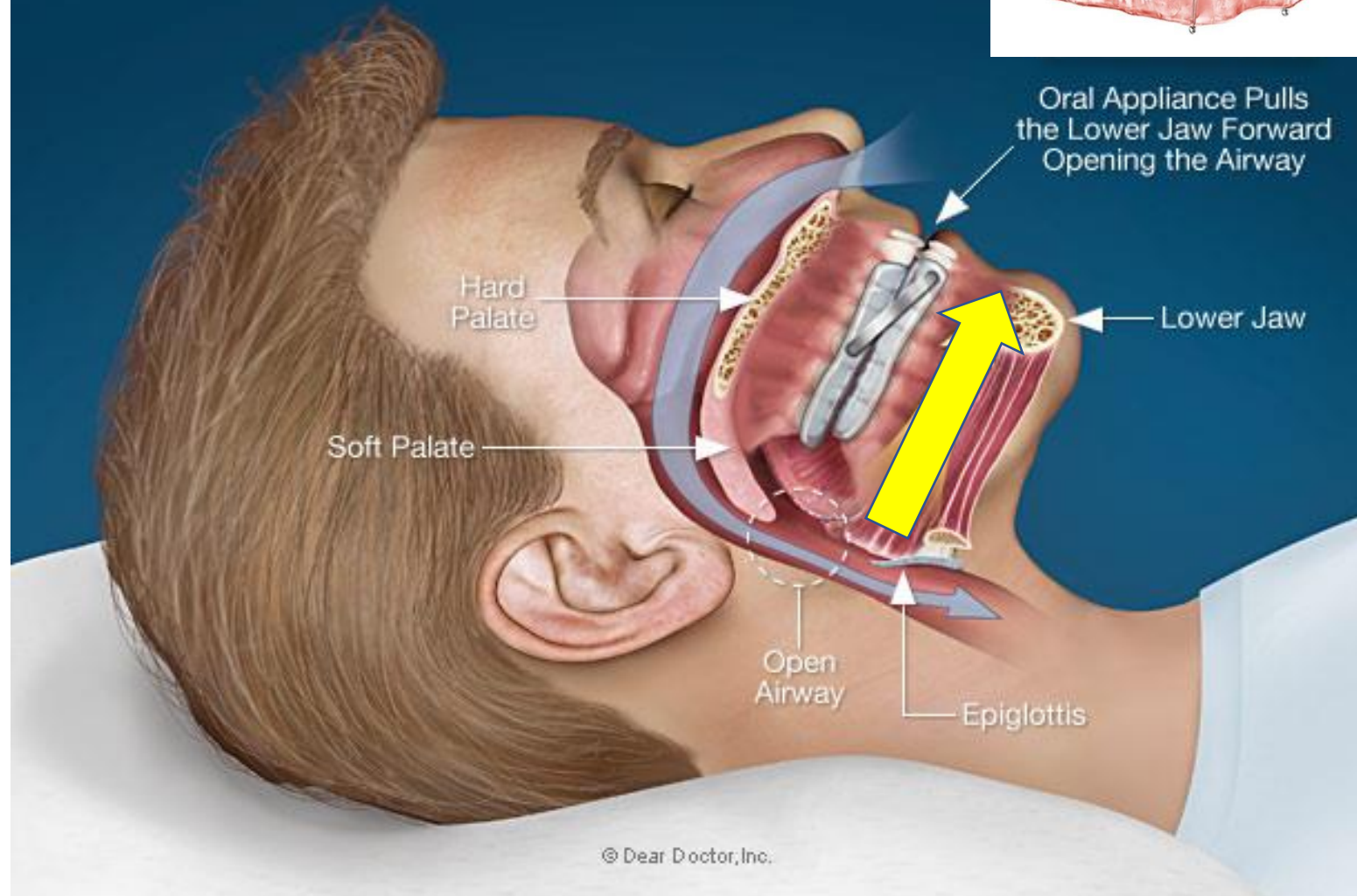
CPAP Therapy

A potential life saving and changing option for the treatment of sleep apnea.



Oral Appliance Therapy

The first and most comfortable option to CPAP for the treatment of obstructive sleep apnea.



CPAP vs. OAT

- CPAP – Continuous Positive Airway Pressure
 - BiPAP
 - AutoPAP
- OAT – Oral Appliance Therapy
 - Mandibular Advancement Appliances
 - Tongue Retaining Devices

CPAP Compliance

Only ~50% of patients use CPAP \geq 4 h per night after 6 months.¹⁴ The proportion of patients maintaining this minimally acceptable level of CPAP usage further drops to 17% after 5 years.

Weaver TE, Sawyer A. Management of obstructive sleep apnea by continuous positive airway pressure. *Oral Maxillofac Surg Clin North Am* 2009;21:403–12.

Oral Appliance Response

In general terms, over a third of patients will show a complete response to oral appliance therapy with a reduction in AHI to $< 5/h$ (or no OSA). Another third will have a clinically important response showing $> 50\%$ reduction in AHI, although AHI remains $> 5/h$ and a third will not achieve $> 50\%$ reduction in AHI.

Sutherland K, Vanderveken OM, Tsuda H, et al. Oral appliance treatment for obstructive sleep apnea: an update. *J Clin Sleep Med* 2014;10:215–27.

Oral appliance treatment of obstructive sleep apnea: an update

Andrew S.L. Chan^{a,b} and Peter A. Cistulli^{a,b}

^aCentre for Sleep Health and Research, Department of Respiratory Medicine, Royal North Shore Hospital, St Leonards and ^bWoolcock Institute of Medical Research, University of Sydney, New South Wales, Australia

Purpose of review

Oral appliances are an alternative to continuous positive airway pressure (CPAP) for the treatment of obstructive sleep apnea (OSA). Although CPAP is a highly efficacious treatment, recent work has focused on the following clinically relevant areas: the effect of device design on efficacy and patient compliance, the role of different modalities for assessing the upper airway in the prediction of treatment outcome, the assessment of the impact of treatment on a range of health outcomes and the evaluation of long-term adverse effects.

There has been an expansion of the research evidence to support the use of oral appliances in clinical practice. Recent work has focused on the following clinically relevant areas: the effect of device design on efficacy and patient compliance, the role of different modalities for assessing the upper airway in the prediction of treatment outcome, the assessment of the impact of treatment on a range of health outcomes and the evaluation of long-term adverse effects.

Introduction

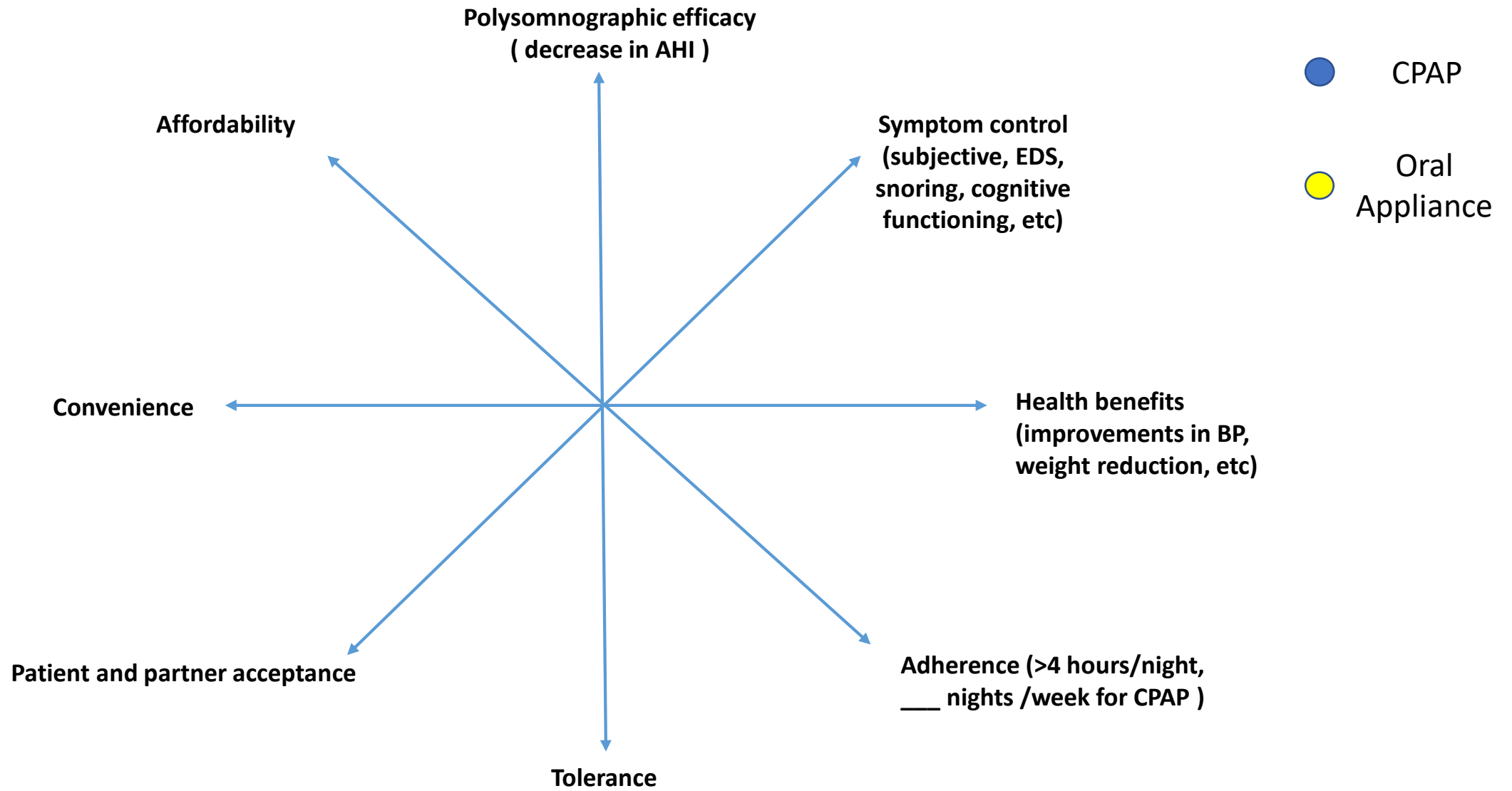
Oral appliances are an alternative to continuous positive airway pressure (CPAP) for the treatment of obstructive sleep apnea (OSA) [1]. Although CPAP is a highly efficacious treatment, there is a need for other treatment options because the clinical effectiveness of CPAP is often limited by poor patient acceptance and tolerance, and suboptimal compliance [2–4]. With increasing recognition of the role of craniofacial factors in the pathogenesis of OSA, there has been an expansion of the research evidence to support the use of oral appliances in clinical practice [5]. Mandibular advancement devices (MADs) are the most common class of oral appliance used for the treatment of OSA. They mechanically protrude the mandible with the aim of preventing collapse of the upper airway [1]. These devices are also known as mandibular advancement appliances, mandibular repositioning appliances or mandibular advancement splints. Tongue-retaining devices, the other main class of oral appliance used for the treatment of OSA, use a suction pressure to maintain the tongue in a protruded position during sleep [5]. Most research studies of oral appliance

treatment for OSA have focused on the use of MADs in adult patients, and this will be the focus of this review.

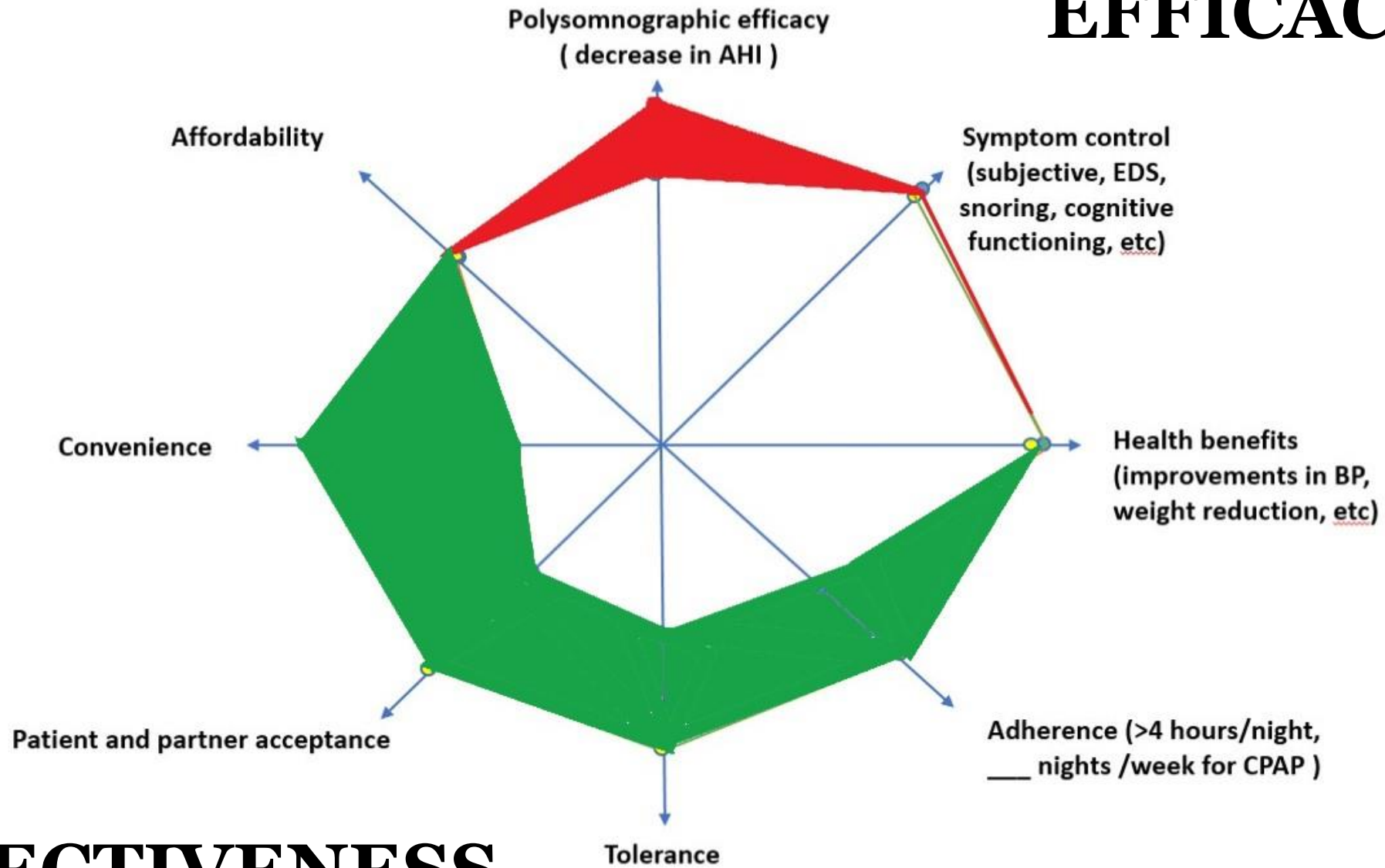
Clinical guidelines and clinical efficacy

In 2006, the American Academy of Sleep Medicine (AASM) updated its practice parameters for the treatment of OSA with oral appliances. In this update, the AASM stated that oral appliances are indicated for use in patients with mild-to-moderate OSA who prefer oral appliances to CPAP, who do not respond to CPAP, are not appropriate candidates for CPAP, or who fail treatment attempts with CPAP or treatment with behavioral measures such as weight loss or sleep position change. As CPAP is a more efficacious treatment, it is recommended that CPAP should be considered before oral appliances for patients with severe OSA [6], and in patients in whom urgent treatment is indicated to control severe symptoms (e.g. sleepiness while driving) or medical comorbidities. The accompanying evidence-based review of the literature [5] provided the basis of this revised recommendation, with randomized controlled studies, using an inactive acrylic dental plate as a placebo, confirming



Chan ASL, Cistulli PA. Oral appliance treatment of obstructive sleep apnea: an update. *Curr Opin Pulm Med*. 2009; 15:591-598.



EFFICACY



EFFECTIVENESS

Current evidence suggests that, despite the superior efficacy of CPAP, both treatments produce similar subjective and objective health benefits. The superior self-reported tolerance and compliance associated with MAD treatment is a likely explanation. Data comparing the costs of each treatment are scant. CPAP, continuous positive airway pressure; MAD, mandibular advancement devices.  CPAP; , MAD.

It only helps if you use it !

EFFICACY VERSUS EFFECTIVENESS IN OSA

OSA. Despite discrepancies in efficacy (apnea-hypopnea index [AHI] reduction) between CPAP and oral appliances, randomized trials show similar improvements in health outcomes between treatments, including sleepiness, quality of life, driving performance, and blood pressure. Similar results in terms of health outcomes suggests that although the two treatments have different efficacy and treatment usage profiles, these result in similar overall effectiveness. In this narrative review, we discuss efficacy versus effectiveness in relation to CPAP and oral appliance treatment of OSA.

KEYWORDS: obstructive sleep apnea, treatment effectiveness, efficacy, CPAP, oral appliances

CITATION: Sutherland K, Phillips CL, Cistulli PA. Efficacy versus effectiveness in the treatment of obstructive sleep apnea: CPAP and oral appliances. *Journal of Dental Sleep Medicine* 2015;2(4):175–181.

Efficacy and effectiveness are important concepts to distinguish when evaluating treatment performance. Treatment efficacy refers to how well an intervention works under ideal circumstances whereas, effectiveness is how well an intervention performs in the real world where conditions are not controlled. Therefore treatment effectiveness is particularly important in management of chronic disease. Obstructive sleep apnea (OSA) is a common sleep disorder characterized by repetitive upper airway obstruction leading to intermittent hypoxia and sleep fragmentation. There has been a dramatic increase in OSA prevalence over the last two decades, attributable to the obesity epidemic, with at least moderate OSA now evident in 17% of middle-aged men and 9% of middle-aged women.¹ OSA is associated with excessive daytime sleepiness and lower quality of life as well as increased risk of workplace and motor vehicle accidents, hypertension and cardiovascular disease, type 2 diabetes, and all-cause mortality.^{2–9} Therefore effective management of this chronic disorder is imperative to not only improve symptoms but to prevent long-term health risks. Standard care is the highly efficacious treatment, continuous positive airway pressure (CPAP). This therapy involves delivery of pressurized air to the upper airway during sleep via a nasal mask interface and tube connected to a pump. The pressurized air acts to splint open the upper airway preventing it from collapsing during sleep. The effectiveness of this therapy is therefore dependent upon its ability to overcome airway collapse (efficacy) as well as the time course over which a patient applies it during sleep (compliance). While the efficacy of CPAP is generally high, in the real world long-term health effects of CPAP are likely to be compromised by low compliance and suboptimal hours of treatment use. Treatment usage as a proportion of the total sleep period when a patient is vulnerable to OSA is often overlooked as a confounder of efficacy.

However, treatment usage compared to sleep time is an important aspect of real-world effectiveness. Importantly, treatment effectiveness warrants consideration when comparing effects of other OSA treatment options which may not have the same level of efficacy as CPAP but may have a better usage profile. In this review we discuss efficacy and effectiveness between first line OSA treatment CPAP and the leading alternative device treatment, oral appliances.

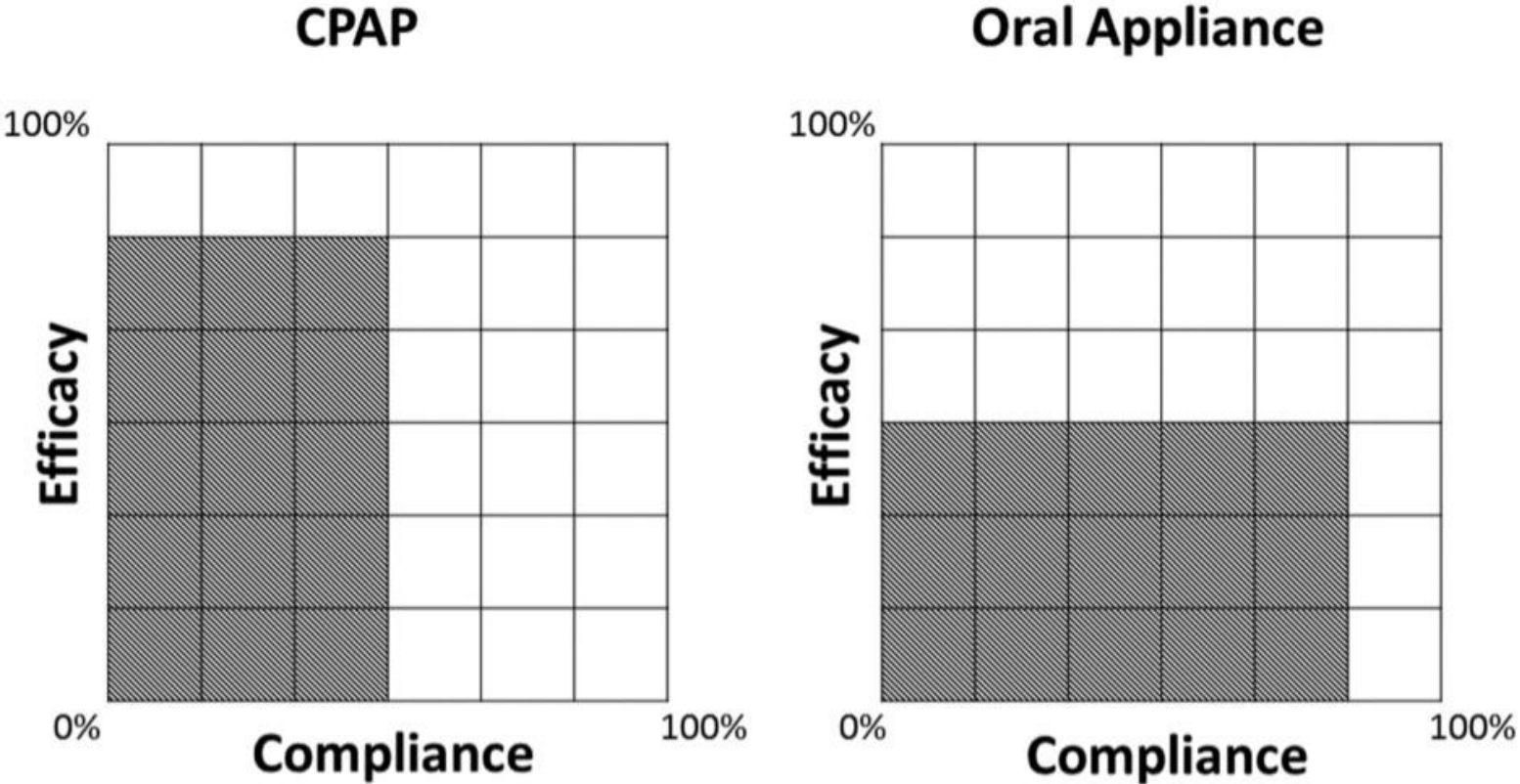
EFFICACY VERSUS EFFECTIVENESS IN OSA

Efficacy, in the context of OSA, reflects the ability of treatment to prevent the occurrence of obstructive breathing events during periods when the treatment is being physically applied. This is assessed by the number of obstructive breathing events *per hour of sleep* or apnea-hypopnea index (AHI). An AHI < 5 events/h indicates absence of disease or a completely efficacious treatment. In a fully compliant patient (using treatment for 100% of sleep time) efficacy measured as AHI on treatment (AHI_{treatment}) will give an accurate reflection of OSA treatment effectiveness. However sleep time off treatment becomes an important consideration when compliance is suboptimal. The potential impact of suboptimal CPAP compliance on AHI has been considered using formulas that adjust AHI_{treatment} for sleep time off treatment when AHI can presumably revert to untreated levels (AHI_{untreated}).^{10,11} When the untreated portion of the night with OSA reoccurrence is taken into consideration, CPAP effectiveness can dramatically decrease depending on OSA severity and total sleep time. Good CPAP adherence is generally set at a benchmark of 4 h/night; however, the rationale for this benchmark is not overly evidence based. Moreover when taking into consideration sleep time off treatment, 4 h of CPAP use during an 8-h sleep period may only reduce

Sutherland, K, Phillips, CL, Cistulli, PA, *Efficacy versus effectiveness in the treatment of obstructive sleep apnea: CPAP and oral appliances*. *Journal of Dental Sleep Medicine*. 2015; 2 (4) 175 – 181.

Figure 1—Comparison of treatment effectiveness profile of CPAP and oral appliances.

□ Sleep time vulnerable to disease ■ Effective treatment



Efficacy (y axis) reflects the ability of treatment to prevent obstructive breathing events when it is physically applied. Compliance (x axis) reflects the hours the treatment is applied for over the total sleep time when obstructive events can occur. “Effectiveness” requires both efficacy and compliance and the balance of these likely reflects over health outcomes. This schematic illustrates the scenario of an oral appliance which is only half as efficacious as CPAP but has two-fold greater compliance which results in equivalent effectiveness (shaded area).

Oral Appliance Treatment for Obstructive Sleep Apnea: An Update

Kate Sutherland, Ph.D.^{1,2}; Olivier M. Vanderveken, M.D., Ph.D.^{3,4}; Hiroko Tsuda, Ph.D.⁵;
Marie Marklund, Ph.D.⁶; Frederic Gagnadoux, M.D., Ph.D.^{7,8,9}; Clete A. Kushida, M.D., Ph.D., F.A.A.S.M.¹⁰;
Peter A. Cistulli, M.D., Ph.D.^{1,2}; on behalf of the ORANGE-Registry (Oral Appliance Network on Global Effectiveness)

¹Centre for Sleep Health and Research, Department of Respiratory Medicine, Royal North Shore Hospital, St Leonards, Sydney, NSW, Australia; ²NHMRC Centre for Integrated Research and Understanding of Sleep (CIRUS), University of Sydney and Woolcock Institute of Medical Research, Sydney, Australia; ³Department of Otolaryngology and Head and Neck Surgery, Antwerp University

Head-to-head trials confirm CPAP is superior in reducing OSA parameters on polysomnography, however, this greater efficacy does not necessarily translate into better health outcomes in clinical practice.

Obstructive sleep apnea (OSA) is a common sleep disorder characterized by recurring collapse of the upper airway during sleep, resulting in sleep fragmentation and oxygen desaturation. OSA is defined as the occurrence of 5 or more episodes of complete (apnea) or partial (hypopnea) upper airway obstruction per hour of sleep (apnea-hypopnea index [AHI]) and is estimated to occur in around 24% of middle-aged men and 9% of women.¹ Daytime symptoms such as sleepiness, cognitive impairment, and effects on quality of life

Oral appliances (OA) are designed to improve upper airway configuration and prevent collapse through alteration of jaw and tongue position. The most common mechanism of action is to hold the lower jaw in a more anterior position (OA_m). These appliances are variously termed “mandibular advancement devices (MAD),” “mandibular advancement splints (MAS),” or mandibular repositioning appliances (MRA).” Imaging studies show that mandibular advancement with OA_m enlarges the upper airway space, most notably in the lateral

Sutherland K, Vanderveken OM, Tsuda H, et al. Oral appliance treatment for obstructive sleep apnea: an update. *J Clin Sleep Med* 2014;10:215–27.



CLINICAL REVIEW

Meta-analysis of randomised controlled trials of oral mandibular



Both MAD and CPAP are clinically effective in the treatment of OSAH. Although CPAP has a greater treatment effect, MAD is an appropriate treatment for patients who are intolerant of CPAP and may be comparable to CPAP in mild disease.

repeated interruption of breathing during sleep due to episodic collapse of the pharyngeal airway. These episodes usually cause oxygen desaturation and are terminated by micro-arousals from sleep. This sleep disruption commonly causes excessive daytime sleepiness (EDS) [1].

Published studies suggest that OSAH affects 2%–7% of the adult population [2]. It becomes more prevalent in middle age and males have approximately double the risk of developing the condition [3]. The main modifiable risk factor for OSAH is obesity, particularly

have also been associated with OSAH [2,4].

The sequelae of OSAH can be serious. There is a causal link with hypertension [5]. A recent meta-analysis estimated the risk of cardiovascular disease (CVD) to be 2.5 times higher in patients with moderate-severe OSAH [6]. This association is supported by biologically plausible mechanisms. Intermittent hypoxia, micro-arousals and excessive negative intrathoracic pressure swings may all play a role, mediated via sympathetic activation, oxidative stress and inflammation, as well as through direct cardiac effects [7]. There is also evidence for improvement in cardiovascular outcomes when OSA is treated. While the case is strongest for hypertension, there may be other cardiovascular benefits, although conclusive evidence is still needed. There are other consequences of OSAH.

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Oral Appliance Versus Continuous Positive Airway Pressure in Obstructive Sleep Apnea Syndrome: A 2-Year Follow-up

Michiel H. J. Doff, PhD¹; Aarnoud Hoekema, PhD¹; Peter J. Wijkstra, PhD²; Johannes H. van der Hoeven, PhD²; James J. R. Huddleston Slater, PhD¹; Lambert G. M. de Bont, PhD¹; Boudewijn Stegenga, PhD¹

¹Department of Oral and Maxillofacial Surgery, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands;

²Department of Home Mechanical Ventilation, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands;

³Department of Clinical Neurophysiology, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands

Study Objectives: Oral appliance therapy has emerged as an important alternative to continuous positive airway pressure (CPAP) in treating patients with obstructive sleep apnea syndrome (OSAS). In this study we report about the subjective and objective treatment outcome of oral appliance therapy and CPAP in patients with OSAS.

Design: Cohort study of a previously conducted randomized clinical trial.

Setting: University Medical Center, Groningen, The Netherlands.

Patients or Participants: One hundred three patients with OSAS.

Interventions: CPAP and oral appliance therapy (Thornton Adjustable Positioner type-1, Airway Management, Inc., Dallas, TX, USA)

Measurements and Results: Objective (polysomnography) and subjective (Epworth Sleepiness Scale, Functional Outcomes of Sleep Questionnaire, Medical Outcomes Study 36-item Short Form Health Survey [SF-36]) parameters were assessed after 1 and 2 years of treatment. Treatment was considered successful when the apnea-hypopnea index (AHI) was < 5 or showed substantial reduction, defined as reduction in the index of at least 50% from the baseline value to a value of < 20 in a patient without OSAS symptoms while undergoing therapy.

Regarding the proportions of successful treatments, no significant difference was found between oral appliance therapy and CPAP in treating mild to severe OSAS in a 2-year follow-up. More patients (not significant) dropped out under oral appliance therapy (47%) compared with CPAP (33%). Both therapies showed substantial improvements in polysomnographic and neurobehavioral outcomes. However, CPAP was more effective in lowering the AHI and showed higher oxyhemoglobin saturation levels compared to oral appliance therapy ($P < 0.05$).

Conclusions: Oral appliance therapy should be considered as a viable treatment alternative to continuous positive airway pressure (CPAP) in patients with mild to moderate obstructive sleep apnea syndrome (OSAS). In patients with severe OSAS, CPAP remains the treatment of first choice.

Clinical Trial Information: The original randomized clinical trial, of which this study is a 2-year follow-up, is registered at ISRCTN.org; identifier: ISRCTN18174167; trial name: Management of the obstructive sleep apnea-hypopnea syndrome: oral appliance versus continuous positive airway pressure therapy; URL: <http://www.controlled-trials.com/ISRCTN18174167>.

Keywords: Continuous positive airway pressure, obstructive sleep apnea syndrome, oral appliances, treatment outcome

Citation: Doff MHJ; Hoekema A; Wijkstra PJ; van der Hoven JH; Slater JJRH; de Bont LGM; Stegenga B. Oral appliance versus continuous positive airway pressure in obstructive sleep apnea syndrome: a 2-year follow-up. *SLEEP* 2013;36(9):1289-1296.

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is a sleep related breathing disorder characterized by snoring and repetitive pharyngeal collapse.¹ It is associated with excessive daytime sleepiness, a decreased quality of life, increased cardiovascular morbidity, and a higher risk of traffic accidents.^{2,3} The standard treatment, i.e., continuous positive airway pressure (CPAP), reduces upper airway obstructions and improves quality of life.⁴ However, because of the cumbersome nature of CPAP, patients often have difficulty adhering to or may even abandon treatment. Oral appliance therapy has been shown to be superior to CPAP regarding treatment success in patients with mild to moderate OSAS in

the short term.⁵ Furthermore, many patients prefer oral appliance therapy to CPAP.⁶ Long-term outcomes of oral appliance therapy have been described in a few studies.⁷⁻¹¹ In four studies, respiratory parameters deteriorated in some patients during the follow-up period, even in patients who were treated successfully at short-term follow-up.^{7,8,10,11} Some studies have been restricted to those patients with mild and moderate OSAS or included patients who had already undergone surgical treatment of OSAS. To our knowledge, no published parallel study has evaluated the 2-y outcome of oral appliance versus CPAP therapy in previously untreated patients with mild to severe OSAS.

The primary aim of this parallel cohort study was to evaluate the 2-y objective and subjective outcome of oral appliance and CPAP therapy in patients with OSAS, representing the entire spectrum of the disorder and to gain more insight into the specific indications for both treatments. In this study we report on the 2-y follow-up of a cohort of a previously conducted randomized controlled trial (RCT).⁵

METHODS

Patients and Study Protocol

After assessing 228 patients with OSAS, 103 participants were recruited (between September 2002 and August 2005) for the

A commentary on this article appears in this issue on page 1271.

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Oral Appliance Versus Continuous Positive Airway Pressure in Obstructive Sleep Apnea Syndrome: A 2-Year Follow-up

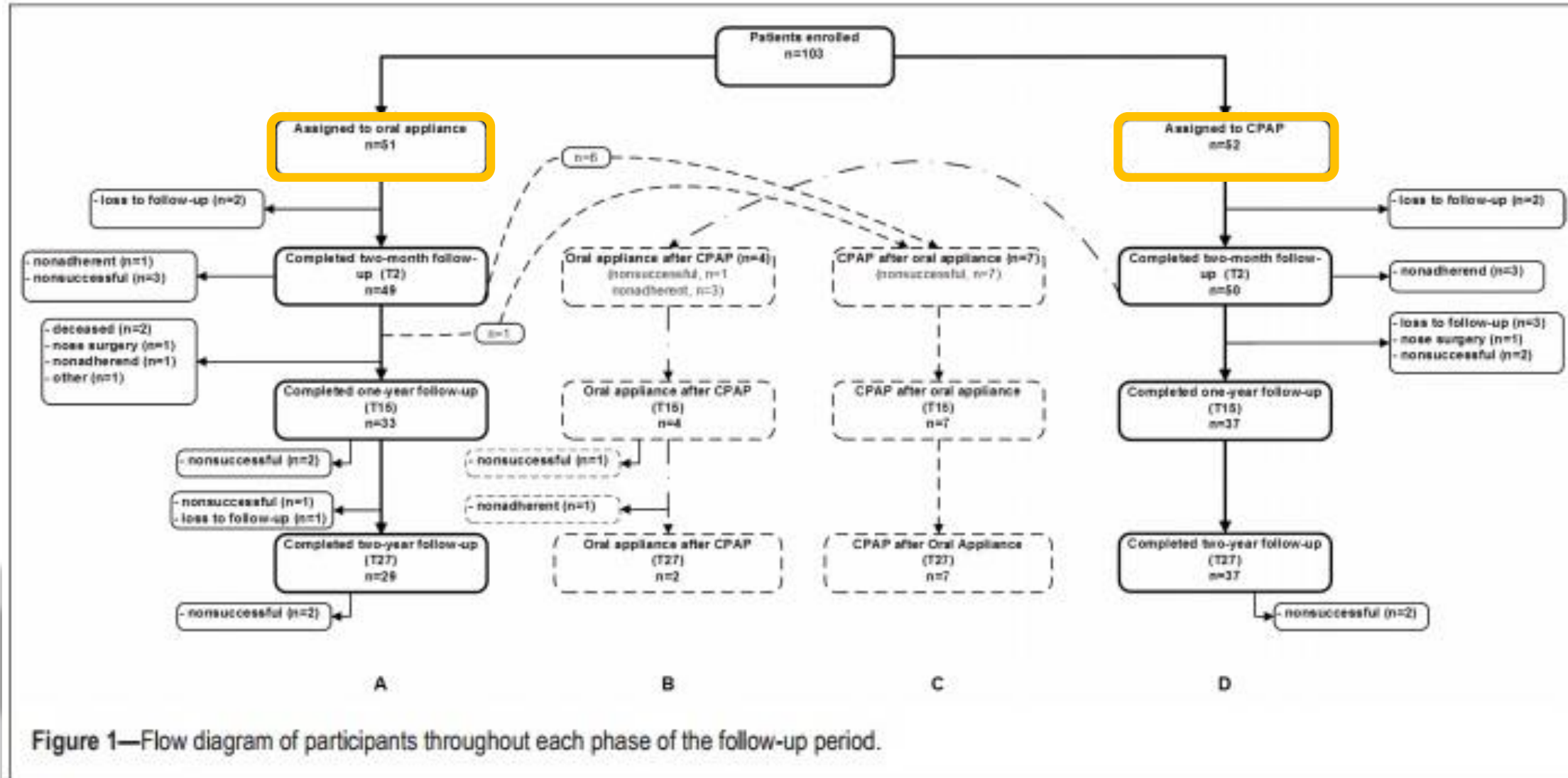
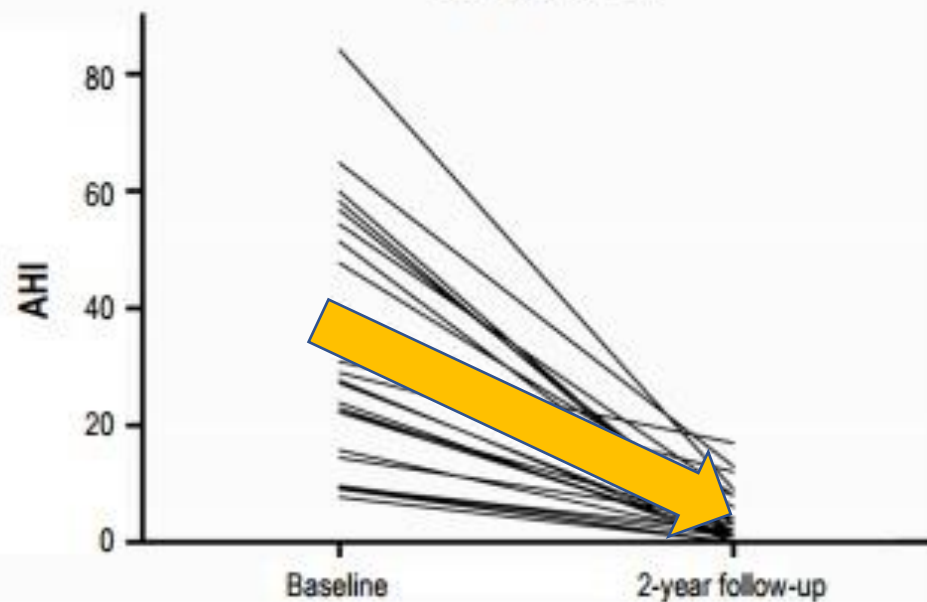


Figure 1—Flow diagram of participants throughout each phase of the follow-up period.

Oral Appliance Versus Continuous Positive Airway Pressure in Obstructive Sleep Apnea Syndrome: A 2-Year Follow-up

Michiel H. J. Doff, PhD¹; Arnoud Hoekema, PhD¹; Peter J. Wijkstra, PhD²; Johannes H. van der Hoeven, PhD³; James J. R. Huddlestone Slater, PhD⁴;
 1. Department of Oral and Maxillofacial Surgery, University Medical Center Groningen, Groningen, The Netherlands; 2. Department of Otolaryngology, University Medical Center Groningen, Groningen, The Netherlands; 3. Department of Pulmonology, University Medical Center Groningen, Groningen, The Netherlands; 4. Department of Sleep Medicine, University Medical Center Groningen, Groningen, The Netherlands

Oral Appliance



CPAP

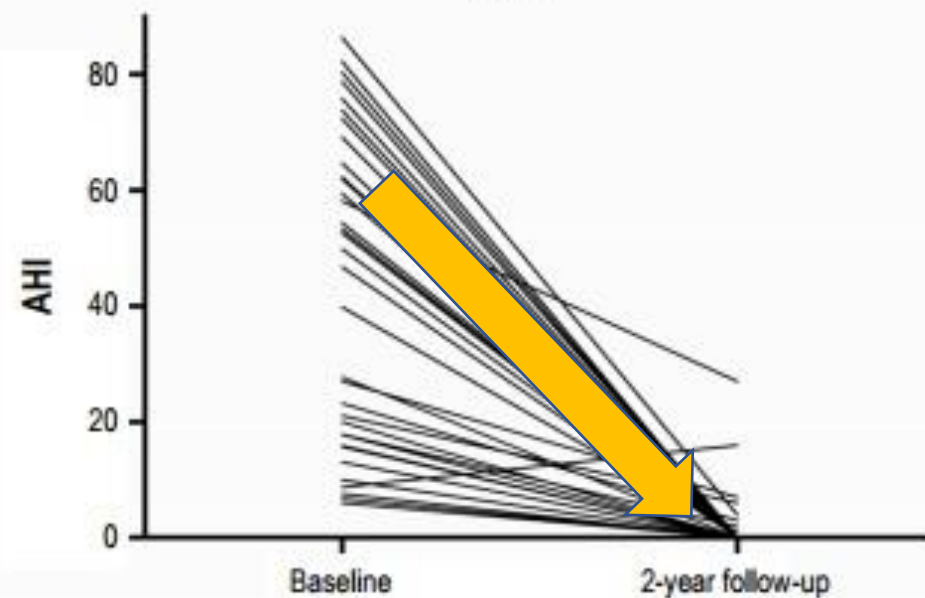


Figure 2—Individual values of the apnea-hypopnea index (AHI) of the patients who completed the entire follow-up in the randomized treatment group. CPAP, continuous positive airway pressure.

Submitted in final revised form February, 2013

Accepted for publication February, 2013

Address correspondence to: Michiel H. J. Doff, DMD, PhD, BEng, Department of Oral and Maxillofacial Surgery, University Medical Center Groningen, University of Groningen, Hanzeplein 1, PO Box 30.001, 9700 RB, Groningen, The Netherlands; Tel: +3150 3613840; Fax: +3150 3611136; E-mail: m.h.j.doff@umcg.nl

SLEEP, Vol. 36, No. 9, 2013

CONTROLLED TRIAL (RCT)

METHODS

Patients and Study Protocol

After assessing 228 patients with OSAS, 103 participants were recruited (between September 2002 and August 2005) for the

In conclusion, regarding the percentage of successful treatments, no significant differences were found between oral appliance therapy and CPAP in treating mild to severe OSAS in a 2-y follow-up. However, CPAP was more effective in lowering the AHI and showed higher oxyhemoglobin saturation levels compared with oral appliance therapy. Furthermore, CPAP proved to be more successful in patients with severe OSAS. However, even in a 2-y follow-up, oral appliance therapy seems to be a viable alternative to CPAP in the treatment of mild and moderate OSAS. Oral appliances may be considered as a long-term alternative in patients with severe OSAS who do not respond to CPAP or in whom treatment attempts with CPAP fail. Further research with larger groups of patients is needed to investigate which patients with severe OSAS can be treated successfully with an oral appliance.

Long-Term Effectiveness of Oral Appliance versus CPAP Therapy and the Emerging Importance of Understanding Patient Preferences

Commentary on Doff et al. Oral appliance versus continuous positive airway pressure in obstructive sleep apnea syndrome: a 2-year follow-up. *SLEEP* 2013;36:1289-1296.

Fernanda R. Almeida, DDS, MSc, PhD¹; Nick Bansback, PhD²

¹Faculty of Dentistry, University of British Columbia, Vancouver, BC, Canada; ²School of Population and Public Health, University of British Columbia, Vancouver, BC, Canada

The two most common therapies used to treat obstructive sleep apnea (OSA) are: (1) continuous positive airway pressure (CPAP), and (2) mandibular advancement splints (MAS), which are the most commonly used oral appliance. These therapies differ in efficacy, cost, comfort, and side effects. Physicians typically select CPAP as the primary treatment since it is the most effective option in reducing the apnea-hypopnea index (AHI). For patients who consider the benefits worth the negatives and become adherent users of CPAP, this is the most appropriate course of action. However, the remaining 30% to 50% of patients for whom the discomfort, noise, and other negatives outweigh benefits become non-adherent to CPAP. Untreated OSA is asso-

with severe OSA when compared to CPAP.⁶ There are various trials showing that despite the presence of residual apneas and the inferior efficacy of MAS compared to CPAP in the reduction of AHI, MAS presents similar health outcomes as presented with surrogates to cardiovascular disease such as blood pressure,^{7,8} endothelial function,⁹ and microvascular reactivity.¹⁰

They hypothesize that this is because the suboptimal efficacy with MAS therapy is counterbalanced by the superior adherence relative to CPAP, resulting in similar effectiveness of both treatments. Phillips and collaborators compared CPAP to MAS in a large randomized, controlled, crossover trial of moderate to severe OSA patients over a 3-month trial period.¹¹ This study

Despite the inferior efficacy of MAS compared to CPAP in the reduction of AHI, MAS present similar health outcomes related to cardiovascular disease such as BP reduction, endothelial function and microvascular reactivity.

They hypothesize that this is because the suboptimal efficacy with MAS therapy is counterbalanced by the superior adherence relative to CPAP, resulting in similar effectiveness of both treatments.

any statistical difference between the treatments in terms of Epworth Sleepiness Scale, FOSQ-score, and the SF-36. In fact, the only difference identified between treatments was in the AHI and the lowest oxyhemoglobin saturation.

The findings of the trial by Doff et al.⁵ build on an emerging evidence base. For example, a recent non-concurrent cohort study confirmed this finding, where the authors followed 208 control subjects compared to 254 severe OSA; 177 patients were treated with CPAP and 72 with MAS over a mean period

contraindication for MAS therapy. Another limitation of study⁷ is lack of an objective assessment to measure adherence with MAS therapy. Vanderveken and collaborators¹³ evaluated a recently developed micro-sensor in 51 patients over a period of 3 months, and their results illustrated the safety and feasibility of objective measurement of MAS adherence.

If the emerging evidence suggests MAS is an effective alternative therapy for OSA, the next question is how and when to determine if a patient should receive CPAP or MAS? Conven-

A Randomized Crossover Study of an Oral Appliance vs Nasal-Continuous Positive Airway Pressure in the Treatment of Mild-Moderate Obstructive Sleep Apnea*

Kathleen A. Ferguson, BSc, MD, FCCP; Takashi Ono, DDS, PhD; Alan A. Lowe, DMD, PhD; Sean P. Keenan, MD; and John A. Fleetham, MD

Study objective: To compare efficacy, side effects, patient compliance, and preferences between oral appliance (OA) therapy and nasal-continuous positive airway pressure (N-CPAP) in the treatment of mild-moderate obstructive sleep apnea (OSA).
Design: Randomized, prospective, crossover study.
Setting: University hospital and tertiary sleep referral center.
Patients: Twenty-seven unselected patients with mild-moderate OSA.
Interventions: There was a 2-week wash-in and a 2-week wash-out period (OA and N-CPAP). Efficacy, side effects, compliance, and patient preferences were assessed using a questionnaire and home sleep monitoring.
Measurements and results: Two patients dropped out early in the study. The mean apnea/hypopnea index (AHI) was significantly lower with N-CPAP (3.5 ± 1.6) (mean ± SD) than with the OA (9.7 ± 7.3) (p < 0.05). Treatment success (reduction of AHI to < 5) was achieved in 48% of patients with N-CPAP and 24% with the OA. Compliance failures (unable or unwilling to use the device) were more common with N-CPAP (62%) than with the OA (24%). Side effects were more common with N-CPAP (p < 0.005). Seven patients were treatment successes with N-CPAP and preferred OA, and one preferred N-CPAP as a long-term treatment. We conclude that OA is an effective treatment in mild-moderate OSA and is associated with fewer side effects and greater patient compliance.

Key words: nasal CPAP; obstructive sleep apnea; oral appliances

Abbreviations: AHI=apnea/hypopnea index; EMG=electromyogram; N-CPAP=nasal-continuous positive airway pressure; OA=oral appliance; OSA=obstructive sleep apnea; SaO₂=arterial oxygen saturation

Obstructive sleep apnea (OSA) is a common disorder that may affect at least 2 to 4% of the adult

For editorial comment see page 1140.

population.¹ The treatment of OSA depends on the

*From the Division of Respiratory Medicine and Department of Clinical Dental Sciences, University of British Columbia, Vancouver, BC.

Supported by a British Columbia Lung Association Research Grant. Nasal CPAP machines were provided by Resipronics Inc, Murfreesville, Pa (REMstar Choice) and ARS VitalAire, Vancouver, BC (Healthdyne Tranquility Plus).

Manuscript received May 25, 1995; revision accepted December 6. Reprint requests: Dr. Fleetham, Respiratory Division, 2775 Heather Street, Vancouver, BC, Canada, V5Z 3J5

severity of symptoms, and reduction of obstructive symptoms may be required. N-CPAP is the gold standard treatment for OSA. Reported long-term use of N-CPAP in patients with OSA is 50 to 80%, and less symptomatic patients are more likely to discontinue treatment. However, even among patients who report regular use of the treatment, covert monitoring has

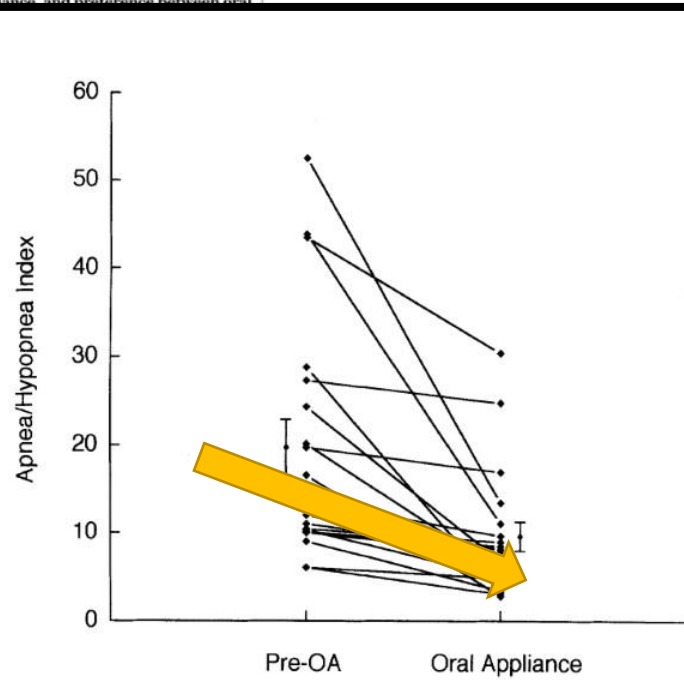


FIGURE 2. AHI with and without the OA (mean ± SE).

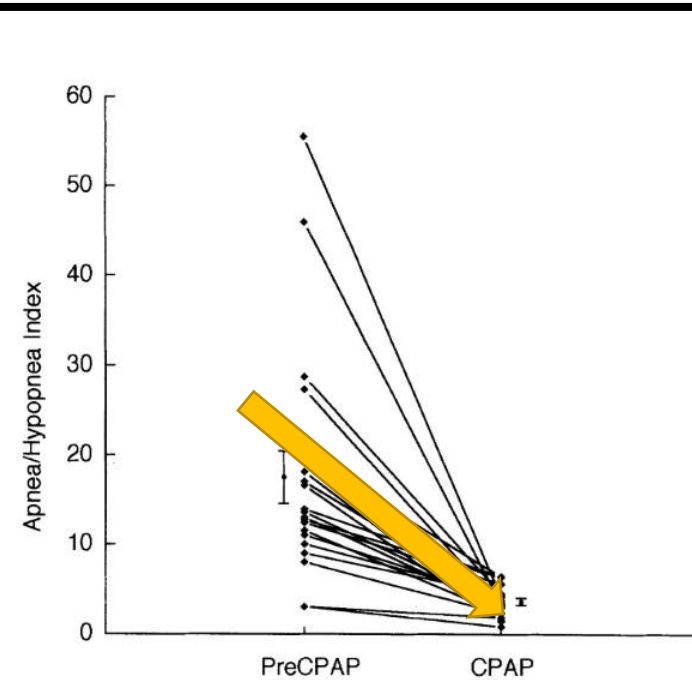
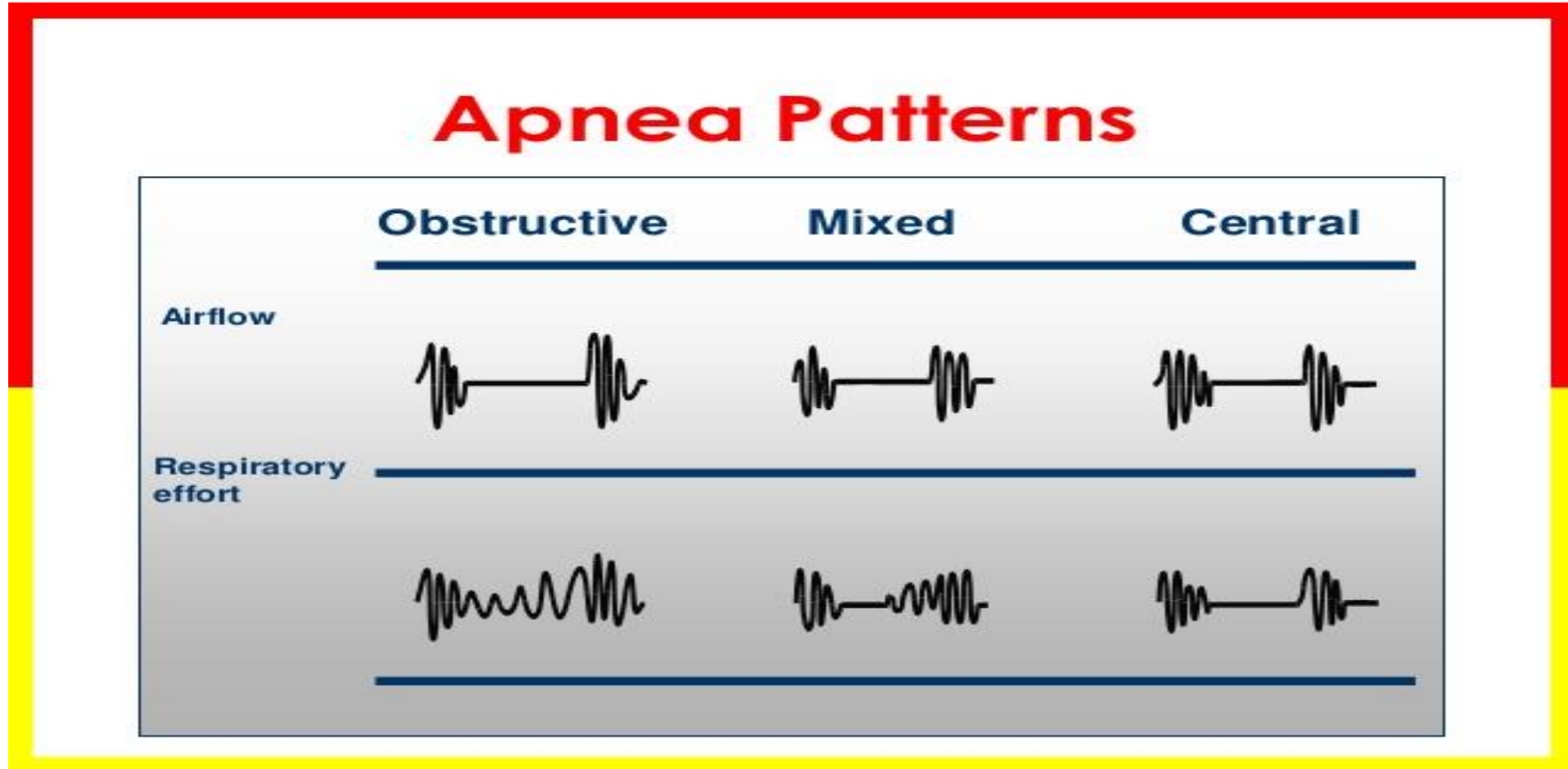


FIGURE 3. AHI with and without N-CPAP (mean ± SE).

Obstructive Apnea vs. Central Apnea



OSA – Increased Risk Of

- **High blood pressure**
- **Heart failure**
- **Heart rhythm disturbances**
- **Atherosclerotic heart disease**
- **Sudden heart attack (MI)**
- **Pulmonary hypertension**
- **Insulin resistance (diabetes)**
- **Memory and cognitive problems**
- **Depression**
- **Anxiety**
- **Gastroesophageal reflux disease (GERD)**
- **Stroke**

Heart Disease in the United States

610,000 die per year

325,000 sudden cardiac death

735,000 heart attacks per year

1 cause of death in the U.S.

Heart Disease: Know the Facts



Did you know ...



Heart disease and stroke are responsible for one in every three deaths in the U.S.

Cardiac arrest is the number one cause of death.

#1

Heart attack warning signs include:



Every 3  seconds

someone dies from heart disease or stroke



The best chance for victims of cardiac arrest, heart attack or stroke is to call 911 immediately, as soon as you see the signs.



The faster you call, the faster help can arrive.

Obstructive Sleep Apnea

Night symptoms

- **Snoring**
- **Gasping**
- **Awakening with gasping**
- **Frequent awakenings**
- **Night sweats**
- **Fragmented, unrefreshing sleep**
- **Insomnia symptoms**
- **Sleep related bruxism**

Day symptoms

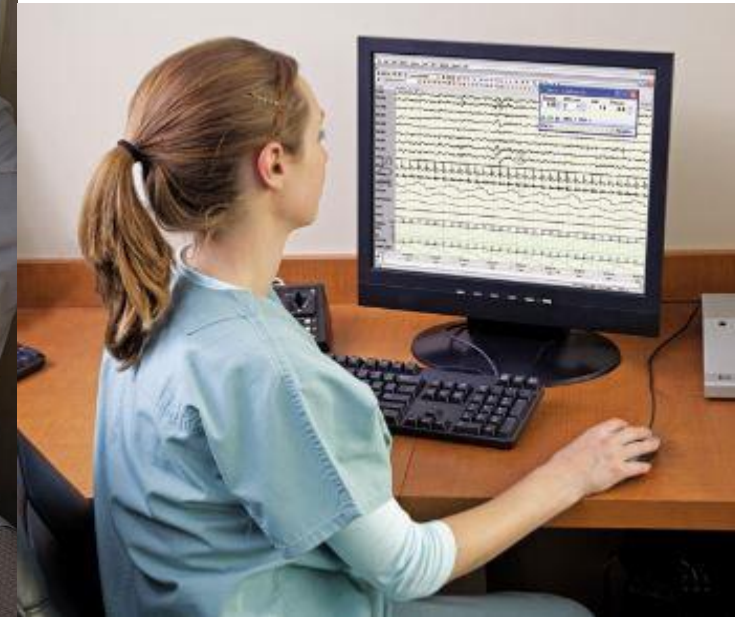
- **Excessive daytime sleepiness**
- **Unrefreshing sleep**
- **Poor memory**
- **Poor concentration**
- **Fatigue**
- **Morning headaches**
- **Impotence, decreased sex drive**
- **Depression**

Dentistry is in a unique position to discover patients with SDB

- We see more health conscious patients**
- We tend to see them once if not twice a year**
- We can directly view the oral airway and the oral manifestations of OSA**
- We can more directly question patients to screen for SDB**

OSA Diagnosis

- Refer for EVALUATION



PSG vs. HSAT

Important point about HSAT:

You can not RULE OUT sleep apnea with an HSAT



© Colin Archer/The Average Angler/2012



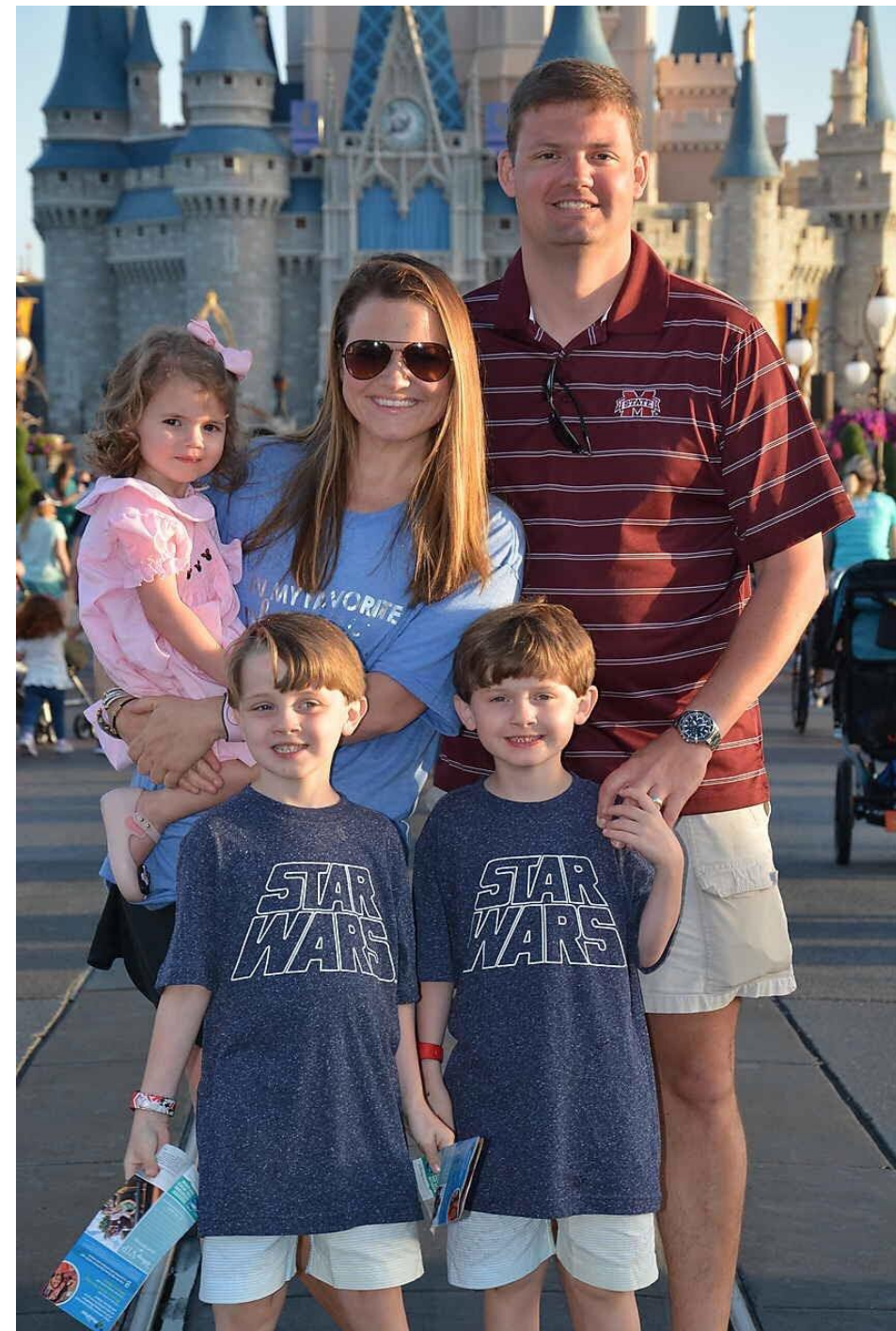
Sleep Apnea in Children

- **Snoring**
- **Hyperactivity**
- **Developmental delay**
- **Poor concentration**
- **Nocturnal Enuresis**
- **Obesity**
- **Large tonsils**
- **Headaches**
- **Night terrors**
- **Nightmares**

Sleep Apnea in Children

- Children are not supposed to snore
- Large percentage of children with OSA improve after adenotonsillectomy
- This is true even with smaller tonsils
- Enlarged adenoids cause mouthbreathing

Bo



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Sleep Apnea in Children

Obstructive Sleep Apnea in Children

JAMES CHAN, M.D., Cleveland Clinic Foundation, Cleveland, Ohio
JENNIFER C. EDMAN, M.D., Fairview Hospital, Cleveland, Ohio
PETER J. KOLTAI, M.D., Cleveland Clinic Foundation, Cleveland, Ohio

Obstructive sleep-disordered breathing is common in children. From 3 percent to 12 percent of children snore, while obstructive sleep apnea syndrome affects 1 percent to 10 percent of children. The majority of these children have mild symptoms, and many outgrow the condition. Consequences of untreated obstructive sleep apnea include failure to thrive, enuresis, attention-deficit disorder, behavior problems, poor academic performance, and cardiopulmonary disease. The most common etiology of obstructive sleep apnea is adenotonsillar hypertrophy. Clinical diagnosis of obstructive sleep apnea is reliable; however, the gold standard evaluation is overnight polysomnography. Treatment includes the use of continuous positive airway pressure and weight loss in obese children. These

A patient information handout on sleep apnea in children, written by the authors of this article, is provided on page 1159.

Snoring is associated with higher levels of inattention and hyperactivity.

81% of snoring children with ADHD could have their ADHD eliminated if their habitual snoring were effectively treated.

Sleep 20(12): 1185-1192

Children with ADHD are 2 ½ times more likely to be bed wetters (enuresis).

South Med J, 1997 May; 90(5):503-5.

The majority of these children have mild symptoms, and many outgrow the condition. OSA often results from adenotonsillar hypertrophy, neuromuscular disease, and craniofacial abnormalities.

hypertrophy, neuromuscular disease, and craniofacial abnormalities.

Sleep-disordered breathing refers to a pathophysiologic continuum that includes snoring, upper airway resistance syndrome, obstructive

hypertrophy in most children with OSA. There is some evidence that adenotonsillectomy improves clinical symptoms.⁶⁻⁸ [Strength-of-recommendation (SOR) Evidence level B, clinical cohort studies] However, many children

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ORIGINAL ARTICLE

Sleep-Related Disorders in Children with Attention-Deficit Hyperactivity Disorder: Preliminary Results of a Full Sleep Assessment Study

Silvia Miano,¹ Maria Esposito,² Giuseppe Foderaro,³ Gian Paolo Ramelli,⁴ Valdo Pezzoli³ & Mauro Manconi¹

¹ Sleep and Epilepsy Center, Neurocenter of Southern Switzerland, Civic Hospital of Lugano, Lugano, Switzerland

² Clinic of Child and Adolescent Neuropsychiatry, Department of Mental Health, Physical and Preventive Medicine, Second University of Naples, Naples, Italy

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Keywords

Attention; Children; Epilepsy; Hyperactivity; Sleep

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Received 22 January 2016; revision 10 April 2016; accepted 5 May 2016

doi: 10.1111/ncs.12573

doi: 10.1111/ncs.12573

Introduction

SUMMARY

Background and methods: We present the preliminary results of a prospective case-control sleep study in children with a diagnosis of attention-deficit hyperactivity disorder (ADHD). A deep sleep assessment including sleep questionnaires, sleep habits, a video-polysomnographic recording with full high-density electroencephalography (EEG) and cardiorespiratory polygraphy, multiple sleep latency test, and 1-week actigraphic recording were performed to verify whether children with ADHD may be classified into one of the following five phenotypes: (1) hypoarousal state, resembling narcolepsy, which may be considered a "primary" form of ADHD; (2) delayed sleep onset insomnia; (3) sleep-disordered breathing; (4) restless legs syndrome and/or periodic limb movements; and (5) sleep epilepsy and/or EEG interictal epileptiform discharges. **Results:** Fifteen consecutive outpatients with ADHD were recruited (two female, mean age 10.6 ± 2.2 , age range 8–13.7 years) over 6 months. The narcolepsy-like sleep phenotype was observed in three children, the sleep onset insomnia phenotype was observed in one child, mild obstructive sleep apnea was observed in three children, sleep hyperkinesia and/or PLMs were observed in five children, while IEDs and/or nocturnal epilepsy were observed in three children. Depending on the sleep phenotype, children received melatonin, iron supplementation, antiepileptic drugs, or stimulants. **Conclusions:** Our study further highlights the need to design an efficient sleep diagnostic algorithm for children with ADHD, thereby more accurately identifying cases in which a full sleep assessment is indicated.

well as dopamine transporter genes appear to be implicated [2,6]. Brain imaging studies have demonstrated a dysfunction of the

Attention Deficit Hyperactivity Disorder and Sleep

John H. Herman, PhD

KEYWORDS

- Attention deficit/hyperactivity disorder
- Periodic limb movement disorder

KEY POINTS

- ADHD is well known to be associated with sleep-related symptoms and behaviors.
- ADHD may be associated with sleep-related symptoms and behaviors.
- ADHD may be associated with sleep-related symptoms and behaviors.
- ADHD is frequently associated with sleep-related symptoms and behaviors.
- Obstructive sleep apnea, snoring, and restless legs syndrome are associated with ADHD.
- Stimulant medication in children with ADHD may improve sleep-related symptoms and behaviors.
- Melatonin, and not zolpidem, is effective for improving sleep-related symptoms and behaviors.
- ADHD often appears comorbid with sleep-related symptoms and behaviors.
- Children with ADHD frequently have sleep-related symptoms and behaviors that are alleviated by sleep-related interventions.

1

ORIGINAL RESEARCH
published: 11 August 2017
doi: 10.3389/fneur.2017.00410



Behavioral and Sleep Problems Mediate the Relationship between Sleep-Disordered Breathing Deficits in Children

J. Hunter^{2,4} and Leila Kheirandish-Goza³

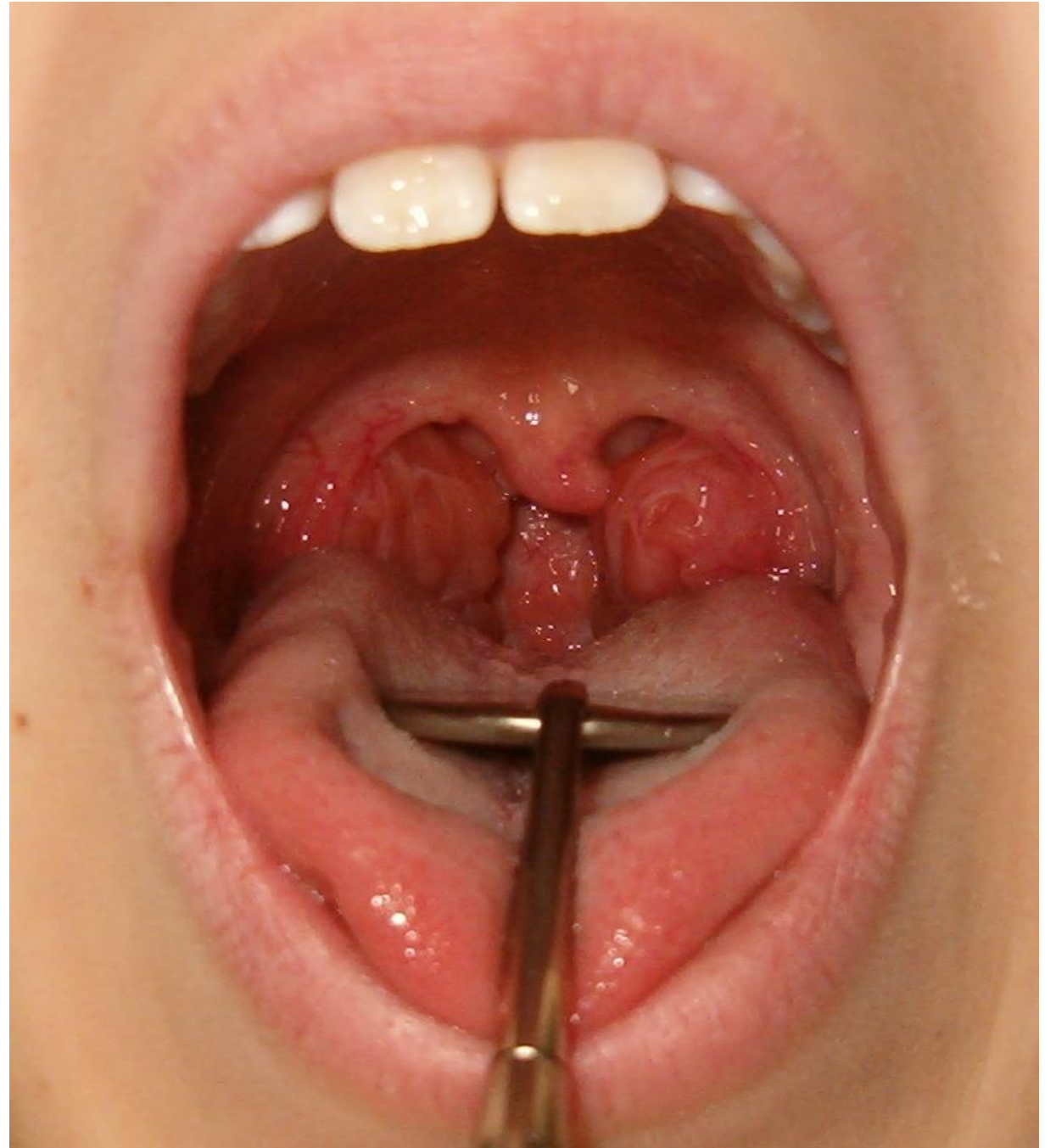
¹ Biological Sciences Division, The University of Chicago, Chicago, IL, United States, ² Department of Pediatrics, Pritzker School of Medicine, The University of Chicago, Chicago, IL, United States, ³ Department of Psychiatry and Behavioral Science, Biological Sciences Division, The University of Chicago,

Over the past several decades have illustrated that sleep-disordered breathing (SDB) are at greater risk for cognitive and behavioral problems. Although behavioral problems have been associated with SDB, the relationship between SDB and cognitive functioning, these relationships have not been fully elucidated.

In a community-based cohort of 1,115 children who were screened for SDB, we examined the relationships between SDB, behavior, and cognition, and two pathways based on propensity score weighting and mediation analysis to test the mediational role of parent-reported behavior and cognitive functioning in the relationship between SDB and cognitive functioning. Multiple

SARAH

- 9 yo
- Reported snoring
- Behavior problems in school
- ADHD like behavior – reported by teacher
- Inattentive
- Would fall asleep during car ride home
- Nocturnal enuresis



ADHD and Sleep Disordered Breathing in Children

- Children do not react to sleepiness the same way as adults
- Have you ever wondered why they give hyperactive, inattentive children “Speed” as a treatment for their ADHD?
- Ritalin, Focalin and Adderall are all amphetamines - stimulants

ADHD and Sleep Disordered Breathing in Children

- Problems are not just OSA in children
- There is a big problem with the advent of electronics (in our house we call them “screens”)
- Improper sleep hygiene – worse over the last 50 years
- School start times

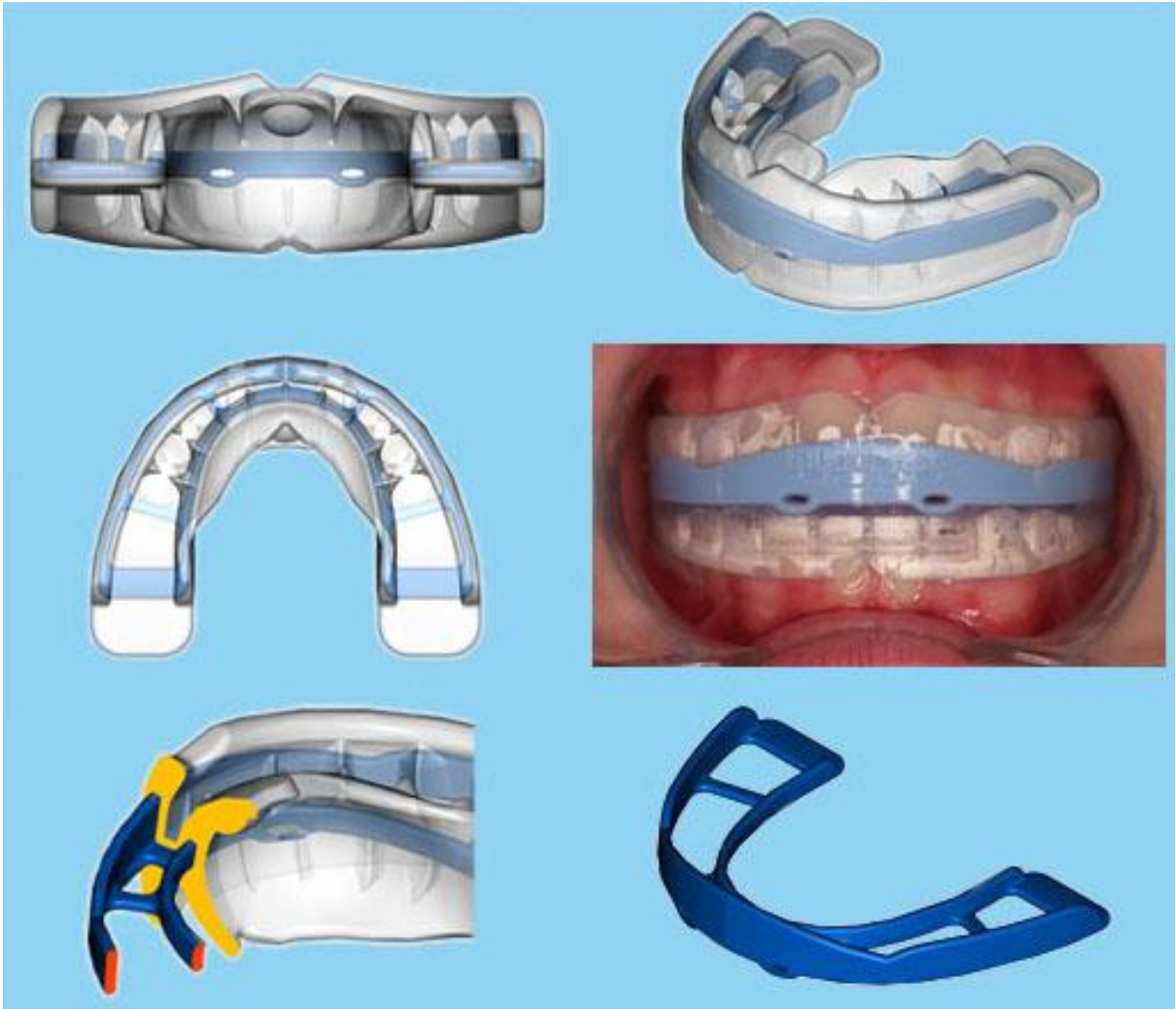
OSA in Children



OSA in Children



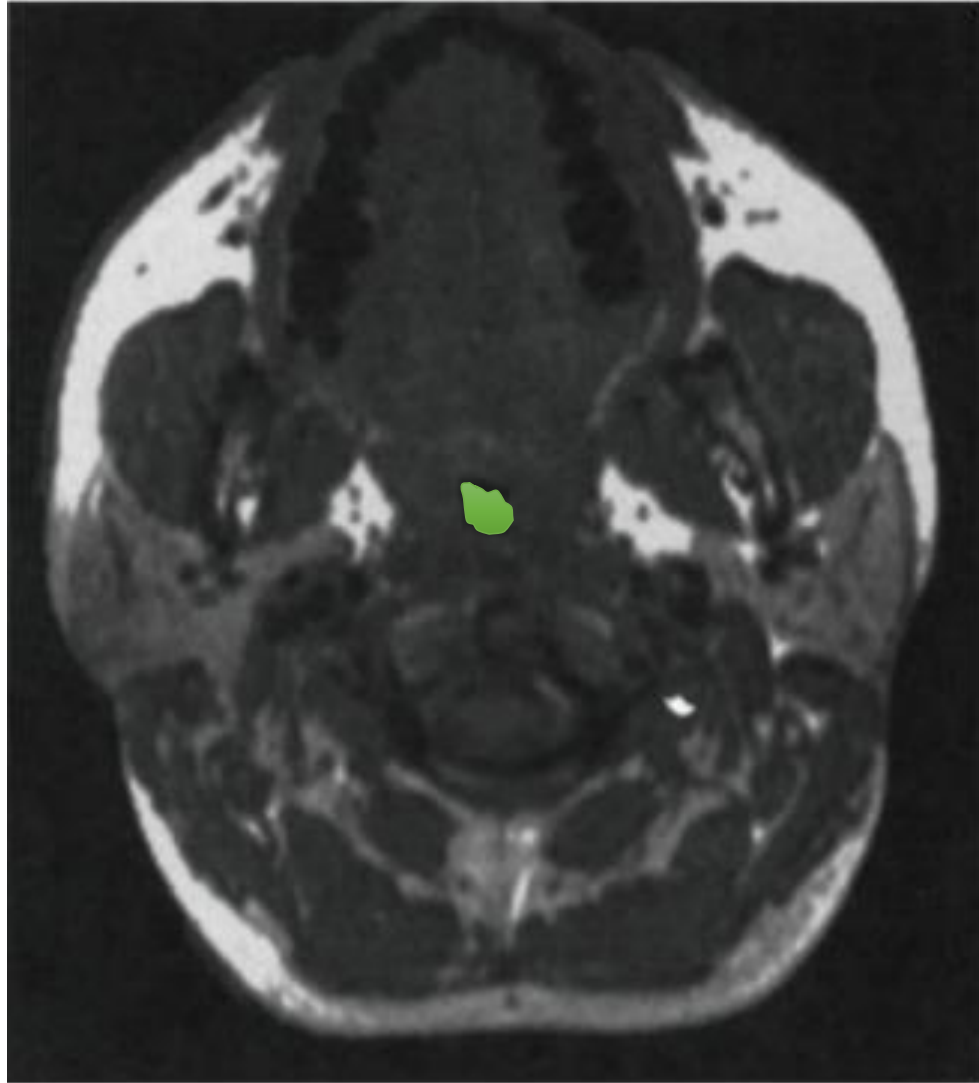
Myofunctional Appliance Therapy



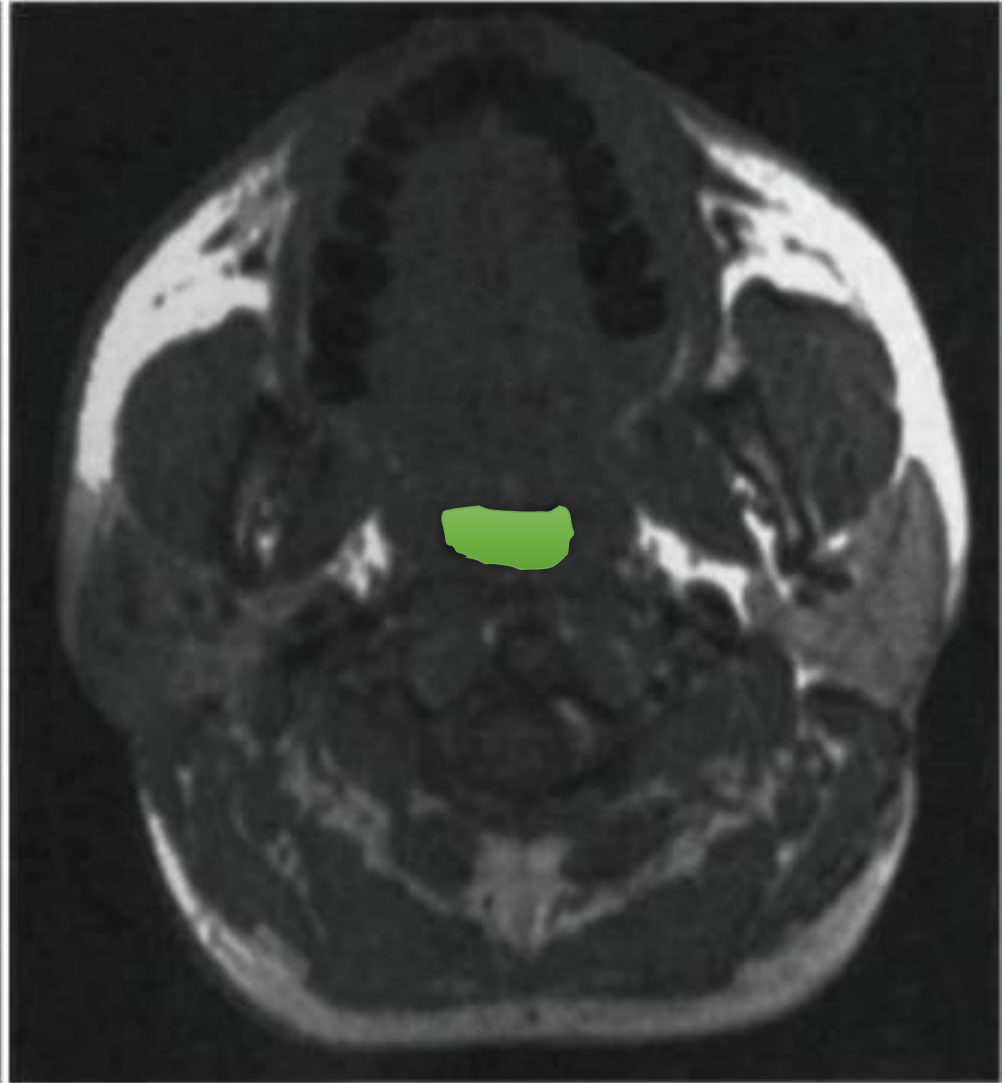
CPAP Therapy - 1980



Positive Airway Pressure



0 cmH₂O



15 cmH₂O

Humidification - 1995



Bi Level PAP – Mid 1990's

AutoTitration PAP – Early 2000's

- Obstructive sleep apnea treated by independently adjusted inspiratory and expiratory positive airway pressures via nasal mask. Physiologic and clinical implications. *Sanders MH, Kern N Chest. 1990 Aug; 98(2):317-24.*
- Automated continuous positive airway pressure titration for obstructive sleep apnea syndrome. *Teschler H, Berthon-Jones M, Thompson AB, Henkel A, Henry J, Konietzko N Am J Respir Crit Care Med. 1996 Sep; 154(3 Pt 1):734-40.*

Bi Level PAP – Mid 1990's

AutoTitration PAP – Early 2000's



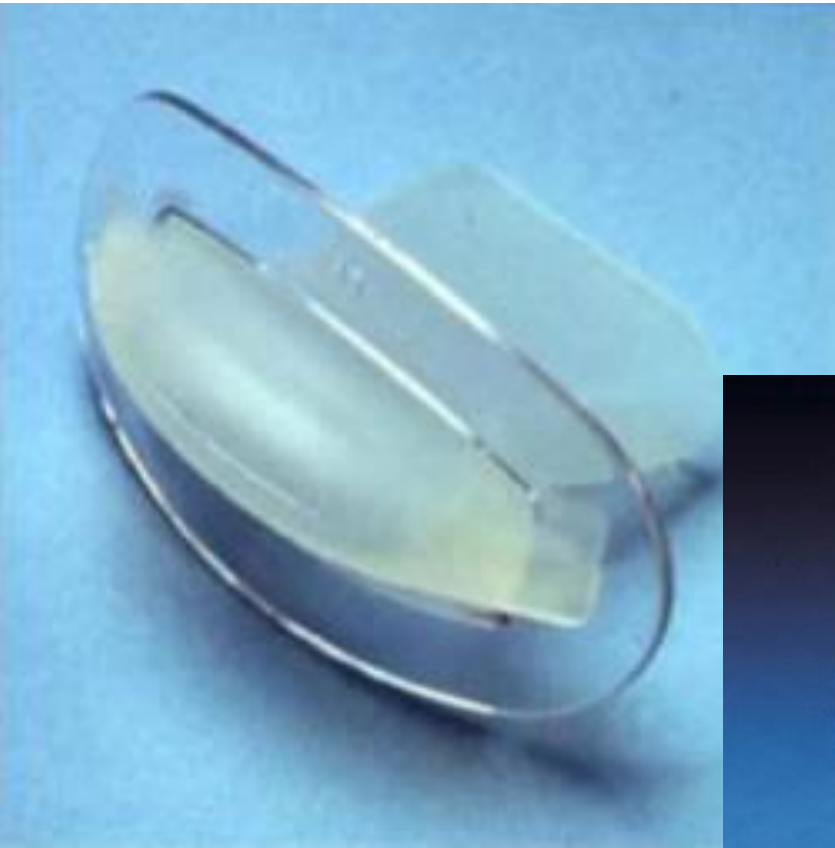
Oral Appliances for the Treatment of Obstructive Sleep Apnea and Snoring

- **Two Classes of Oral Appliances**
- **Tongue Retaining Devices (TRD)**
- **Mandibular Repositioning Appliances / Mandibular Advancement Appliances (MRA or MAD)**

Oral Appliances

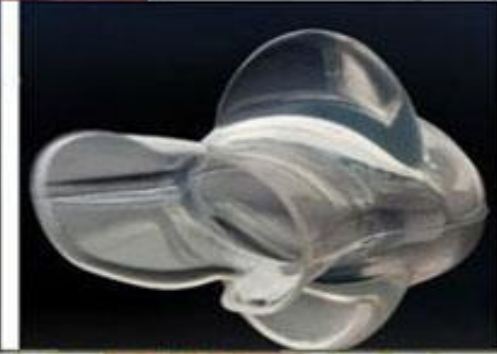
- Tongue Retaining Device**
- (When you might use a TRD)**
- Edentulous Patients**
- Too few teeth – Periodontally compromised teeth**
- Non-apneic snores or very mild OSA**
- Down's syndrome**

Oral Appliances



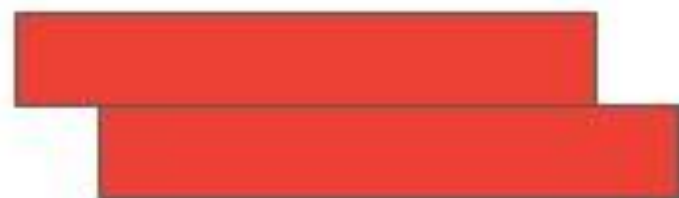
Oral Appliances







Mono-block
articulation
(TMJ)



Hinge-based
articulation
(TMJ & incisors)



Compression-based
articulation
(lower canine)



Traction-based
articulation
(pre-molars & canine)



Traction-based
articulation
(rear-molars)



Mono-block articulation



Hinge-based articulation



Compression-based articulation

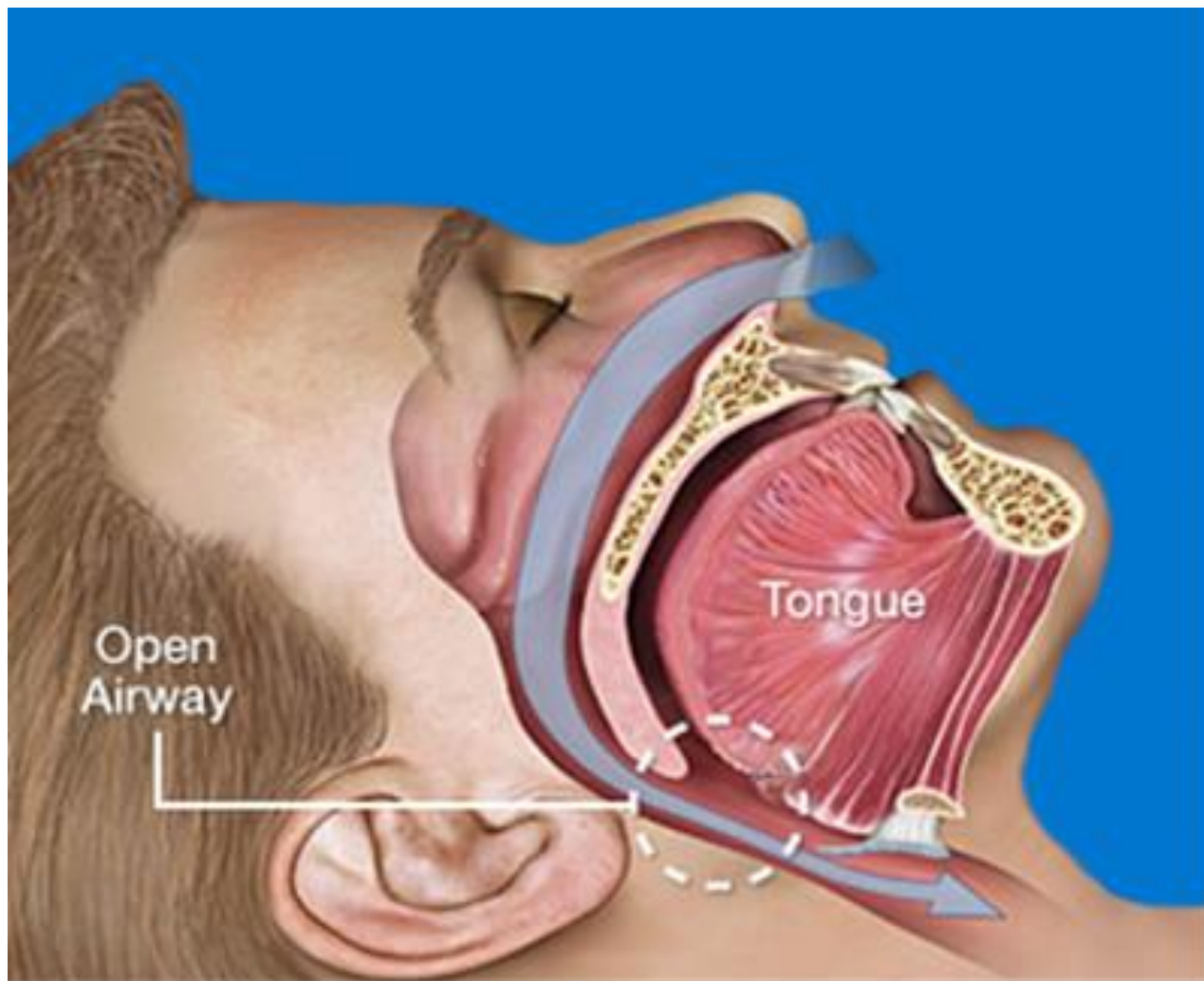


Traction-based articulation

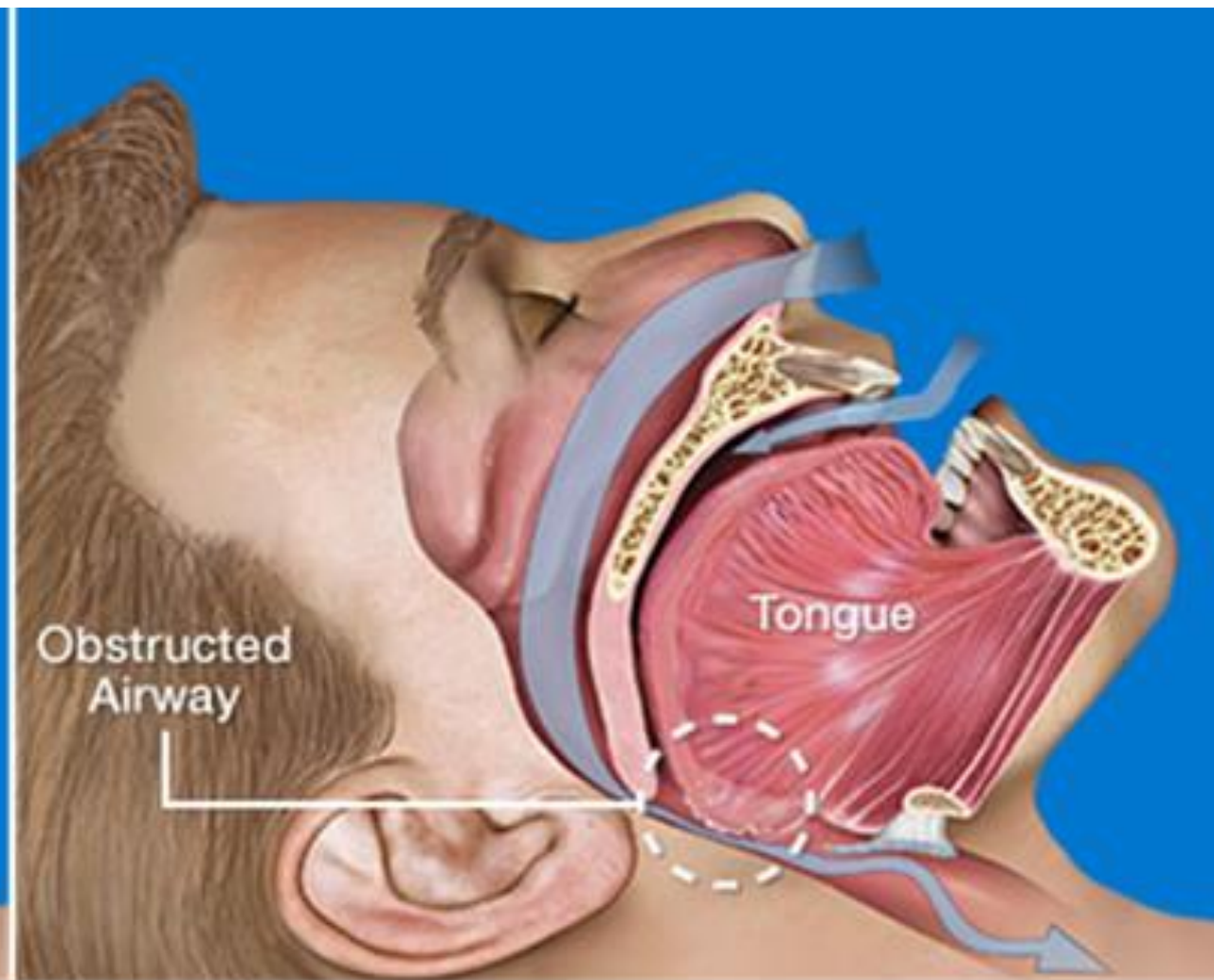


Traction-based articulation





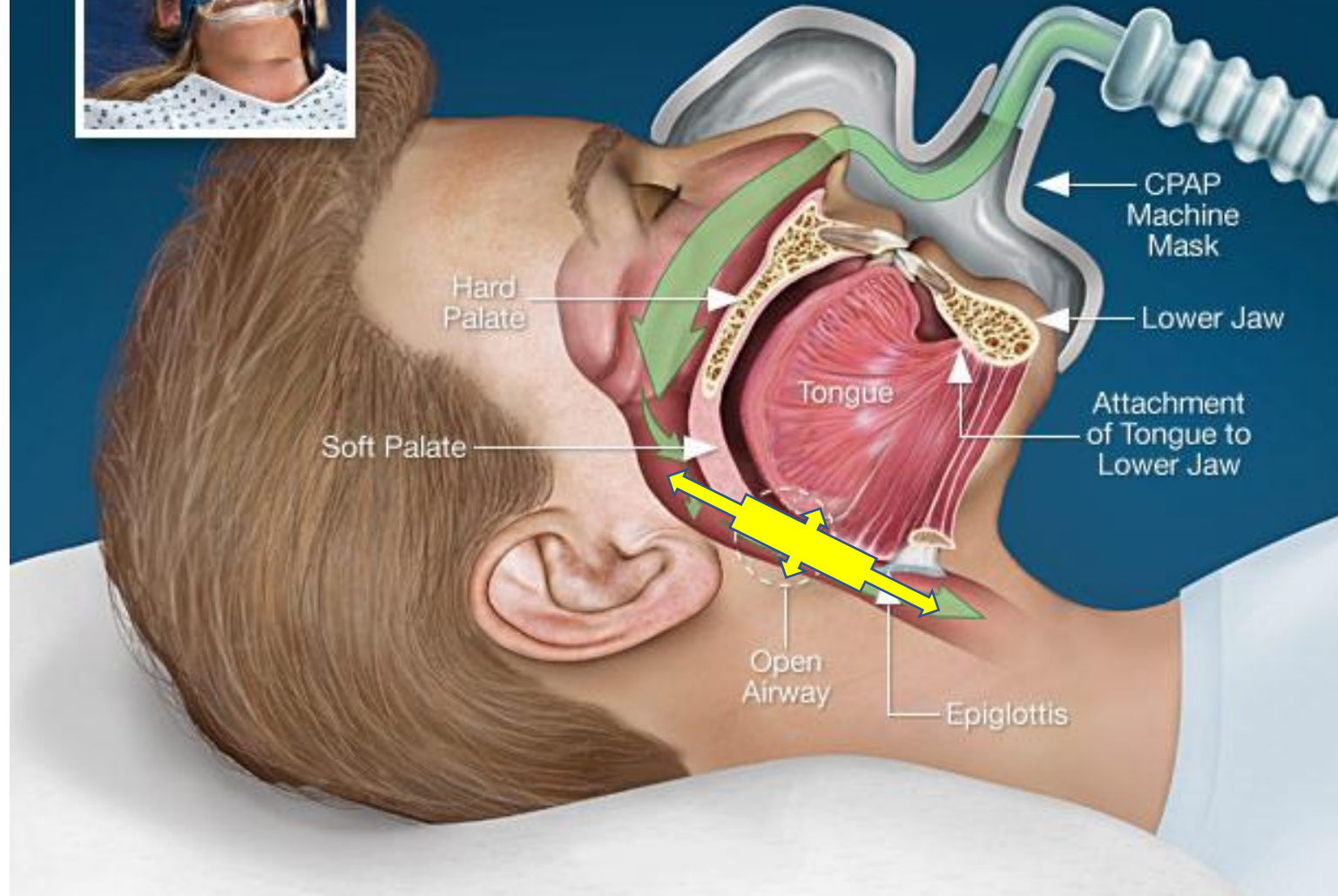
Non-Obstructed Airway



Obstructed Airway

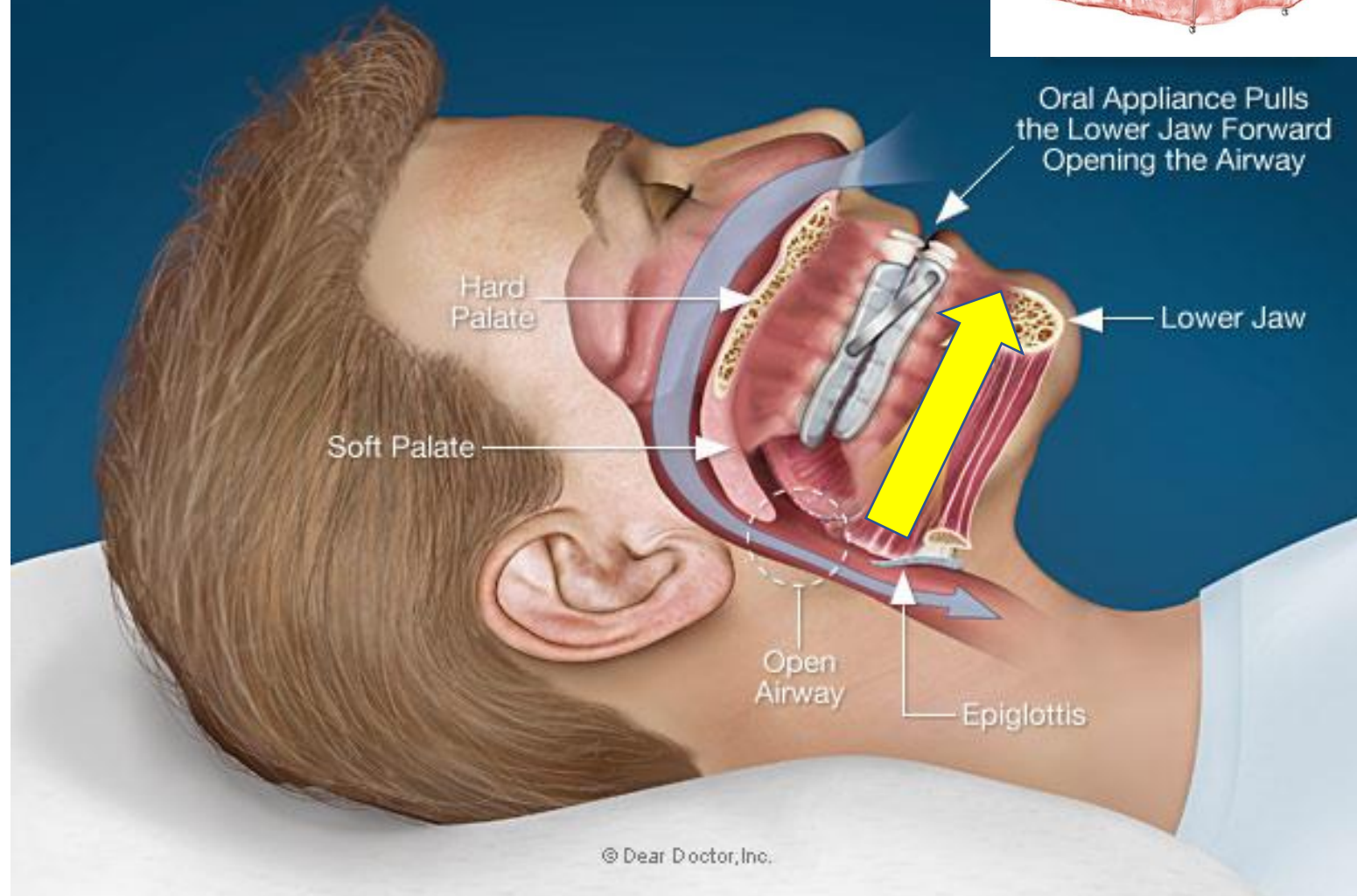
CPAP Therapy

A potential life saving and changing option for the treatment of sleep apnea.

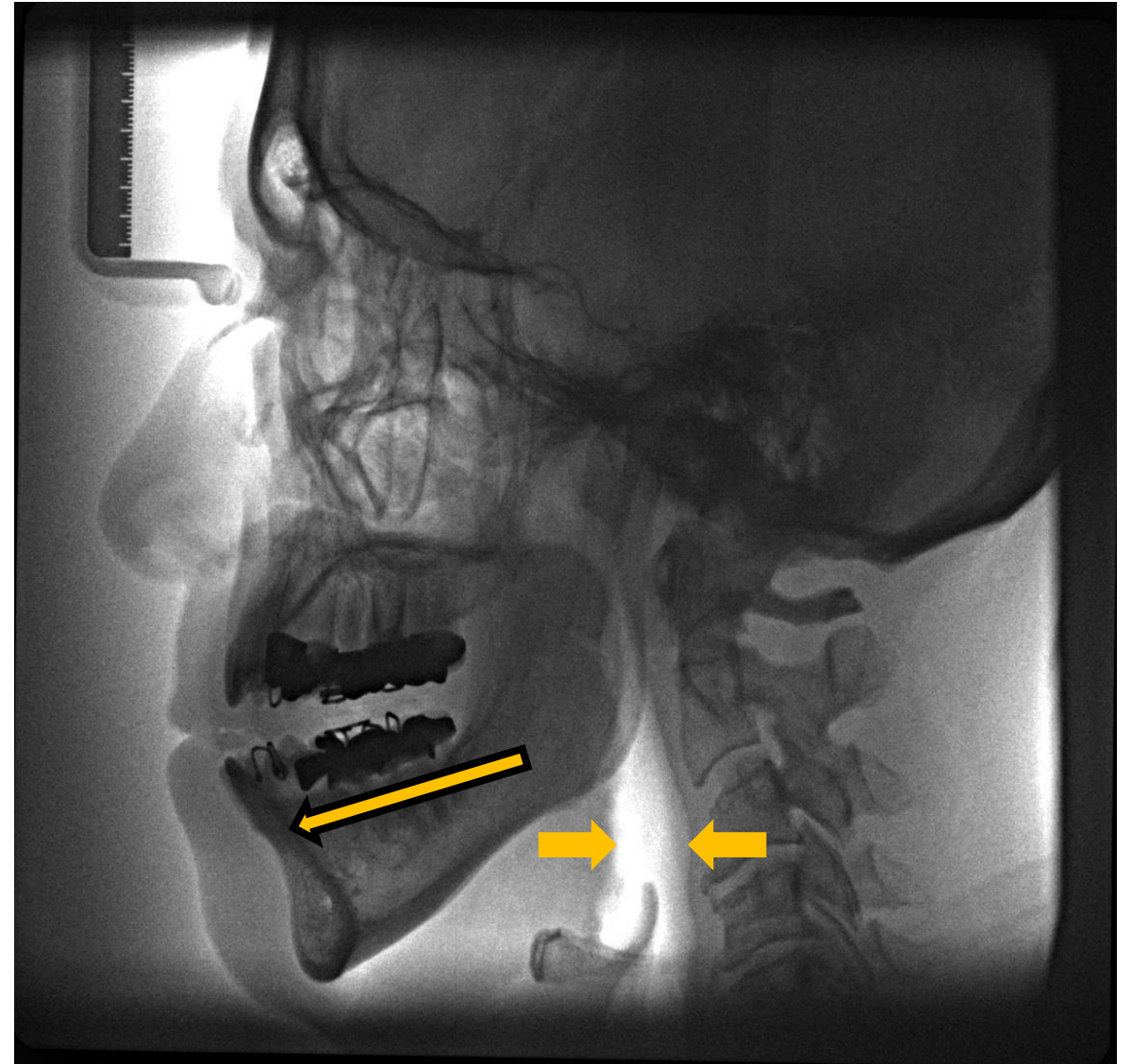
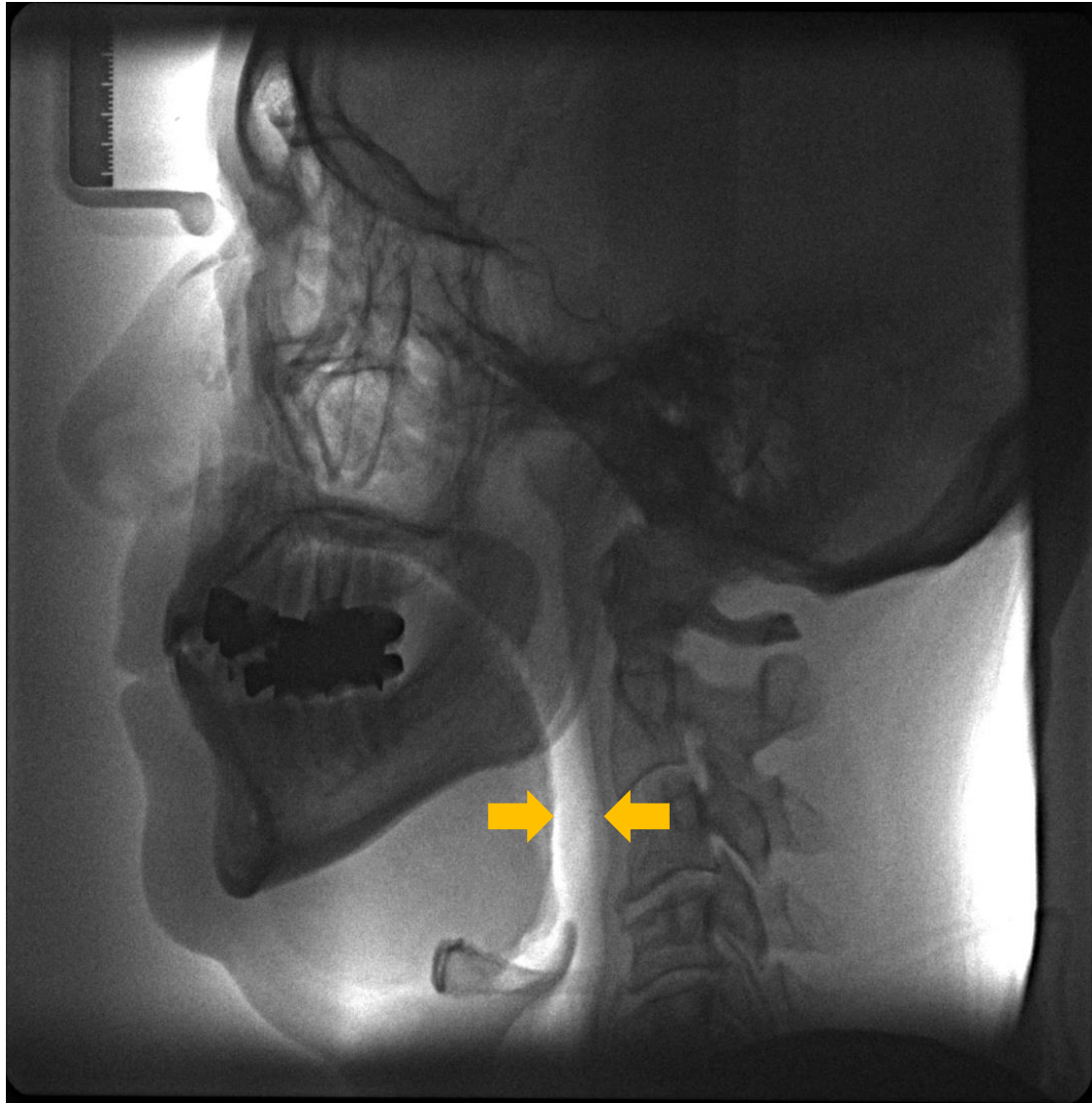


Oral Appliance Therapy

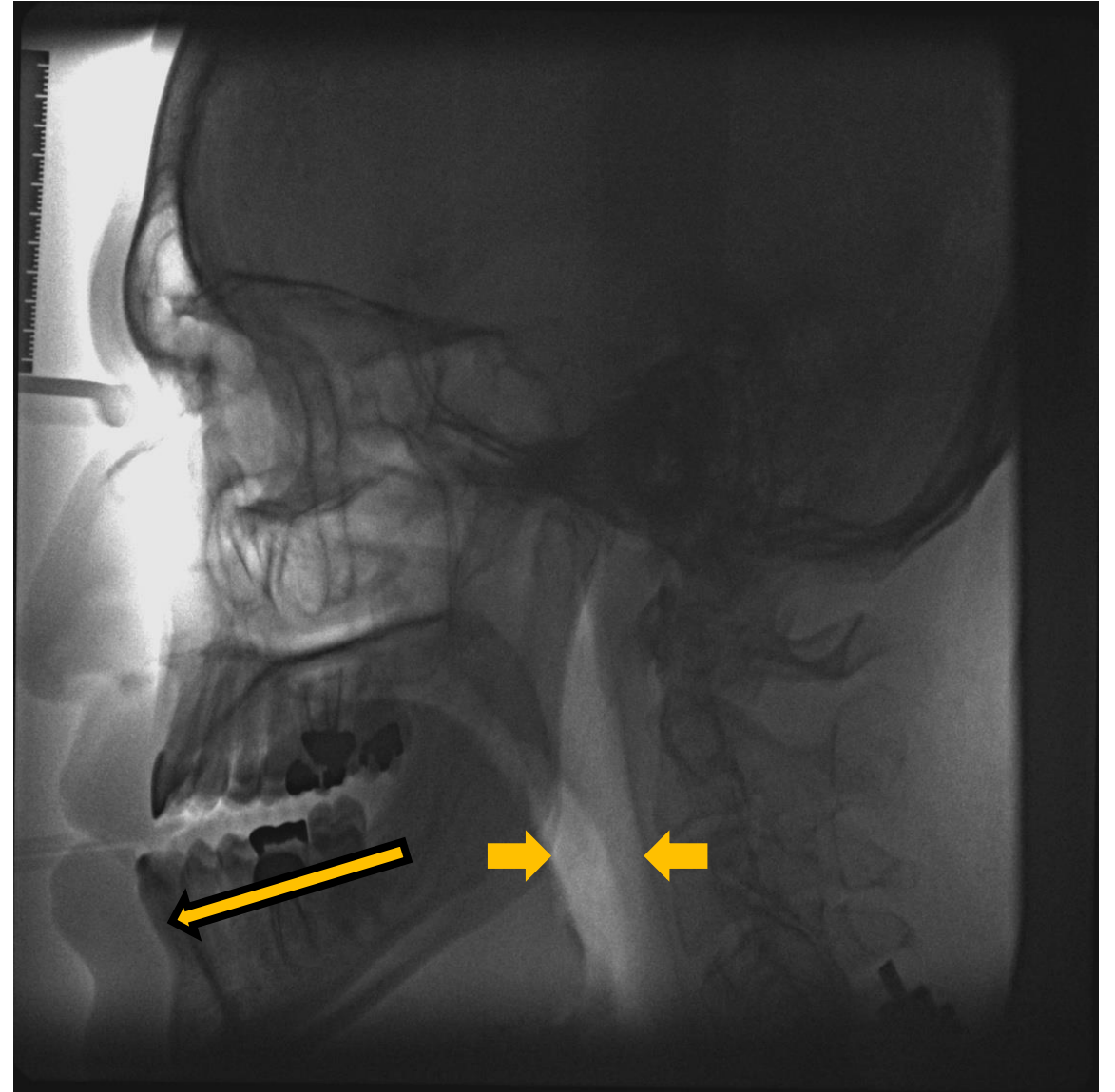
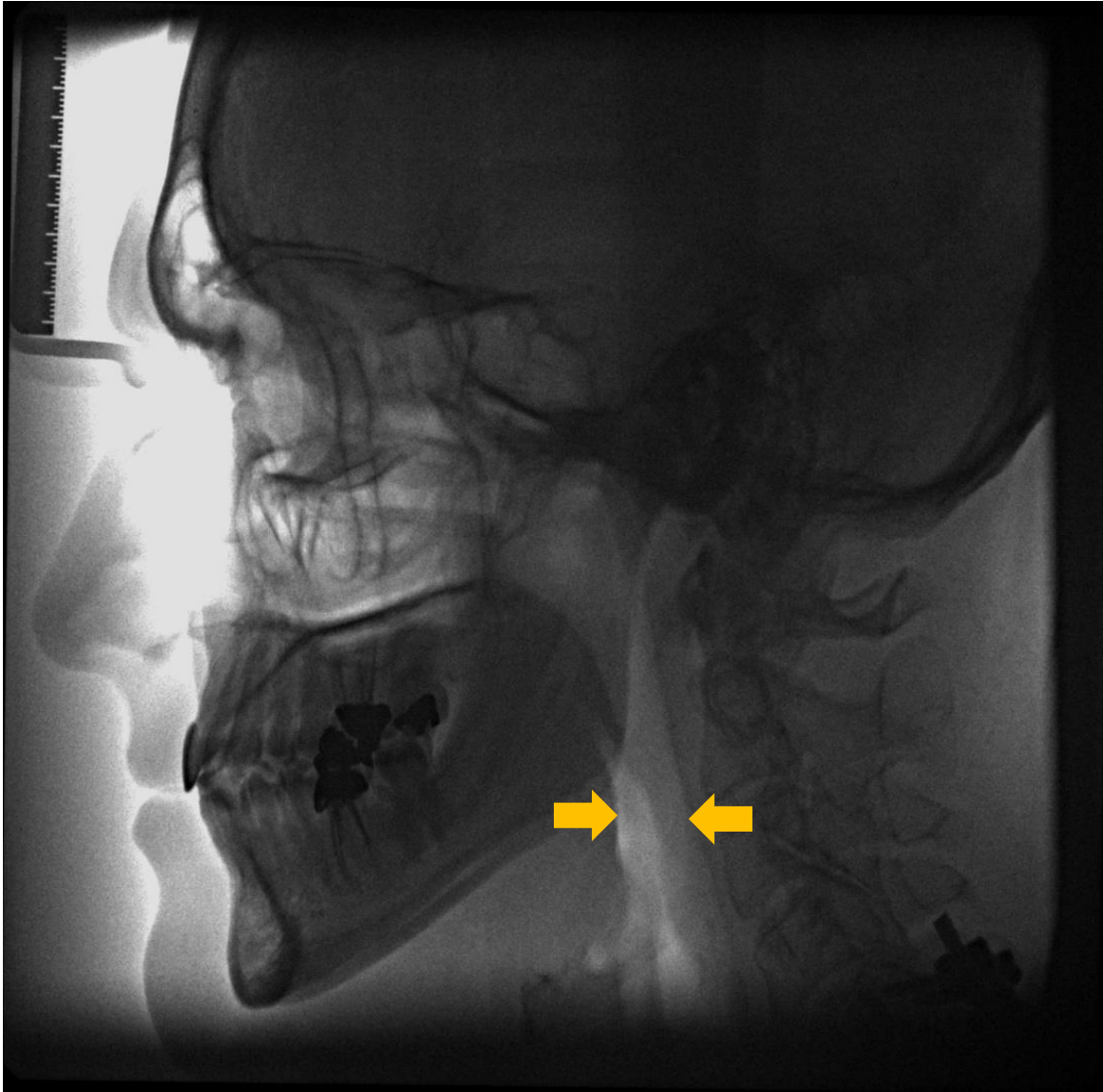
The first and most comfortable option to CPAP for the treatment of obstructive sleep apnea.



How Oral Appliances Work



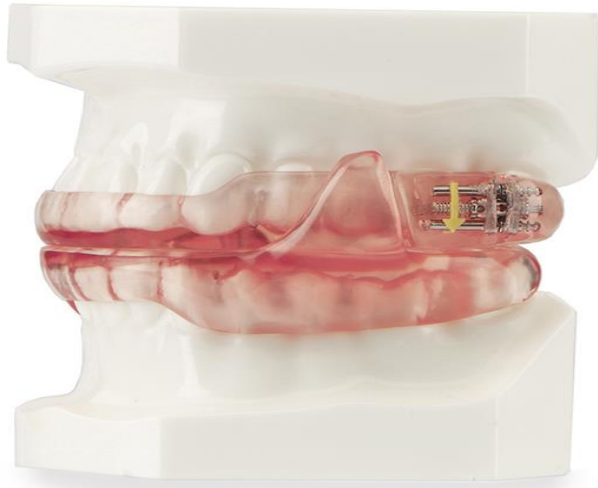
How Oral Appliances Work





ORAL APPLIANCES

- **OAT** – Oral Appliance Therapy
- **MAD** – Mandibular Advancement Device
- **MAS** – Mandibular Advancement Splint



Obstructive Sleep Apnea

- The major treatment options are:
 - Continuous Positive Airway Pressure (CPAP) therapy
 - Oral Appliance Therapy (OAT)
 - Surgery





**SLEEP
APNEA?**





Clinical Practice Guideline for the Treatment of Obstructive Sleep Apnea and Snoring with Oral Appliance Therapy: An Update for 2015

An American Academy of Sleep Medicine and American Academy of Dental Sleep Medicine
Clinical Practice Guideline

Kannan Ramar, MBBS, MD¹; Leslie C. Dort, DDS²; Sheri G. Katz, DDS³; Christopher J. Lettieri, MD⁴; Christopher G. Harrod, MS⁵; Sherene M. Thomas, PhD⁵; Ronald D. Chervin, MD⁶

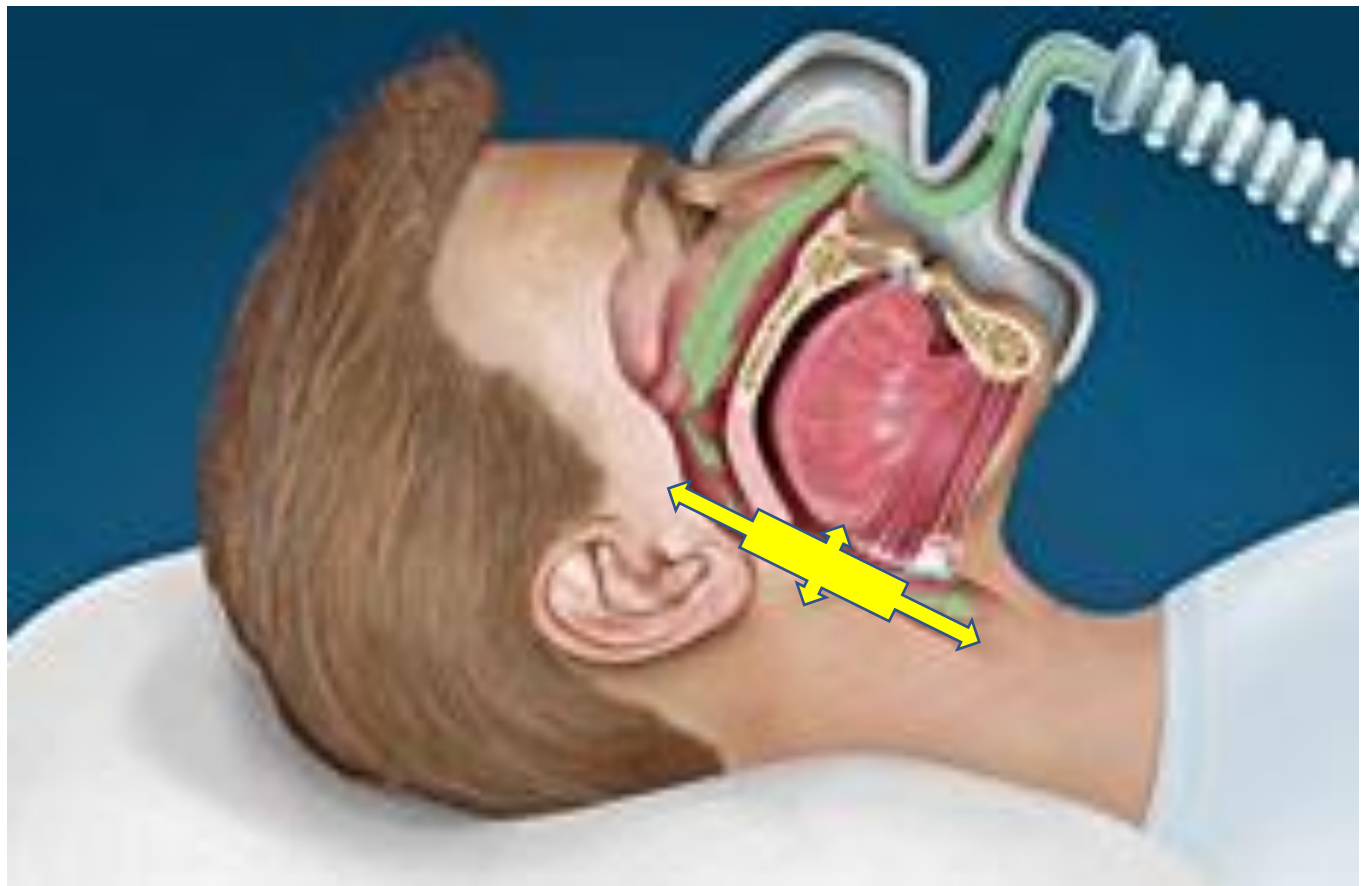
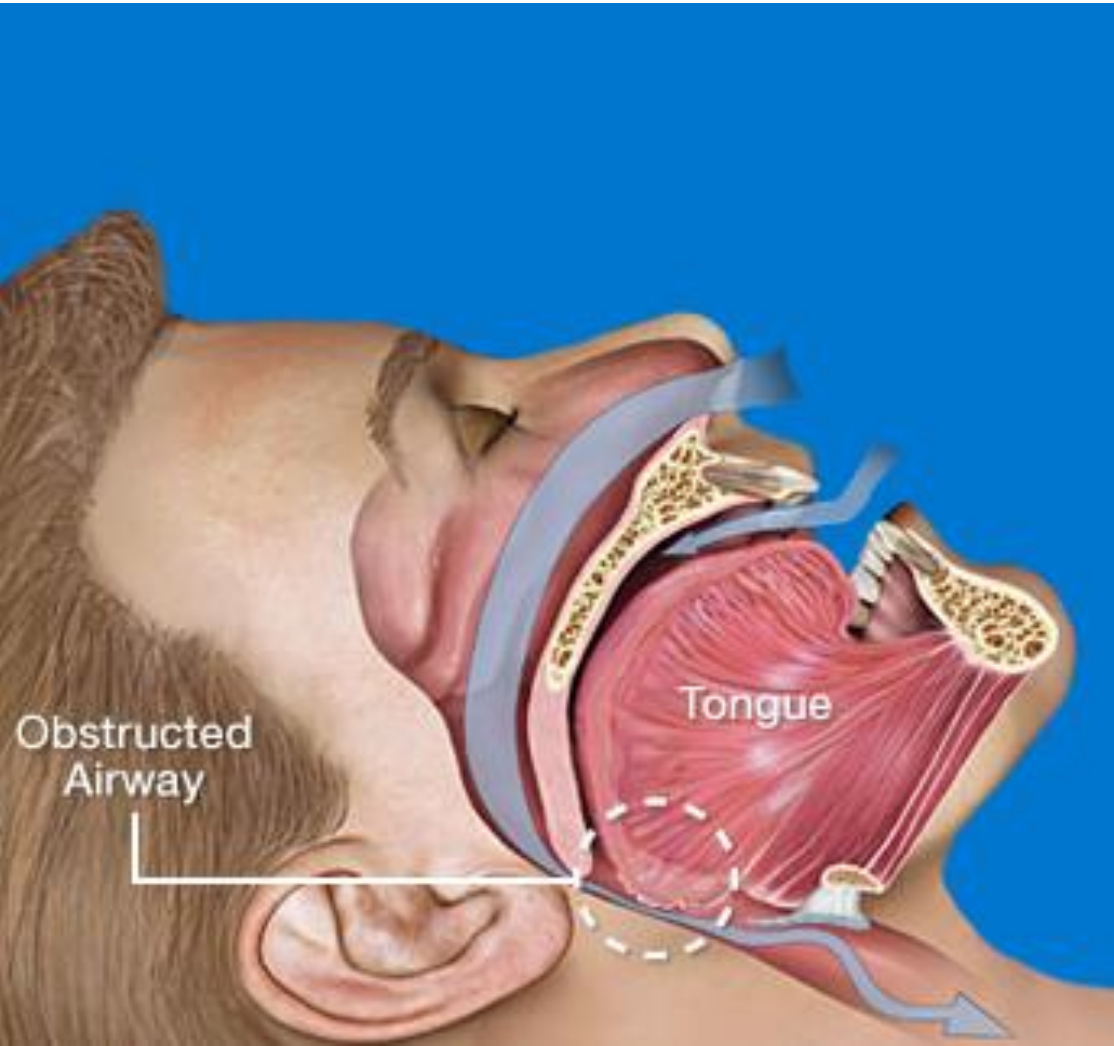
¹Mayo Clinic, Rochester, MN; ²University of Calgary, Calgary, Alberta, Canada; ³Atlanta, GA; ⁴Walter Reed National Military Medical Center, Bethesda, MD; ⁵American Academy of Sleep Medicine, Darien, IL; ⁶University of Michigan, Ann Arbor, MI

Introduction: Since the previous parameter and review paper publication on oral appliances (OAs) in 2006, the relevant scientific literature has grown considerably, particularly in relation to clinical outcomes. The purpose of this new guideline is to replace the previous and update recommendations for the use of OAs in the treatment of obstructive sleep apnea (OSA) and snoring.

Methods: The American Academy of Sleep Medicine (AASM) and American Academy of Dental Sleep Medicine (AADSM) commissioned a seven-member task force. A systematic review of the literature was performed and a modified Grading of Recommendations Assessment, Development, and Evaluation (GRADE) process was used to assess the quality of evidence

patients with obstructive sleep apnea who are intolerant of CPAP therapy or prefer alternate therapy. (STANDARD)

4. We suggest that qualified dentists provide oversight—rather than no follow-up—of oral appliance therapy in adult patients with obstructive sleep apnea, to survey for dental-related side effects or occlusal changes and reduce their incidence. (GUIDELINE)
5. We suggest that sleep physicians conduct follow-up sleep testing to improve or confirm treatment efficacy, rather than conduct follow-up without sleep testing, for patients fitted with oral appliances. (GUIDELINE)
6. We suggest that sleep physicians and qualified dentists instruct adult patients treated with oral appliances for

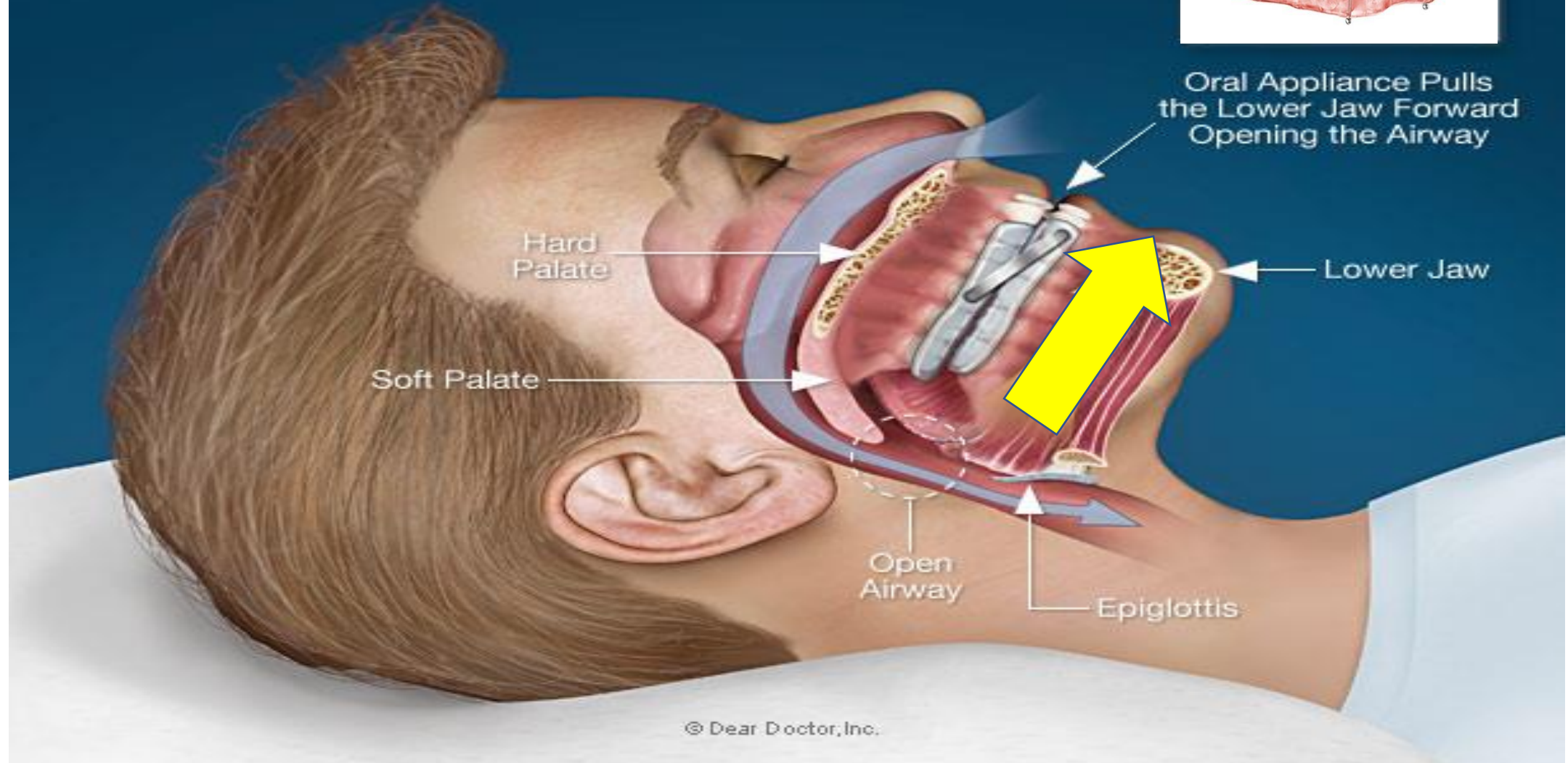


Oral Appliance Therapy

The first and most comfortable option to CPAP for the treatment of obstructive sleep apnea.



Oral Appliance Pulls the Lower Jaw Forward Opening the Airway



Oral Appliances

Mono-block articulation
(TMJ)



Monoblock

Hinge-based articulation
(TMJ & incisors)



Anterior Hinge

Compression-based articulation
(lower canine)



Bilateral Push

Traction-based articulation
(pre-molars & canine)

Interlocking



Traction-based articulation
(rear-molars)

Bilateral Pull



Oral Appliances

- Things to consider when selecting an appliance

Lateral bruxer

Current or past TMJ issues

Retention issues ( or )

Missing teeth

Future restorative work
planned

Allergies (Sensitivities)

Want to keep mouth closed

Want to keep mouth open

Manual dexterity or poor
vision

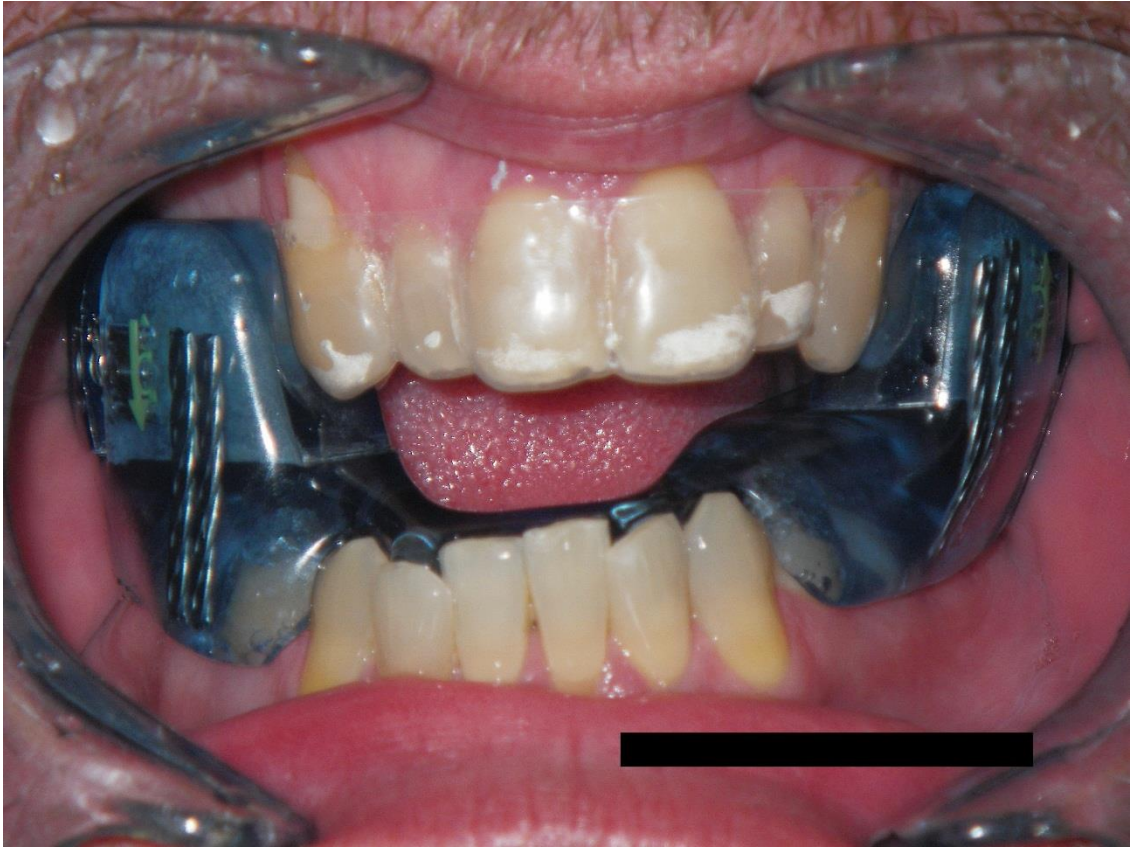
Ability to get in for follow-up

Past history of OAT

Oral Appliances - Monoblock



Oral Appliances - Monoblock



Oral Appliances - Anterior Hinge Based (Push/Pull)



Oral Appliances - Anterior Hinge Based (Push/Pull)



Oral Appliances – Compression Based (Bilateral Push)



Oral Appliances – Compression Based (Bilateral Push)



Oral Appliances – Traction Based (Bilateral Pull)



Oral Appliances – Traction Based (Bilateral Pull)



Oral Appliances – Traction Based (Interlocking)



Oral Appliances – Traction Based (Interlocking)





Oral Appliances

Mono-block articulation
(TMJ)



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Hinge-based articulation
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Traction-based articulation
(rear-molars)

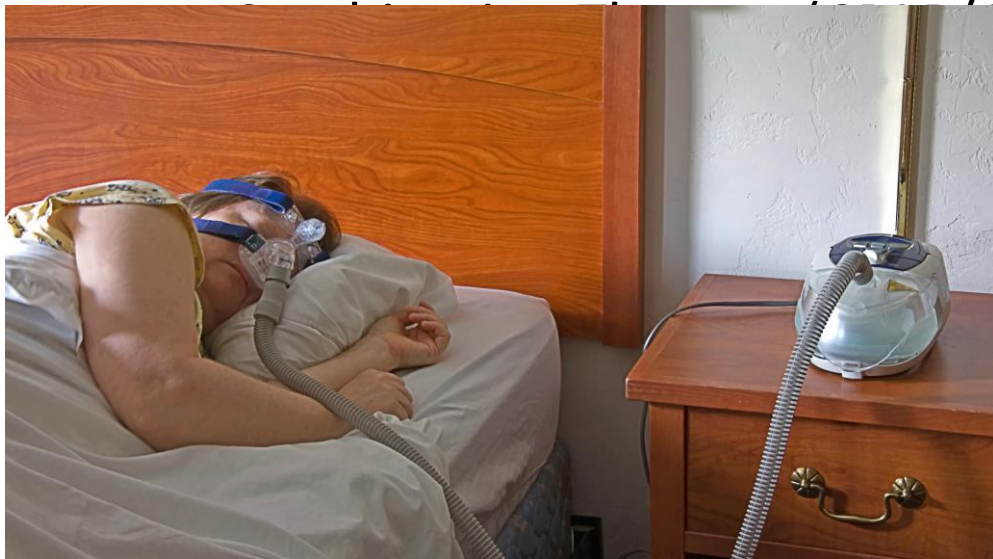
Bilateral Pull



Treatments



- CPAP – Continuous Positive Airway Pressure
 - Nasal
 - Full Face Mask
 - Nasal Pillows



(DA)

Dental Sleep Medicine Standards for Screening, Treating, and Managing Adults with Sleep-Related Breathing Disorders

Standards of Practice Committee of the American Academy of Dental Sleep Medicine: Mitchell Levine, DMD (Chair)¹; Kathleen M. Bennett, DDS²; Michelle K. Cantwell, DMD³; Kevin Postol, DDS⁴; David B. Schwartz, DDS⁵

¹University of Tennessee, College of Dentistry, Memphis, TN; Division of Dental Sleep Medicine and Orofacial Pain, College of Dentistry, University of Tennessee, Memphis, TN ²Associated with UC Health Sleep Medicine Fellowship Program, Cincinnati, OH; ³Center for Dental Sleep Medicine, Lancaster, PA; ⁴Sleep Disordered Dentistry, Ballwin, Missouri; ⁵The Center for Sleep Medicine, Skokie, Illinois

Oral appliance therapy (OAT) has been used to manage sleep-related breathing disorders (SRBDs), such as obstructive sleep apnea (OSA) and snoring, for more than 20 years. However, dental sleep medicine standards of clinical practice have not been clearly defined. SRBD prevalence rates have grown to double digits, presenting an increased need for dentists proficient in dental sleep medicine. A standardized approach to patient management, which underscores the collaborative nature necessary between dentists and physicians, is needed. These standards provide guidance for patient examination, patient screening, education, and treatment management including follow-up care. Although this paper introduces best practices for the practice of dental sleep medicine as it currently exists, the reader should recognize the fluid and dynamic nature of dental sleep medicine and understand that periodic updates to these standards will be required.

Keywords: best practice, obstructive sleep apnea, oral appliance therapy, sleep-related breathing disorders, standard

Citation: Levine M, Bennett K, Cantwell M, Postol K, Schwartz D. Dental sleep medicine standards for screening, treating, and managing adults with sleep-related breathing disorders. *J Dent Sleep Med*. 2018;5(3):61-68.

INTRODUCTION

Sleep-related breathing disorders (SRBDs) are one of six classifications of sleep disorders identified in the International Classification of Sleep Disorders, Third Edition (ICSD-3),¹ the American Academy of Sleep Medicine's (AASM) clinical text for the diagnosis of sleep disorders. Obstructive Sleep Apnea (OSA) is a SRBD associated with upper airway collapse. OSA has an estimated prevalence of 12% (includes both diagnosed and undiagnosed).² There is abundant literature to support the utility of oral appliances (OAs; also known as mandibular advancing devices) as an effective treatment of OSA in adults.³⁻⁶ There is limited evidence to suggest that mandibular advancement (also referred to as functional appliance therapy in the orthodontic literature) and maxillary expansion can be effective treatment modalities in the management of pediatric OSA.

The American Academy of Dental Sleep Medicine (AADSM) recognizes the inconsistency of the sleep medicine curricula in US and Canadian dental schools. The AADSM and others offer educational opportunities to provide dentists with the requisite knowledge to effectively treat and manage OSA patients. Yet, despite these efforts, there are no uniform standards on the practice of dental sleep medicine.

In 2015, the AASM and AADSM issued the *Clinical Practice Guideline for the Treatment of Obstructive Sleep Apnea and Snoring with Oral Appliance Therapy*.⁷ This guideline offers clarity on the desired qualifications of a dentist participating in the treatment and ongoing

management of OSA and snoring. The guideline stipulates that a dentist should have at least one of the following: (1) diplomate certification in dental sleep medicine by a non-profit organization; (2) designation as the dental director of a dental sleep medicine facility accredited by a nonprofit organization; or (3) obtain the designation of "qualified dentist." The qualified dentist is encouraged to continue their education in dental sleep medicine and seek either diplomate and/or dental director status. Throughout this paper, our use of the designation "qualified" includes the diplomate certified dentist, the dental director of an accredited facility, as well as the dentist who has completed the qualified dentist requirements established in the 2015 clinical practice guideline.

To ensure high-quality patient care is provided, qualified dentists treating and managing patients in whom SRBDs have been diagnosed should adhere to standards of care in an ethical and medicolegal framework, including following best practices for informed consent, risk management, quality assurance, and record keeping. Patient care should be delivered within the scope of the qualified dentist's competence in a patient-centered environment that recognizes the diversity of patient populations. The qualified dentist treating and managing patients with SRBDs should educate the patient and appropriate caregivers as to the etiology of SRBDs according to evidence-based practices, critical thinking, and outcomes assessments. Finally, the qualified dentist should identify known risk modifiers and work with patients and other health care professionals to effectively

Table 1—Side effects.

Temporomandibular joint-related side effects

- Transient morning jaw pain
- Persistent temporomandibular joint pain
- Tenderness in muscles of mastication
- Joint sounds

Intraoral tissue-related side effects

- Soft tissue and tongue irritation
- Gingival irritation
- Excessive salivation/drooling
- Dry mouth

Occlusal changes

- Altered occlusal contacts/bite changes
- Incisor changes
- Decreased overjet and overbite
- Alterations in position of mandibular canines and molars
- Interproximal gaps

Damage to teeth or restorations

- Tooth mobility
- Tooth fractures or damage to dental restorations

Appliance issues

- Appliance breakage
- Allergies to appliance material
- Gagging
- Anxiety

Management of Side Effects of Oral Appliance Therapy for Sleep-Disordered Breathing

Rose D. Sheats, DMD¹; Thomas G. Schell, DMD²; Alan O. Blanton, DDS³; Patricia M. Braga, DDS⁴; B. Gail Demko, DMD⁵; Leslie C. Dort, DDS⁶; Donald Farquhar, DDS⁷; Sheri G. Katz, DDS⁸; Jean-Francois Masse, DMD⁹; Robert R. Rogers, DMD¹⁰; Steven C. Scherr, DDS¹¹; David B. Schwartz, DDS¹²; Jamison Spencer, DMD, MS¹³

¹Chapel Hill, North Carolina; ²Lebanon, New Hampshire; ³Memphis, Tennessee; ⁴Inver Grove Heights, Minnesota; ⁵Grand Blanc, Michigan; ⁶Calgary, Alberta, Canada; ⁷Midland, Ontario, Canada; ⁸Atlanta, Georgia; ⁹Quebec City, Quebec, Canada; ¹⁰Wexford, Pennsylvania; ¹¹Pikeville, Maryland; ¹²Skokie, Illinois; ¹³Raleigh, North Carolina

As the field of oral appliance therapy (OAT) to manage obstructive sleep apnea has evolved over the past 30 years, side effects of therapy have become increasingly recognized. Although the most commonly observed side effect is unwanted tooth movement, a number of other side effects have been reported through anecdotes, case reports, and observational studies. Members of the American Academy of Dental Sleep Medicine developed a set of consensus recommendations to guide dentists in the management of side effects as a consequence of OAT. Thirteen expert clinicians were appointed to the panel, which used the modified RAND/UCLA Appropriateness Method to review the body of evidence on OAT side effects and to establish the recommendations. Clinicians are encouraged to use these recommendations in conjunction with their clinical expertise to minimize the side effects of OAT. The recommendations are based on knowledge to date and are expected to evolve over time. Future research should aim at timely identification of these side effects for positive treatment outcomes.

KEYWORDS: malocclusion, mandibular advancement, mandibular repositioning, mouth diseases and therapeutics, oral device, orthodontic appliance, sleep apnea (obstructive and snoring), tooth disease

CITATION: Sheats RD, Schell TG, Blanton AO, Braga PM, Demko BG, Dort LC, Farquhar D, Katz SG, Masse JF, Rogers RR, Scherr SC, Schwartz DB, Spencer J. Management of side effects of oral appliance therapy for sleep-disordered breathing. *Journal of Dental Sleep Medicine*. 2017;4(4):111–125.

INTRODUCTION

The American Academy of Dental Sleep Medicine (AADSM) and American Academy of Sleep Medicine recently updated their clinical practice guideline for the treatment of obstructive sleep apnea (OSA) and snoring with oral appliance therapy (OAT).¹ The guideline included the following recommendation: “We suggest that qualified dentists provide oversight—rather than no follow-up—of oral appliance therapy in adult patients with obstructive sleep apnea, to survey for dental-related side effects or occlusal changes and reduce their incidence.”

The management of side effects is essential to maximize treatment adherence and the clinical effectiveness of oral appliances. The guideline further states that although multiple manuscripts refer to side effects, the overall evidence is limited and of low quality.

The field of dental sleep medicine lacks a set of published guidelines that clinicians and dentists can refer to for the management of side effects associated with OAT. Most of the information available to clinicians is derived from individual lecturers and is anecdotal. In an effort to begin to address this gap in knowledge, the AADSM Board of Directors convened a panel of experts to develop consensus-based recommendations for managing the most common side effects encountered in OAT.

BACKGROUND

OSA has a reported prevalence of 2% to 8% in older literature, with more recent estimates suggesting that more than 18 million adults in the United States have sleep apnea, a leading cause of excessive daytime sleepiness. An oral appliance, while effective in ameliorating the respiratory events of OSA, often causes alterations in occlusal (tooth) contacts and mandibular positioning as well as other side effects. During the Advanced Course in Oral Appliance Therapy in 2009, the AADSM first catalogued some of these side effects and proposed solutions for their management. This was originally published in *Dialogue* and was considered a work in progress.²

The purpose of this consensus paper is to update those recommendations and to develop a touchstone reference for practitioners and researchers seeking guidance on the management of side effects of OAT for sleep-disordered breathing.

METHODS

Expert Panel Selection

In accordance with the recommendations of the RAND Appropriateness Method,³ the Consensus Conference panel comprised 13 voting members. All panel members were dentists who were trained and experienced in the overall care of oral health, the temporomandibular joint (TMJ), dental occlusion, and associated oral structures with focused emphasis on the proper protocol for diagnosis, treatment,

Policy Statement on a Dentist's Role in Treating Sleep-Related Breathing Disorders

Nancy Addy, DDS¹; Kathleen Bennett, DDS²; Alan Blanton, DDS³; Leslie Dort, DDS⁴; Mitchell Levine, DMD⁵; Kevin Postol, DDS⁶; Thomas Schell, DMD⁷; David Schwartz, DDS⁸; Rose Sheats, DMD⁹; Harold Smith, DDS¹⁰; for the American Academy of Dental Sleep Medicine Board of Directors

¹Snoring and Sleep Apnea Dental Treatment Center, Leawood, Kansas; ²Associated with UC Health Sleep Medicine Fellowship Program, Cincinnati, Ohio; ³Center for Dental Sleep Medicine and Orofacial Pain, University of Tennessee Health Science Center, Memphis, Tennessee; ⁴University of Calgary, Calgary, Alberta, Canada; ⁵Jacksonville Center for Snoring and Sleep Apnea, Jacksonville, Florida; ⁶Family and Cosmetic Dentistry, Ballwin, Missouri; ⁷Schellnoble Dentistry, Lebanon, New Hampshire; ⁸The Center for Sleep Medicine, Skokie, Illinois; ⁹Chapel Hill, North Carolina; ¹⁰Dental Sleep Medicine of Indiana, Indianapolis, Indiana

The American Academy of Dental Sleep Medicine (AASDM) is the only non-profit national professional society dedicated exclusively to the practice of dental sleep medicine and firmly believes that by screening and providing oral appliance therapy, dentists, with appropriate training and in collaboration with physicians, help reduce the number of undiagnosed and untreated patients with sleep-disordered breathing, which includes snoring and obstructive sleep apnea.

It is the position of the AASDM that:

- Dentists play an integral role in reducing the public health burden of undiagnosed and untreated sleep-related breathing disorders.
- Dentists should screen patients for sleep-disordered breathing with questionnaires and by evaluating the airway.
- Physicians are responsible for diagnosing sleep-disordered breathing and primary snoring, as well as prescribing the most appropriate or acceptable treatment options.
- Education in dental sleep medicine is required in order for dentists to provide safe, quality care to patients using oral appliance therapy for sleep-related breathing disorders. At minimum, dentists should meet the educational requirements defined by the AASDM to be a "Qualified Dentist" in dental sleep medicine.¹
- Dentists should verify oral appliance treatment efficacy using objective data only as permitted within their scope of practice and as defined by their state dental practice acts.
- Following the fitting and initial titration of an oral appliance by a "Qualified Dentist," the patient should always be referred back to the physician. Physicians should confirm the treatment efficacy of oral appliance therapy in a timely manner.
- Dentists need to provide timely, appropriate and ongoing follow-up care to manage dental-related side effects of oral appliance therapy.
- Dentists, in close collaboration with physicians, are an integral component to successfully managing sleep-related breathing disorders with oral appliance therapy.

Sleep-related breathing disorders impact a significant portion of the population. It is estimated that 23.5 million of United States adults have undiagnosed or untreated obstructive sleep apnea—costing billions²; increasing the risk of health complications such as hypertension, congestive heart failure, atrial fibrillation, coronary artery disease, stroke and type 2 diabetes³; in addition to reducing the quality of life for a significant portion of the population.

It is imperative that dentists receive postgraduate training to be able to provide and manage oral appliance therapy and its side effects. Inappropriately chosen and monitored oral appliance therapy by an inadequately trained dentist exposes patients to potentially life-threatening outcomes and dentists to potentially serious medicolegal liability. The AASDM recommends that dentists have at minimum: a valid state dental license, proof of liability coverage, and at least 25 hours of recognized continuing education in dental sleep medicine provided by a non-profit organization focused on dental sleep medicine or accredited dental school within the last two years in order to provide oral appliance therapy to patients with sleep-disordered breathing.¹ The AASDM encourages all dentists providing oral appliance therapy to become "Qualified Dentists" and subsequently Diplomates of the American Board of Dental Sleep Medicine.

Dentists play an integral role in screening patients for sleep-related breathing disorders and referring patients to a physician for diagnosis. When oral appliance therapy is prescribed by a physician, qualified dentists provide custom-made, adjustable oral appliances, in addition to providing diligent ongoing follow-up. Dentists who are not properly trained in oral appliance therapy may provide ineffective treatment and follow-up care, potentially reducing referrals from physicians to dentists and the potential role that dentistry plays in lessening the burden of snoring and sleep apnea on public health.

CITATION

Addy N, Bennett K, Blanton A, Dort L, Levine M, Postol K, Schell T, Schwartz D, Sheats R, Smith H. Policy statement on a dentist's role in treating sleep-related breathing disorders. *Journal of Dental Sleep Medicine*. 2018;5(1):25–26.

AADSM Treatment Protocol: Oral Appliance Therapy for Sleep Disordered Breathing: An Update for 2013

June 2013

Conditions presented by a patient may require the dentist to deviate from this protocol while collaborating with the patient's physician to maximize treatment efficacy.

1. Medical assessment must be made by a physician before oral appliance therapy (OAT) is initiated. (1-4)
 - a. In order for the dentist to practice within the limits of his or her license as designated and required by the state in which the dentist practices, and in compliance with all applicable state and federal regulations, the dentist shall refer the patient to the physician for a complete medical evaluation and diagnosis to determine the absence or presence, and severity, of sleep-disordered breathing (SDB), which may include snoring, upper airway resistance syndrome (UARS) or obstructive sleep apnea (OSA). Following diagnosis, the dentist may provide OAT as appropriate with a prescription provided by a physician that has had a face-to-face evaluation. The treatment of primary snoring does not require a physician's prescription; or
 - b. The physician refers the patient directly to the dentist for OAT as appropriate.
2. The diagnostic sleep study is interpreted by a medical sleep specialist, who provides a copy of the interpretation to the dentist for review. The reviewed copy of the interpretation shall be maintained in the patient record.
3. The dentist assesses the patient through a complete clinical examination, including a determination of the current health and prognosis of oral tissues that might be affected by OAT. Evaluation of a recent radiographic survey is important to a complete examination. The dentist recommends the choice of appliance (1, 2, 5, 6, 7, 8), discloses and discusses relevant fees with the patient, and explains the rationale for OAT to the patient while recording all appropriate documentation. A dentist who owns or has any partial ownership of the device, or patent for the device, that is being recommended for treatment must disclose this information to the patient as a potential conflict of interest (COI) prior to the delivery of the device to the patient.
4. The dentist communicates the proposed plan for OAT to the patient's physician, and appropriate health care providers, and the dentist regularly provides the patient's physician and other health care providers with progress and follow-up notes, as well as other pertinent information. (1,2)
5. The dentist shall provide the patient with a copy of the consent form prior to appliance delivery. (9)
6. In accordance with protocol established between the treating dentist and referring physician, the dentist fabricates a custom-made oral appliance and meets with the patient for an initial calibration and adjustment. After this initial calibration, the dentist may obtain objective data during an initial trial period to verify that the oral appliance effectively improves upper airway patency during sleep by enlarging the upper airway and/or decreasing upper airway collapsibility. If necessary, the dentist makes further adjustments to the device during a final calibration to ensure that optimal fit and positioning have been attained. (10-13)
7. Following the final calibration, the dentist refers the patient back to the physician for a medical evaluation and assessment of OAT outcomes. To ensure satisfactory therapeutic benefit, an order may be written for the patient to undergo an overnight sleep test with the oral appliance in place. If the treatment is sub-therapeutic, the physician and dentist collaborate to discuss: the possibility of further calibration, validated alternative treatments, or combining positive airway pressure (PAP) therapy with OAT. (11-13)
8. Patients diagnosed with primary snoring may be treated without objective, follow-up data; however, the patients should be reevaluated at least annually.
9. Follow-up protocol after the final calibration should include a patient evaluation every six (6) months for the first year and at least annually thereafter. The annual recall exam should: verify appliance efficacy and occlusion stability; check the structural integrity of the device; ensure that there is a resolution of symptoms such as snoring and daytime sleepiness; inquire about patient comfort and adherence to therapy; and screen for possible side effects. If the patient's annual assessment reveals symptoms of worsening OSA or the potential need for additional adjustments to the device, then the dentist shall communicate this information to the patient's physician. (1, 2, 5, 14-16)
10. Knowledge of various appliances is strongly recommended, as no single appliance is effective for treatment of all patients. Dentists who treat SDB are encouraged and have a responsibility to routinely pursue additional education in the field and to comply with all applicable state and federal regulations. (6, 7, 8, 17, 18)

AADSM Treatment Protocol

1. **Medical assessment must be made by a physician** before oral appliance therapy (OAT) is initiated. (1-4)

a. In order for the dentist to practice within the limits of his or her license as designated and required by the state in which the dentist practices, and in compliance with all applicable state and federal regulations, **the dentist shall refer the patient to the physician for a complete medical evaluation and diagnosis to determine the absence or presence, and severity, of sleep-disordered breathing (SDB), which may include snoring, upper airway resistance syndrome (UARS) or obstructive sleep apnea (OSA).** Following diagnosis, the dentist may provide OAT as appropriate with **a prescription provided by a physician** that has had a face-to-face evaluation. The treatment of primary snoring does not require a physician's prescription; or

b. The physician refers the patient directly to the dentist for OAT as appropriate.

AADSM Treatment Protocol

- 2. **The diagnostic sleep study is interpreted by a medical sleep specialist, who provides a copy of the interpretation to the dentist for review.** The reviewed copy of the interpretation shall be maintained in the patient record.

- 3. **The dentist assesses the patient through a complete clinical examination, including a determination of the current health and prognosis of oral tissues that might be affected by OAT.** Evaluation of a recent radiographic survey is important to a complete examination. The dentist recommends the choice of appliance (1, 2, 5, 6, 7, 8), discloses and discusses relevant fees with the patient, and explains the rationale for OAT to the patient while recording all appropriate documentation. A dentist who owns or has any partial ownership of the device, or patent for the device, that is being recommended for treatment must disclose this information to the patient as a potential conflict of interest (COI) prior to the delivery of the device to the patient.

AADSM Treatment Protocol

- 4. **The dentist communicates the proposed plan for OAT to the patient's physician, and appropriate health care providers**, and the dentist regularly provides the patient's physician and other health care providers with progress and follow-up notes, as well as other pertinent information. (1,2)
- 5. **The dentist shall provide the patient with a copy of the consent form** prior to appliance delivery. (9)
- 6. In accordance with protocol established between the treating dentist and referring physician, **the dentist fabricates a custom-made oral appliance and meets with the patient for an initial calibration and adjustment**. After this initial calibration, the dentist may obtain objective data during an initial trial period to verify that the oral appliance effectively improves upper airway patency during sleep by enlarging the upper airway and/or decreasing upper airway collapsibility. If necessary, the dentist makes further adjustments to the device during a final calibration to ensure that optimal fit and positioning have been attained. (10-13)

AADSM Treatment Protocol

- 7. Following the final calibration, **the dentist refers the patient back to the physician for a medical evaluation and assessment of OAT outcomes.** To ensure satisfactory therapeutic benefit, an order may be written for the patient to undergo an overnight sleep test with the oral appliance in place. If the treatment is sub-therapeutic, the physician and dentist collaborate to discuss: the possibility of further calibration, validated alternative treatments, or combining positive airway pressure (PAP) therapy with OAT. (11-13)
- 8. **Patients diagnosed with primary snoring may be treated without objective, follow-up data; however, the patients should be reevaluated at least annually.**

AADSM Treatment Protocol

- 9. **Follow-up protocol after the final calibration should include a patient evaluation every six (6) months for the first year and at least annually thereafter.** The annual recall exam should: verify appliance efficacy and occlusion stability; check the structural integrity of the device; ensure that there is a resolution of symptoms such as snoring and daytime sleepiness; inquire about patient comfort and adherence to therapy; and screen for possible side effects. If the patient's annual assessment reveals symptoms of worsening OSA or the potential need for additional adjustments to the device, then the dentist shall communicate this information to the patient's physician. (1, 2, 5, 14-16)
- 10. Knowledge of various appliances is strongly recommended, as no single appliance is effective for treatment of all patients. **Dentists who treat SDB are encouraged and have a responsibility to routinely pursue additional education in the field** and to comply with all applicable state and federal regulations. (6, 7, 8, 17, 18)

Take Home Points

- While it is up to the physician to diagnose a patient with OSA, and prescribe treatment, the dentist must understand the terminology, the science, the disorder and have a good understanding of the various therapeutic options available.
- There are published guidelines that are accepted by the sleep physicians and sleep dentists and are gaining wide acceptance by insurance companies and malpractice carriers. Being ignorant of these guidelines does not protect you if you decide to treat patients without input from a physician.

Patient Management

- **Appointment Sequence**

- Initial consultation
- Comprehensive exam, History, Work-up (Impressions and bite registration)
- Appliance delivery
- 2cd Day phone call
- 1 – 2 week initial follow-up
- Calibration follow-up
- Long-term follow-up

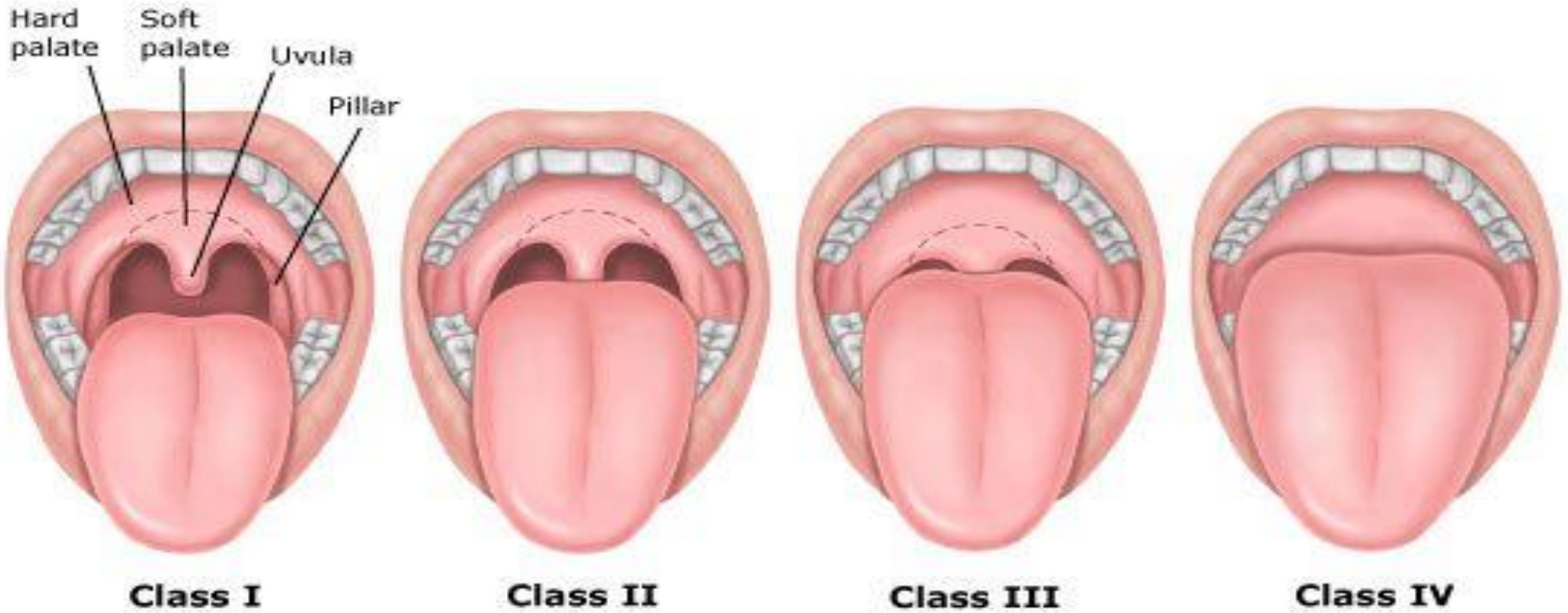
Patient Management

- **New patient Initial Consultation (Appointment # 1)**
 - Patient demographics
 - Medical insurance information – verify insurance and pre-authorization
 - Appliance candidacy paperwork and notes
 - Referral information (Referral from certified sleep physician)
 - Release of information to obtain PSGs and progress notes
 - Informed consent signed
 - Waiver of liability signed
 - Appointment made for exam work-up

Patient Management

- **Appliance candidacy**
 - Adequate number of teeth
 - Healthy teeth
 - Healthy supporting structures
 - Any TMJ issues
 - Evaluate the airway (Mallampati)

Mallampati Classification



Patient Management

- **Appliance candidacy**

- Adequate number of teeth
- Healthy teeth
- Healthy supporting structures
- Any TMJ issues
- Evaluate the airway (Mallampati)
- Enough opening to insert appliance (42 mm – 52 mm avg)
- Psychological and physical assessment

Patient Management

- **Comprehensive exam, History, Work-up (Impressions and bite registration) (Appointment # 2)**
 - Medical history
 - Sleep history
 - Family and social history
 - Comprehensive oral hard and soft tissue exam



Patient Management

- **Comprehensive exam, History, Work-up (Impressions and bite registration) (Appointment # 2)**
 - Medical history
 - Sleep history
 - Family and social history
 - Comprehensive oral hard and soft tissue exam
 - Radiographs (Panorex, Ceph, CBCT?)
 - Comprehensive TMD evaluation (Joint exam, Muscle palpations, etc.)
 - Range of Motion (ROM) measurements (protrusive, lateral, vertical, etc.)
 - Intraoral and extraoral photographs









Patient Management

- **Appliance Delivery (Appointment # 3)**
 - Quality check appliance when it comes in from lab (Correct appliance, good fit to models, correct patient, etc.)
 - Delivery appliance and make any initial adjustments to patient comfort
 - Make AM positioner (reprogrammer)







Common Management Considerations

- **Verification and/or Correction of Midline Position** – describes an effort to ascertain and maintain the appropriate lateral position of the mandible in its forward position
- **Verification and/or Correction of Occlusion** – describes an effort to ascertain balanced occlusal forces OA both bilaterally and anteriorly-posteriorly. This may encompass changes to the vertical dimension of the OA.
- **Habitual Occlusion** – refers to the position of closure between the dental arches in which the patient feels the teeth fit together most comfortably with minimal muscular stress

Patient Management

- **Appliance Delivery (Appointment # 3)**
 - Quality check appliance when it comes in from lab (Correct appliance, good fit to models, correct patient, etc.)
 - Delivery appliance and make any initial adjustments to patient comfort
 - Make AM positioner
 - Give written and verbal use and care instructions

Patient Management

- **Appliance Delivery (Appointment # 3)**
 - Quality check appliance when it comes in from lab (Correct appliance, good fit to models, correct patient, etc.)
 - Delivery appliance and make any initial adjustments to patient comfort
 - Make AM positioner
 - Give written and verbal use and care instructions
 - Best to take photos of appliance in place
 - Set appointment for 1 – 2 week initial follow-up
 - Make sure patient has contact information for any emergency

Patient Management

- **Second Day Phone Call**
 - **This is a phone call made by a staff member to check on patient to see how treatment is going, if there are any questions or there are any concerns.**
 - **This is a requirement for facility accreditation.**
- **Utilize telemedicine whenever possible during follow-up**
 - **Check-up calls, progress verification, ancillary therapy effectiveness, etc.**

Patient Management

- **Initial Follow-up Appointment (Appointment # 4)**

- Made within one to two weeks after delivery of appliance.
- Check appliance for fit and integrity.
- Check for any side effects
- Check on subjective symptom relief.
 - Snoring, night time awakenings, waking refreshed, decreased daytime sleepiness, etc.
- Check on appliance usage - # of days worn, # of hours/night
- Go over use and care of appliance.
- Ask about bed partner observations

Patient Management

- **Calibration follow-up appointments (Appointment # 5)**
 - Determine whether or not to adjust appliance if subjective symptoms have not resolved
 - These appointments are roughly monthly during first three months after delivery.
 - Some patients require more – high maintenance patients
 - Some patients may need assistance with adjustments (dexterity issues, the elderly, cognitively impaired)
 - Goal is subjective symptom relief

Ferguson, Cartwright, Rogers and Schmidt-Norwara, 2006

REVIEW

Oral Appliances for Snoring and Obstructive Sleep Apnea: A Review

Kathleen A. Ferguson, MD¹; Rosalind Cartwright, PhD²; Robert Rogers, DMD³; Wolfgang Schmidt-Norwara, MD⁴

The efficacy of OAs was established for controlling OSA in some but not all patients with treatment success (AHI less than or equal to 10) achieved on average in 52% of patients.

cians. The Committee embraces the principles of evidence-based medicine including standardized methods for literature review and criterion-based ratings of research quality. The methods are

sleep apnea?

- Do patients use OA in the treatment of snoring and obstructive

SCIENTIFIC INVESTIGATIONS

Effect of a Titration Polysomnogram on Treatment Success with a Mandibular Repositioning Appliance

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Study Objectives: Mandibular repositioning appliance (MRA) therapy is a treatment option for patients with mild to moderate sleep apnea and for patients who do not tolerate continuous positive airway pressure. Titration of MRAs consists of sequential mandibular advancement guided by symptom improvement. The goal of the study was to determine if patients with an elevated apnea hypopnea index (AHI), despite the use of a subjectively optimized MRA, could achieve better results with additional titration during polysomnography (PSG).

Methods: Patients were enrolled if they had an AHI $\geq 15/h$ and were referred for MRA therapy. The MRA was advanced until symptoms improved. During the PSG, the technologist monitored the patient's sleep and increased mandibular protrusion until the AHI was improved.

Results: There was a significant improvement in AHI, minimum oxygen saturation, and total sleep time with the MRA before further advance-

ment. At the final PSG, 65.2% of patients had an AHI ≤ 10 associated with at least a 50% reduction in AHI. The incomplete responders had their appliance further titrated, and this improved the results of MRA therapy by 30.4% to a total success rate of 95.6%.

Conclusions: This study shows that it is possible to improve the results of MRA therapy by further advancing the appliance during a titration PSG in patients with an incomplete response. The titration night improved the results of the usual clinical advancement of the MRA with substantially more patients achieving a successful outcome.

Keywords: Obstructive sleep apnea syndrome, treatment, oral appliance, titration, mandibular repositioning appliance

Citation: Almeida FR; Parker JA; Hodges JS; Lowe AA. Effect of a Titration Polysomnogram on Treatment Success with a Mandibular Repositioning Appliance. *J Clin Sleep Med* 2009;5(3):XXX-XXX.

Mandibular repositioning appliance (MRA) therapy for snoring and obstructive sleep apnea (OSA) is an accepted treatment option for patients with mild to moderate disease. A recent

study used to initiate MRA therapy in a fashion similar to the titration of nasal continuous positive airway pressure (CPAP). The first study of overnight titration used an appliance that was removed

Almeida, Parker, Hodges, Lowe and Ferguson; 2009

- This study established that overall success rates with oral appliances (MAD, MRD, etc.) could be improved from 52% (Ferguson, et al., 2006)
- In their study, Almeida and Parker had an initial success rate of 64% by just treating to subjective symptom relief.
- By incorporating HSAT and further titration of oral appliance, that success rate improved to over 80%
- By utilizing in lab PSG with titration of oral appliance, the success rate was over 90 %.
- Success was defined as reduction of the pre-treatment AHI by at least 50 % and ≤ 10 . with this criteria, they were able to improve AHI by 30.4 % over just treating to Subjective symptom relief alone (64 % to 95%). Success defined as AHI reduction of 50 % and < 5 , AHI improved by 17.4 % (64% to 82 %)

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Almeida, Parker, Hodges, Lowe and Ferguson; 2009

One protocol:

Initial protrusive position of 60%

Patient advances to subjective control of symptoms

PSG – patient was wakened to advance 1 mm/
wakening for a maximum of 3 awakenings

Offer PAP if OA not effective after 3 adjustments

Calibration HSAT

- This is an area of much debate presently.
- The sleep physicians (AASM) see use of HSAT by dentists as outside the scope of dentistry.
- There is a big push by some dentists that do OAT to have their state boards declare that is within the scope of practice for dentists.
- This is an area to watch closely over the next year.
- My personal thoughts

Patient Management

- **Long-term follow-up Appointments**
 - Established protocol from the AADSM recommends that **following follow-up appointments**
 - First long-term follow-up appointment occurs 6 months after appliance delivery
 - Next follow-up appointment occurs 12 months after appliance delivery
 - Long-term follow-up appointments occur annually after the first year for the life of the appliance.
 - Most appliances will be effective for 3 – 5 years before needing to be remade.

Patient Management

- **Follow-up appointments are to check for:**
 - Appliance integrity
 - Dental changes
 - Return of subjective symptoms

Management of Side Effects of Oral Appliance Therapy for Sleep-Disordered Breathing

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As the field of oral appliance therapy (OAT) to manage obstructive sleep apnea has evolved over the past 30 years, side effects of therapy have become increasingly recognized. Although the most commonly observed side effect is unwanted tooth movement, a number of other side effects have been reported through anecdotes, case reports, and observational studies. Members of the American Academy of Dental Sleep Medicine developed a set of consensus recommendations to guide dentists in the management of side effects as a consequence of OAT. Thirteen expert clinicians were appointed to the panel, which used the modified RAND/UCLA Appropriateness Method to review the body of evidence on OAT side effects and to establish the recommendations. Clinicians are encouraged to use these recommendations in conjunction with their clinical expertise to minimize the side effects of OAT. The recommendations are based on knowledge to date and are expected to evolve over time. Future research should aim at timely identification of these side effects for positive treatment outcomes.

KEYWORDS: malocclusion, mandibular advancement, mandibular repositioning, mouth diseases and therapeutics, oral device, orthodontic appliance, sleep apnea (obstructive and snoring), tooth disease

CITATION: Sheats RD, Schell TG, Blanton AO, Braga PM, Demko BG, Dort LC, Farquhar D, Katz SG, Masse JF, Rogers RR, Scherr SC, Schwartz DB, Spencer J. Management of side effects of oral appliance therapy for sleep-disordered breathing. *Journal of Dental Sleep Medicine*. 2017;4(4):111–125.

INTRODUCTION

The American Academy of Dental Sleep Medicine (AADSM) and American Academy of Sleep Medicine recently updated their clinical practice guideline for the treatment of obstructive sleep apnea (OSA) and snoring with oral appliance therapy (OAT).¹ The guideline included the following recommendation: “We suggest that qualified dentists provide oversight—rather than no follow-up—of oral appliance therapy in adult patients with obstructive sleep apnea, to survey for dental-related side effects or occlusal changes and reduce their incidence.”

The management of side effects is essential to maximize treatment adherence and the clinical effectiveness of oral appliances. The guideline further states that although multiple manuscripts refer to side effects, the overall evidence is limited and of low quality.

The field of dental sleep medicine lacks a set of published guidelines that clinicians and dentists can refer to for the management of side effects associated with OAT. Most of the information available to clinicians is derived from individual lecturers and is anecdotal. In an effort to begin to address this gap in knowledge, the AADSM Board of Directors convened a panel of experts to develop consensus-based recommendations for managing the most common side effects encountered in OAT.

BACKGROUND

OSA has a reported prevalence of 2% to 8% in older literature, with more recent estimates suggesting that more than 18 million adults in the United States have sleep apnea, a leading cause of excessive daytime sleepiness. An oral appliance, while effective in ameliorating the respiratory events of OSA, often causes alterations in occlusal (tooth) contacts and mandibular positioning as well as other side effects. During the Advanced Course in Oral Appliance Therapy in 2009, the AADSM first catalogued some of these side effects and proposed solutions for their management. This was originally published in *Dialogue* and was considered a work in progress.²

The purpose of this consensus paper is to update those recommendations and to develop a touchstone reference for practitioners and researchers seeking guidance on the management of side effects of OAT for sleep-disordered breathing.

METHODS

Expert Panel Selection

In accordance with the recommendations of the RAND Appropriateness Method,³ the Consensus Conference panel comprised 13 voting members. All panel members were dentists who were trained and experienced in the overall care of oral health, the temporomandibular joint (TMJ), dental occlusion, and associated oral structures with focused emphasis on the proper protocol for diagnosis, treatment,

- Consensus Conference – 13 Board Certified experts in Dental Sleep Medicine
- Over 150 years of experience
- 181 articles
- 143 articles used to support the findings
- 69 Articles cited in final report

Sheats RD, Schell TG, Blanton AO, Braga PM, Demko BG, Dort LC, Farquhar D, Katz SG, Masse JF, Rogers RR, Scherr SC, Schwartz DB, Spencer J. Management of side effects of oral appliance therapy for sleep-disordered breathing. *Journal of Dental Sleep Medicine*. 2017;4(4):111–125.

Table 1—Side effects.

Temporomandibular joint-related side effects

- Transient morning jaw pain
- Persistent temporomandibular joint pain
- Tenderness in muscles of mastication
- Joint sounds

Intraoral tissue-related side effects

- Soft tissue and tongue irritation
- Gingival irritation
- Excessive salivation/drooling
- Dry mouth

Occlusal changes

- Altered occlusal contacts/bite changes
- Incisor changes
- Decreased overjet and overbite
- Alterations in position of mandibular canines and molars
- Interproximal gaps

Damage to teeth or restorations

- Tooth mobility
- Tooth fractures or damage to dental restorations

Appliance issues

- Appliance breakage
- Allergies to appliance material
- Gagging
- Anxiety

Managing Side Effects of OAT

- **Most common Side Effects of OAT (temporary)**
 - Sore teeth
 - Sore Jaw joint
 - Feeling like the bite is off (teeth don't come together just right)
 - Excessive salivation
 - Dry mouth

Managing Side Effects of OAT

- **More Permanent Side Effects**

- Persistent TMJ pain
- Tenderness to muscles of mastication
- Altered occlusion
- Decrease in overbite and overjet
- Alteration in position of mandibular molars and canines
- Interproximal gaps

Temporomandibular Joint Related Side Effects

CAPSULITIS – the most common
TMD issue

Capsulitis – most common TMD issue

- Inflammation of the joint capsule or synovial tissue (synovitis) of the joint
- Usually caused by trauma – Macro- or micro-



Macro trauma vs. Micro trauma



Capsulitis – most common TMD issue

- Inflammation of the joint capsule or synovial tissue of the joint
- Usually caused by trauma – Macro- or micro-
- Can also be caused from oral appliance therapy.
- Usually hurts all the time
- Posterior open bite on the affected side
- Hurts to try and clench on that side
- Tongue depressor test
- Anti-inflammatories



Capsulitis - Treatment

- Anti-inflammatories
 - Ibuprofen 600 mg q6h for 4 – 7 days
 - Medrol Dose pack (MethylPREDNISalone 4mg)
- Physical Therapy – iontophoresis or phonophoresis or just creams
- Aqualizer or soft splint – splint therapy is temporary
- Hard splint if necessary – day and/or night splints may be indicated to reduce adverse joint loading

Managing Side Effects of OAT

•Teeth are going to move...Get over it !

Alan Lowe

- Inform patient and together make a decision to continue treatment or terminate treatment.

Medical Billing

- Remember, this can be a roadblock
- Nothing similar to dental insurance
- Reimbursement relies heavily on documentation
 - Progress notes in SOAP format
 - Letter of Medical Necessity
 - Physician prescribed
 - Supporting documentation (Dx PSG, CPAP intolerance, etc.)
- Entire courses offered on medical insurance coding and filing
- Insurance companies may have to be educated about OAT

Medical Billing

- OAT for the treatment SRDB is a dental procedure to treat a medical condition.
- All procedures, including work-up, exam, history, appliance fabrication, adjustment, titration and follow-up are billed to patients' medical insurance.
- There is no dental insurance coverage for OAT for the treatment of SRDB.
- There is no medical insurance coverage for the treatment of primary disruptive snoring

Medical Billing

- OAT for the treatment of OSA is a covered medical expense for most private insurers.
- Coverage is determined individually by predetermined criteria. (ie. Specific AHI/RDI values, co-morbid conditions, etc.)
- Our experience **WAS** that if covered, treatment is covered 90% - 100% of treatment fee.
- Now insurance companies negotiate fees even if you are not in network with them.

Medical Billing

- Insurance coverage has changed dramatically over the last couple of years.
- Medicare leads the way in establishing reimbursement for OAT.
- Look at companies that will do your medical insurance billing for you for a percentage or a flat fee.

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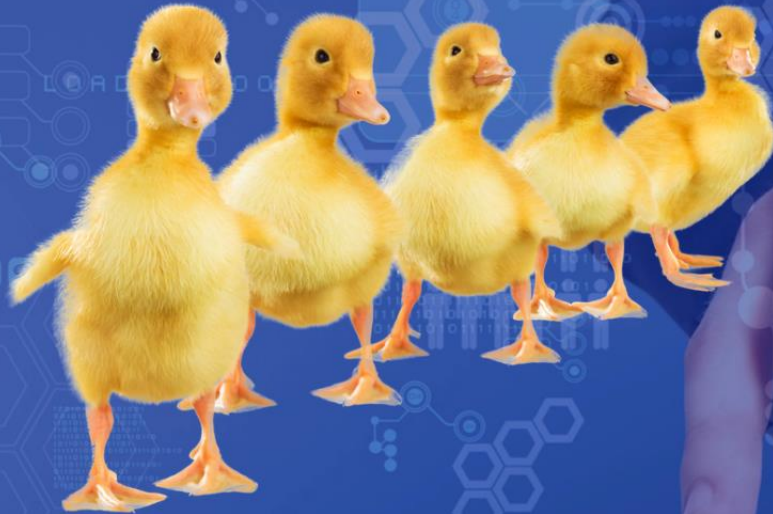
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Through adherence to these Standards, accredited facilities demonstrate a commitment to excellence in the knowledge, experience and ability of dental sleep medicine facilities to manage ongoing care for patients.

Proficiency

Accredited facilities must adhere to the Standards for the appointment, responsibilities and continuing education of staff including a dental director, clinical auxiliaries and coding and billing personnel.

Professionalism

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Practice

olicies and procedures regarding the acceptance of patients, documentation, patient treatment and billing must be developed and meet the Standards for accreditation.

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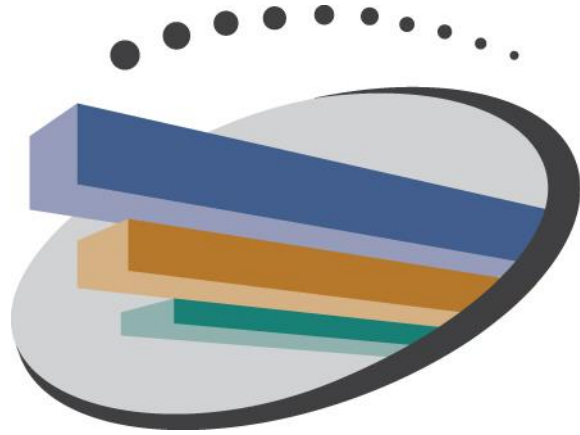
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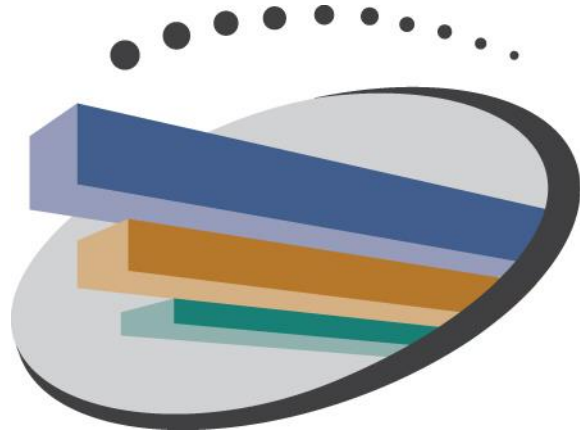
A green highway sign with a white border, tilted slightly to the right. The sign is mounted on a metal lattice structure. The background is a bright blue sky with scattered white clouds. The sign features the word "Change" in a large, bold, white sans-serif font, and the words "Just Ahead" in a smaller, white sans-serif font below it. Five small, square, white reflective markers are visible along the bottom edge of the sign.

Change
Just Ahead



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- Insurance and Medicare

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Core Competencies

- I Impression Taking
- II Record Keeping
- III Bite Acquisition
- IV SOAP Notes
- V Treatment Planning
- VI Device Delivery

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REFLECT



CONCEPTUALISE



EXPERIMENT



THE EXPERIENTIAL
LEARNING
CYCLE

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 - Diagnostics
 - Medical Partnership
 - SOAP
 - Informed Consent
 - Treatment Planning
 - Goal setting
- Images
 - Record keeping
 - Delivery



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Pre-Session:

NO PREREQUISITES

- ✓ Five videos and Assigned Literature
- ✓ Core Competency I: Impression Taking
- ✓ Core competency II: Photographic Record Keeping



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COURSE I

Post-Session:

✓ QDD Examination



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COURSE II

Pre-Session:

- ✓ Assigned Literature
- ✓ Screening and Referral of two patients with SOAP notes
- ✓ Core Competency III: SOAP and Informed Consent
- ✓ Core Competency IV: Treatment Planning
- ✓ Core Competency V: Bite Acquisition



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COURSE III

Pre-Session:

- ✓ Assigned Literature
- ✓ Core Competency VI: Device Delivery and Follow-Up



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COURSE III

Post-Session:

- ✓ Follow Up visit
- ✓ Certification exam





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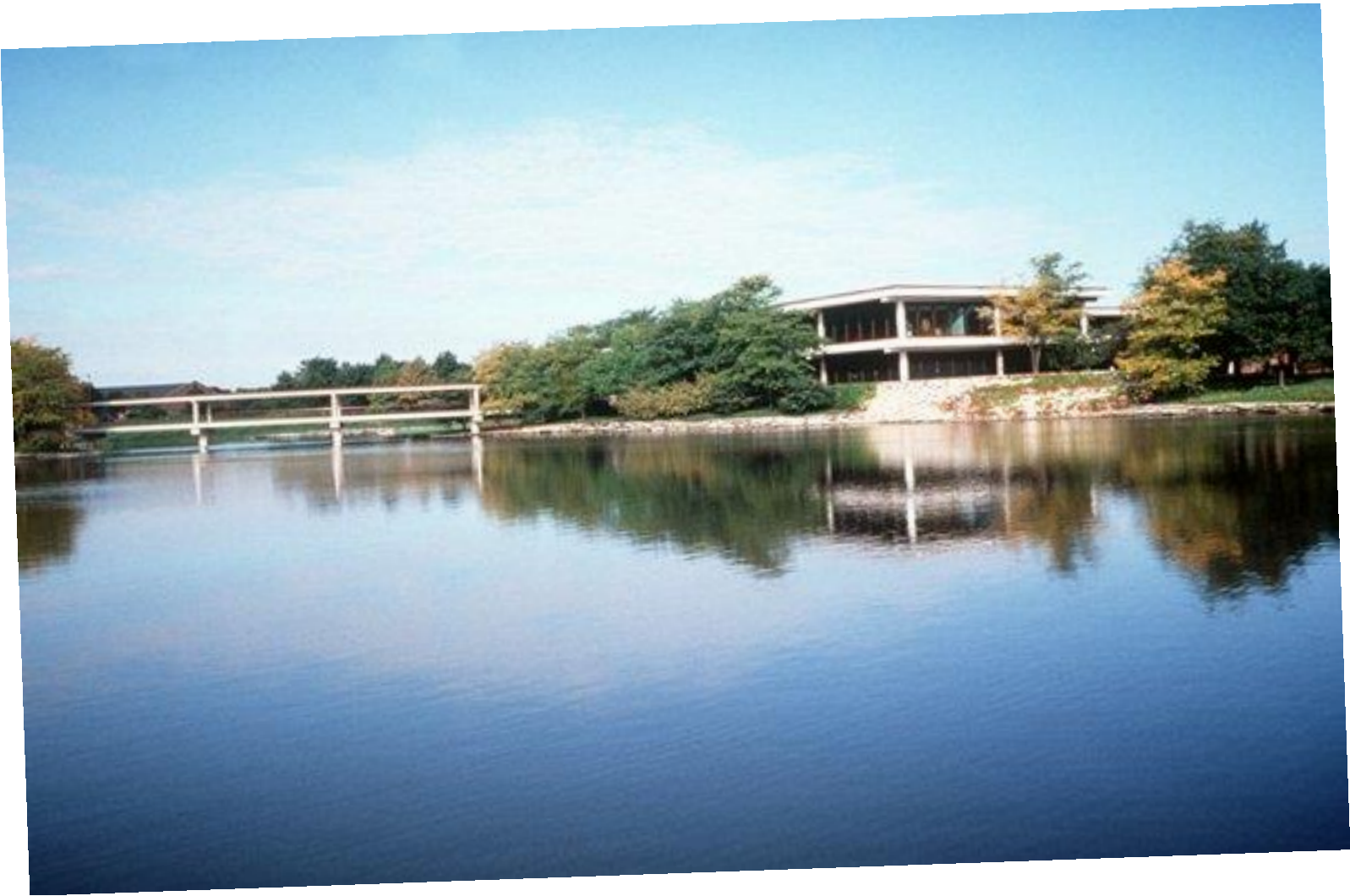
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