“High perceived benefit is the first, and perhaps the most important, step on the road to therapeutic acceptance and utilization”

Principles and Practices of Sleep Medicine, 5th ed.
Chapter 142: Monitoring Techniques for Evaluating Suspected Sleep-Disordered Breathing
Hirshkowitz and Kryger
Human Survival

- Eating
- Sleeping
- Breathing

Neurology
Otolaryngology
Cardiology
Urology
Sexual Function
what's new

...in finding people at risk?
...in getting a diagnosis?
...in treatment options?
...in the list of problems associated with sleep
...in preventing sleep apnea in the first place?
...in the practice management of sleep in the dental office?

Labeling Breathing Problems

- Apnea
- Hypopnea

AHI
New Term: REI

Apnea Levels for Adults

- Mild: AHI > 5
- Moderate: AHI 10 - 30
- Severe: AHI > 30
Apnea Levels for Children

Yes

No

Problems Associated With Sleep

Medical Issues

Social Issues

Problems Associated With Sleep

Medical Issues

Social Issues

OSA and Incident Hypertension During 4 Year Follow Up Period (Peppard et al., NEJM, 2000)

Odds Ratio (OR) for Hypertension at Follow-up

Baseline AHI

0 (Ref) 0.1-4.9 5.0-14.9 >15

OR adjusted for baseline hypertension status
OR for above + age, gender, BMI, etc.

Hypertension = BP of at least 140/90 or use of antihypertensive medications

Cardiovascular Complications of Sleep Apnea

Atul Malhotra, MD

President, American Thoracic Society

AADSM Denver 2016
**Cardiovascular Complications of Sleep Apnea**

Atul Malhotra, MD
President, American Thoracic Society

**AADSM Denver 2016**

- **CPAP vs. MAD for BP**
  - MAD may be Better

**Obstructive Sleep Apnea Among Obese Patients With Type 2 Diabetes**

- 13% were normal
- 33% had mild OSA
- 30% had moderate OSA
- 23% had severe OSA

**Diabetes Care 2009**

- **Prevalence of OSA in type 2 diabetes**
  - Most OSA cases are undiagnosed!!

**Neurotransmitters**

Sleep and Synaptic Homeostasis: Structural Evidence in Drosophila
Sleep and Chronic Pain

Poor sleep is a risk factor

Sleep disruption induces hyperalgesia and central sensitization of nociception

Clinical Implications:

Psychiatric comorbidities
Increased risk of suicide

Aggressive treatment of underlying sleep problems is likely to improve pain control

5 Year Mortality

Non-apnoeic controls 1.00 (reference)

Hypertension 1.65
Current smoking 1.99
Previous heart disease 2.37
CPAP-treated OSA 0.87
MAD-treated OSA 0.98
Untreated OSA 6.53


Hypertension                           1.65
Current smoking                      1.99
Previous heart disease            2.37
CPAP-treated OSA                  0.87
MAD-treated OSA                    0.98
Untreated OSA                         6.53
Non-apnoeic controls             1.00 (reference)
Why Treat OSA?

Using PAP

Improves your Golf Handicap


OSA Conclusions

Strong evidence that OSA causes systemic hypertension

OSA may be atherogenic but causal link is evolving

OSA is highly prevalent in Diabetes T2

Treatment of OSA is beneficial

Susan

Initial Diagnosis (PSG):  "mild" OSA

AHI 13  SpO2 nadir 93%  RDI 15.9

PAP titration (PSG):  5cm H20 = 0 apnea,   7cm = no flow limitation

AHI 1.8  RDI 10

3 years, 6+ masks and 2 flow generators later:

MicrO2 2016

ProGauge:  9mm protrusive range

Initial Setting:  45% forward, 4mm interincisal opening  for U0/L0

NoxT3

at U1/L0  AHI 1.6  ODI 0.6  Flow Limitation index 6.9%

at U1/L2  AHI 2.0  ODI 0.5  Flow Limitation 0.8%
What's For Us and Against Us

What Are We Facing?
Lausanne Switzerland

2121 people
48% male
57 yrs
BMI 25

AHI mean:
6.9 female
14.9 male
23.4% F
49.7% M

More than:
One Third of US Men
4 of every 10 US women
Nearly six in ten African American women
17% of children

What Are We Facing?

Lancet Respir Med 2 Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study

Obesity

Promoting Airway Collapse
- Negative Pressure on Inspiration
- Facial Depression
- Small Mandible

Promoting Airway Patency
- Pharyngeal Dilator
- Muscle Contraction (Genioglossus)
- Long Tongue
- Long (tongue) Traction

AHI > 15
23.4% F
49.7% M

Lancet Respir Med 2 Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study
Each Year
820,000 people fail CPAP
110,000 claims for E0486

Popular Screeners
- Oximetry
- Epworth Sleepiness Scale

Undiagnosed
- 1996: 15% undiagnosed, 85% diagnosed
- 2016: 15% undiagnosed, 85% diagnosed

STOP Smoking: 110,000 claims for E0486
Snoring
Tiredness / sleepy during the day
Observed stop breathing
Pressure if being treated with medication for high blood pressure

BMI > 35
Age > 50
Neck circumference > 40 cm
Gender (male)

Sensitivity: 86 – 96%
NPV: 85 – 94%

Snoring? OR of AHI > 5: 3.9
Stopped breathing? OR of AHI > 5: 5.8
Sens: 65% Spec: 76% PPV 90%

Elbow Test

What About Imaging?

CBCT

Lack of robust evidence to use CBCT as a treatment assessment tool

Three studies using oral appliances and CBCT:

CBCT may emerge as an objective tool to anatomically and functionally assess OSA treatment outcomes

What About Profiling?

- Disease severity
- Body position during sleep
- Age
- Gender
- Weight
- Anatomical features
- Imaging

Wearables?

Getting a Diagnosis

Your Office? Law
Sleep Lab? $$$
Remote?
Clinical Use of a Home Sleep Apnea Test:
An American Academy of Sleep Medicine Position Statement

Ilene M. Rosen, MD, MS; Douglas B. Kirsch, MD; Ronald D. Chervin, MD, MS; Kelly A. Carden, MD; Kannan Ramar, MD; R. Nisha Aurora, MD; David A. Kristo, MD; Raman K. Malhotra, MD, PhD; Jennifer L. Martin, PhD; Eric J. Olson, MD; Carol L. Rosen, MD; James A. Rowley, MD

American Academy of Sleep Medicine Board of Directors

an HSAT is a medical assessment that must be ordered by a physician

What's Our Goal Here?
Symptoms? Physiology?
AHI targets? Open Airway?

Airway

Treatment Options
Surgery OAT PAP Positional
Treatment Options

- Surgery
- PAP
- Positional
- OAT
- Weight Loss
- CN XII stimulant
- Combinations

What Surgery?
- Turbinates
- Adenoids/Tonsils
- Palate
- Lingual Tonsils
- Hyoid
- Epiglottal

Does it Work?
512 of 518 patients improved
AHI: 455 pts 389 improved 175 cured
RDI: 68 pts 44 improved 13 cured

Zaghi S1, Holty JE2, Certal V3, Abdullatif J4, Guilleminault C5, Powell NB6, Riley RW6, Camacho M7.

Persistent moderate or severe obstructive sleep apnea after laparoscopic Roux-en-Y gastric bypass: which patients?

- **205 patients**
  - **AHI 32.3**
  - **Range 15 - 138**
  - **BMI avg 46**

9mo: 74% AHI < 15

**Does it Work?**

Despite its benefits, PAP adherence remains problematic. Largely related to PAP intolerance (or unwillingness):

- 20% don't initiate therapy
- Approximately 30% discontinue in first month
- By 3 years, only ¼ are “regular users” of PAP
Ineffective Dilator Muscles

Low Arousal Threshold

Anatomic Deficits

Ventilatory Control

Oral Appliances

20% have same collapsibility as OSA patients

One Size Doesn’t Fit All

70% have more than one risk factor
Mike

PSG: AHI 17.2  O2 min 87%    CC: EDS
CPAP: AHI 1.2, avg. 3 hours use,   ESS: 7
“sleep is continuously interrupted by PAP and I’m still sleepy during the day”
MicrO2  AHI 2.7  reported 6 - 8 hours/night, wakes 1x, no EDS  ESS: 1
“How would you rate your oral appliance therapy?” 10

PAP vs. MAD
OAs and PAP have similar efficacies

The best treatment for OSA is one that the patient will actually use

Patient education, treatment selection, and individualization of care are key to improving outcomes

C Letteri  AADSM 2016

Mandibular Positioning
Soft Tissues Move
So Does the Mandible
They are Connected!
## Oral Appliance Efficacy

<table>
<thead>
<tr>
<th>OSA severity</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Study A</td>
<td>62.3%</td>
<td>50.8%</td>
<td>39.9%</td>
</tr>
<tr>
<td>- Study B</td>
<td>56.6%</td>
<td>48.1%</td>
<td>21.2%</td>
</tr>
<tr>
<td>Partial Success</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Study A</td>
<td>8%</td>
<td>26.3%</td>
<td>21.7%</td>
</tr>
<tr>
<td>- Study B</td>
<td>13%</td>
<td>25%</td>
<td>24.3%</td>
</tr>
<tr>
<td>Failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Study A</td>
<td>29.7%</td>
<td>22.9%</td>
<td>38.4%</td>
</tr>
<tr>
<td>- Study B</td>
<td>30.4%</td>
<td>26.9%</td>
<td>54.5%</td>
</tr>
</tbody>
</table>

*Success = AHI < 5  
Partial success = > 50% reduction in AHI but >5*

*Study A: Holley et al. Chest 2011 retrospective, CPAP vs MAS n=378  
Study B: Phillips et al. AJRCCM 2013 RCT crossover CPAP vs MAS n=108*

Letters (Almeida, Cistulli and Carra: Principles and Practice: Parameters of Sleep Medicine, 2015, Chapter 151)

---

**MAD**

150+ devices FDA cleared

Materials and Connectors Vary

Allows Precision Medicine

---

Mono-block articulation (TMJ)

Hinge-based articulation (TMJ & incisors)

Compression-based articulation (lower canines)

Traction-based articulation (pre-molars & canines)

Traction-based articulation (rear-molars)

*Slide courtesy of ResMed*
**Sleep Herbst**
- Concerns about Mechanism
- Well Tested Widely Available
- Easy to Adjust
- Free Mandibular Movement
- Minimal Tongue Space Interference
- Great for TMD Patients

**Dorsal**
- Fully Adjustable MAD
- Can Add More Protrusion
- Allows Mouth Opening unless Elastics are Added
- Retention Not Critical
- Very Good Patient Acceptance
- There are many Similar Designs

**DreamTAP**
- Easy to Add More Protrusion and Vertical Support
- Somewhat Rigid Mandibular Positioning
- Needs Excellent Retention
- Very Good Patient Acceptance
- Very Easy Adjustments
- Customizable to Add PAP

**Narval**
- Wide Range of Adjustments
- CAD-CAM
- Aligned with Occlusal Plane
- Easy for Patients to Adjust
- Least Bulky Appliance
- Low Overall Cost
MicrO2

MethyImethacrylate for easy modification
No adjustments – advance with different parts
CAD-CAM
Reproducible

Insurance

Medicare

Jaw Muscle Pain
Drooling
Tooth Sensations
Tongue Tenderness

Complications
**Does OAT Move Teeth?**

77 patients  
Avg treatment: 11 years  
Nearly all with thermoplastic Klearway MAD  

- Overbite: -2.3mm  
- Overjet: -1.9mm  
- Crowding: -1.3mm  

Changes were progressive and continuous


**Obstructive sleep apnea and mandibular advancement splints: occlusal effects and progression of changes associated with a decade of treatment.**

Pliska BT1, Nam H1, Chen H1, Lowe AA1, Almeida FR1.

---

**Does OAT Cause TMD?**

15 patients, 9 men 6 women avg age 51

- TMD severity unchanged over 24 months  
- 6/15 patients still wore their device at 24m  
- TMD was the most frequent reason for stopping


**Effect of Mandibular Advancement Device Therapy on Signs and Symptoms of Temporomandibular Disorders**

Ritva Näpänkangas, corresponding author1,2 Antti Raunio,2,3 Kirsi Sipilä,1,4 and Aune Raustia1,2
Midfacial Hypoplasia and Pediatric OSA: Causes, Correlations, and Orthodontic Interventions

Soleil Roberts, DMD, MSD

Advancement, Force, and Anchorage

**FORCE**

**Soft Tissue**

Stronger forces demonstrated in masseters and anterior temporalis with MAD - decrease over time

Du X1, Hägg U.

Stress and Strain are at a reasonable level during opening - no injury from opening in a healthy TMJ

Li Q, Ren S, Ge C, Sun H, Li H, Duan Y, Rong O1.
Important Technology Needed

MATRx

What’s Coming?

MATRx plus does not have FDA approval and is for ‘investigational use only.’
Not currently for sale in US.
The Future

Now

ID Risk Dx Treat? Hope

The Future

ID Risk Dx Test Treat!

Stopping Sleep Apnea Before it Starts

Pediatric Sleep Breathing Disorders

Seven of Ten Kids Breathe Poorly
Whose Problem?

Risk Factors for Childhood OSAS

No. 1 Risk Factor: Adenotonsillar Hypertrophy
No. 2 Risk Factor: Adenotonsillar Hypertrophy
No. 3 Risk Factor: Adenotonsillar Hypertrophy

Then comes everything else

— says Carol Rosen, MD
Scaffold for the Upper Arch

Lips Together

Breathe Through Your Nose

Tongue in the Roof of Your Mouth

Learn to Swallow Properly

Nasal Breathing, 24/7, eliminating oral breathing, is the only valid ‘Finish Line’ in treatment of pediatric SDB

Towards Restoration of Continuous Nasal Breathing as the Ultimate Treatment Goal in Pediatric Obstructive Sleep Apnea

Christian Guilleminault and Shannon S Sullivan
**BEARS QUESTIONNAIRE**

**Bedtime**
Child have trouble going to bed or falling asleep?

**Excessive Daytime Sleepiness**
Child sleepy or groggy? Tired, moody, ‘out-of-it’?

**Awakening During the Night**
With trouble going back to sleep?

**Regularity and Duration of Sleep**
How many hours? Is this Enough?

**Snoring**
Does my child make any sleep sounds?
Any stopping, choking, or gasping?

---

**Observer Reports**

The distinctive symptoms of OSA in children are remarkably scarce and usually require a high level of suspicion or alternatively, require systematic implementation of explorative screening questions to enable their detection.

Obstructive Sleep Apnea In Children: A Critical Update
Hui-Leng Tan, David Gozal, and Leila Kheirandish-Gozal

Notice Anything?
Even children with risk factors and diagnosable disease have long periods of normal sleep.

Pediatric Obstructive Sleep Apnea Syndrome
Eliot S. Katz, MD, Carolyn M. D'Ambrosio, MD

ADHD

Chronic poor sleep results in:
- daytime tiredness
- difficulties with focused attention
- low negative emotion threshold irritability
- easy frustration
- difficulty modulating impulses

3 Types
- Hyperactive - Impulsive
- Inattentive
- Combined

Seminars in Pediatric Neurology, Mar 1996
ADHD TREATMENT

Medications

Psychiatry

Scope of Problem

U.S. children who have received Dx of ADHD: 11%

http://www.cdc.gov/ncbddd/adhd/data.html

Scope of Problem

WSJ 8/20/2012

Children receiving ADHD medications (2011-2012)

- On ADHD meds: 6%
- Peer problems: 3x
- Injuries: 2x
- Costs: $36 - $53 B / year
- Decreased performance, productivity, quality of life

ADHD - SDB CONNECTION?

Attention Deficit Hyperactivity Disorder And Sleep Disordered Breathing In Pediatric Populations: A Meta-analysis.

Sleep Med Rev. 2013 Dec 24

patients with ADHD symptomatology should receive SDB screening. Treatment of comorbid SDB should be considered before medicating the ADHD symptoms if present.
“The Evidence linking sleep pathology to symptoms of hyperactivity, inattention, and other neurobehavioral deficits is robust and convincing yet replete with contradictions.

Seldom is there so much agreement on the scope and significance of a problem with so little consensus on its meaning and mechanism”

Sleep Time Recommendations

- Infants 4m - 12m: 12 - 16 hours
- Children 1 - 2 years: 11 - 14 hours
- Children 3 - 5 years: 10 - 13 hours
- Children 6 - 12 years: 9 - 12 hours
- Teenagers 13 - 18 years: 8 - 10 hours


Treatment of Children’s Breathing

- Vigilance
- Adenotonsillectomy
- Growth and Development
- PAP
PEDiATRIC SLEEP STUDIES
Always in sleep lab
Can be done at any age
Interpretation is Different for Children
Technologist and Doctor - Special Training

DIAGNOSIS - WHAT CAN DENTISTS DO?
We are Preventive Experts
Watch Growth and Development
Support Families to get Diagnosis
Intervene Where we Can - RPE
Spread the Word

Dr. Pride:
You May Be Smarter than Me, But You’re Not Smarter than Me and My Team
Managing Sleep Therapy in Your Business

Dental
- Procedures
- Low Oversight
- Simple Insurance
- Limited Benefits

Medical
- E & M codes
- DME
- Specific Notes
- Unfamiliar Insurance
- Unlimited Benefits

Growing body of evidence based medical research supporting the use of oral appliance therapy for the treatment of OSA

Patient preferences for and compliance with oral appliance therapy is strong

Cost effectiveness of oral appliance therapy

New diagnostic and compliance monitoring technologies have heightened interest along the continuum of care

Increasing number of multidisciplinary sleep clinics and referral networks are developing that encourage physician/dentist collaboration

Aging and obese population contributing to higher rates of OSA, increased awareness and diagnosis

Sleep Physicians

71% think insurance covers OAT
31% offer new OSA patients OAT as an option
48% refer to several local dentists
82% believe OA adherence = PAP after one year

MRD market volume will double by 2020

Over the past decade, the body of scientific evidence addressing the use of oral appliance therapy and associated clinical outcomes has grown considerably

Ramar, K. et al., Journal of Clinical Sleep Medicine, Vol. 11, No. 7, 2015.
Sleep Physicians

74% are concerned about OAT effectiveness
69% worry about OAT causing discomfort
47% believe OA might have long-term bite effects

Sleep Review Survey
January 2016

“I want to try other strategies to get the patient CPAP adherent.”

Learn to Help PAP

“The oral appliance won’t record the patient’s adherence with the therapy.”

No, but they will

Sleep Review Survey
January 2016

“The patient won’t be able to afford the OA.”

Make them affordable

“I worry dentists are acting outside of the scope of practice in all or in part when treating OSA.”

Practice Parameters

“I don’t know a local dentist who I trust with my patients.”

Get to know them
more from the survey

“The patient may develop side effects from using the oral appliance.”

Yes. Be an Expert

“Patients ‘disappear’ when I refer them to a dentist.”

Communicate

85% undiagnosed

<100 new Sleep Docs / year

Heavy Public Interest

Challenging New Treatment Choices

Preventive Care for Community Health

Navigating Medical Insurance Billing

Medical NOT Dental

Diagnosis

Prescription

Impression and Plan

- It would be nice to start with Call, I will spend minutes in dental of her choice. It would take on visit twice as well.
- Follow-up for rule after OSA is complete:
- Due to the diagnostic, paraphasias and behavioral options of obstructive sleep apnea including CPAP, upper airway, positional, and surgical options.
Medical Coding

Diagnosis
International Classification of Disease (ICD)
G47.33

Procedure
E0486

What Else?
Exam               X-rays             Follow Up
Exam = Evaluation & Management Codes

Verify Benefits
Pre-Authorizations
Documentation & Tracking

Medical Clearing House
Medical Billing Software
Third Party Medical Billing Services
Verify Pre-Authorization

Documentation Financial Contract

Electronic Claim Tracking & Follow-up

“High perceived benefit is the first, and perhaps the most important, step on the road to therapeutic acceptance and utilization.”

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Hirshkowitz and Kryger

Immediate Actions - PASS OFF

P repare Your Team
A ware of Risk Factors
S creen Every Patient
S eek a Diagnosis
O ffer a Solution
F ollow Up Every Patient
F ill In Your Education

You Can’t Unlearn This
These Are Your Patients
What Are You Going To Do?
Help People Live Longer!

Steve Carstensen DDS
Diplomat, American Board of Dental Sleep Medicine
SeattleSleepEd@gmail.com

Dental Sleep Practice Magazine
www.DentalSleepPractice.com