FTS Workshop:
Non-CPAP Treatments for Sleep Apnea

Robert L. Owens, MD
University of California San Diego

ATS 2020 VIRTUAL
July 28th, 2020
Disclosures

• ResMed, a maker of PAP devices, donated money for the UCSD Sleep Medicine Clinic
Outline

• (Brief) Obstructive Sleep Apnea Introduction

• How good is CPAP anyway?

• Non PAP therapies

• Another way to think about OSA Pathogenesis (and non PAP therapy)
Pathophysiology
Pathophysiology

Cardiovascular sequelae

- ↑Endothelin
- ↓Vagus
- Sympathetic activation
- Arousal

Neurocognitive sequelae

- ↑Activity of pharyngeal dilators (genioglossus)
- Maintains upper airway patency
- Sleep fragmentation
- Sleep onset
- ↓Activity of pharyngeal dilators

Inadequate anatomy

- Compensatory negative pressure reflex

- ↑Activity of pharyngeal dilators (genioglossus)
- Maintains upper airway patency
- Sleep fragmentation
- Sleep onset
- ↓Activity of pharyngeal dilators

Hypoxia and hypercapnia

- Airway collapse
- ↑Respiratory effort
Estimation of the global prevalence and burden of obstructive sleep apnoea: a literature-based analysis


Figure 1: Estimated prevalence of obstructive sleep apnoea based on different scoring rules
AASM = American Academy of Sleep Medicine. AHI = apnoea-hypopnoea index.

In US - 54 million
24 million
Does the patient need their OSA treated?
Does the patient need their OSA treated?
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Continuous Positive Airway Pressure
Positive Airway Pressure
Impact of PAP – CV outcomes

Observational Trial of Long-term Cardiovascular Outcomes from OSA

Cumulative incidence of fatal CV events (%)

- Controls
- Snorers
- Mild OSAH
- Severe OSAH
- OSAH with CPAP

Marin Lancet 2005
Impact of PAP – blood pressure

Effect of CPAP (black) vs. sham (white) on BP

Becker Circulation 2003
Effect of OSA treatment on blood pressure
Impact of PAP – Cognitive performance

Findley Clin Chest Med 1992
Impact of PAP – Golf Handicap

Journal of Clinical Sleep Medicine
http://dx.doi.org/10.5664/jcsm.3256

Treatment of Obstructive Sleep Apnea Syndrome with Nasal Positive Airway Pressure Improves Golf Performance

Marc L. Benton, M.D., F.A.A.S.M.; Neil S. Friedman, R.N.

Morristown Medical Center, Morristown, NJ
Impact of PAP – Dose Response

Figure 1—Cumulative proportion of participants obtaining normal threshold values on the Epworth Sleepiness Scale (ESS), Multiple Sleep Latency Test (MSLT), and Functional Outcomes of Sleep Questionnaire (FOSQ). A cumulative proportion function was applied to the data in Table 3. CPAP refers to continuous positive airway pressure.

Stimulants for residual sleepiness in CPAP adherent patients?

Weaver SLEEP 2007
Adherence to CPAP

• Patient report: 75%

• Objectively measured use
  • ≥ 4 hrs for ≥ 5 nights/week: 46%

• Intensive compliance programs: 65-80%
Short-term CPAP adherence in obstructive sleep apnea: a big data analysis using real world data

Peter A. Cistulli\textsuperscript{a,g,*}, Jeff Armitstead\textsuperscript{b,g}, Jean-Louis Pepin\textsuperscript{c,g}, Holger Woehrle\textsuperscript{d,g}, Carlos M. Nunez\textsuperscript{e,g}, Adam Benjafeld\textsuperscript{e,g}, and Atul Malhotra\textsuperscript{f,g}

- 2.62 MILLION patients
  - Mile wide, inch deep?
- 75% of those who were SET UP* met CMS adherence
• Philips EncoreAnywhere
• N= 176,000
• Linked users to zip code
1. Health disparities in PAP adherence
2. Adherence improving over time
Steady Improvements in Acceptability

Interfaces

Auto-titrating PAP

- **AutoSet**
  - \( \text{PRESSURE} \) vs. \( \text{TIME} \)

- **CPAP**
  - \( \text{PRESSURE} \) vs. \( \text{TIME} \)
Steady Improvements in Acceptability

Monitoring

- Usage
- Good mask seal: 7/10
- 2.4 events per/hr: 9/10
- 2 mask on/off events: 8/10
- Your myAir score is: 85/100
Patient Engagement Using New Technology to Improve Adherence to Positive Airway Pressure Therapy: A Retrospective Analysis

Atul Malhotra, MD; Maureen E. Crocker, BS; Leslee Willes, MS; Colleen Kelly, PhD; Sue Lynch, RN; and Adam V. Bengafield, PhD

The patient engagement platform is accessed via logging in on the myAir website. Interactions with the patient include: a myAir score, usage-based praise messages, usage-based exception messages, exception-based leak, exception-based AHI, and "badges." The daily myAir score consists of usage hours, mask seal (to indicate levels of leak), events per hour, and number of times for mask on/off. Personalized coaching and reinforcement messages are sent via e-mail and are designed to increase self-management skills, recognize success, and identify and resolve basic treatment issues. These messages generally provide tips on how to make PAP therapy more comfortable or be messages of encouragement when patients meet a certain milestone (eg, average hours of use > 4 h). Patients in the APE group do not receive any additional materials. Patients in the UCM group did not use the patient engagement tool.
Figure 2 – Distribution of mean nightly positive airway pressure usage. See Figure 1 legend for expansion of abbreviations.
Who to treat with CPAP?

• Can always do a therapeutic trial

• Those with symptoms

• Those with severe medical co-morbidities

• Those with severe disease (by AHI or substantial oxygen desaturations)
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  Anatomy is the underlying problem
• How good is CPAP anyway?
  PAP works, adherence getting better
• Non PAP therapies
• Another way to think about OSA Pathogenesis (and non PAP therapy)
Assumptions about Non PAP therapies

• Adherence for non PAP therapies > CPAP

• Non PAP therapies as effective, or “effective AHI” = CPAP
  • Weighted average of AHI
  • Effectiveness in terms of AHI, ESS, Blood pressure?

• Cheaper?

• More patient-centric
Non PAP Therapies

• Behavioral

• Oral Appliances

• Upper Airway Surgery

• Other Devices
Behavioral Interventions

• **Weight Loss**

• Avoid supine sleep

• Avoid alcohol and sedatives

• Allow adequate time for sleep
Weight loss and OSA severity

Adapted from Peppard JAMA 2000
Gastric Banding Surgery versus Continuous Positive Airway Pressure for Obstructive Sleep Apnea: A Randomized Controlled Trial

<table>
<thead>
<tr>
<th></th>
<th>Baseline (n = 28)</th>
<th>9 mo (n = 25)</th>
<th>18 mo (n = 24)</th>
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</thead>
<tbody>
<tr>
<td><strong>Anthropometry</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>39.1 ± 2.9</td>
<td>35.9 ± 3.5*</td>
<td>35.7 ± 3.9*</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>115.4 ± 16.9</td>
<td>106.7 ± 18.0*</td>
<td>106.1 ± 18.0*</td>
</tr>
<tr>
<td>Neck circumference, cm</td>
<td>40.9 ± 4.3</td>
<td>40.1 ± 4.8</td>
<td>40.6 ± 3.8</td>
</tr>
<tr>
<td>Waist circumference, cm</td>
<td>123.5 ± 10.3</td>
<td>116.4 ± 13.2*</td>
<td>115.0 ± 12.5*</td>
</tr>
<tr>
<td>Hip circumference, cm</td>
<td>127.5 ± 8.6</td>
<td>120.8 ± 8.4*</td>
<td>120.8 ± 8.9*</td>
</tr>
<tr>
<td><strong>Sleep measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHI off CPAP treatment, events/h</td>
<td>51.5 ± 23.5</td>
<td>39.3 ± 26.4*</td>
<td>34.1 ± 24.6*</td>
</tr>
</tbody>
</table>

How much weight do I need to lose?

Bakker AJRCCM 2018
Weight loss is still important and should be part of OSA care

But weight loss is hard....
The Role of Weight Management in the Treatment of Adult Obstructive Sleep Apnea
An Official American Thoracic Society Clinical Practice Guideline


Conclusions: Weight-loss interventions, especially comprehensive lifestyle interventions, are associated with improvements in OSA severity, cardiometabolic comorbidities, and quality of life. The American Thoracic Society recommends that clinicians regularly assess weight and incorporate weight management strategies that are tailored to individual patient preferences into the routine treatment of adult patients with OSA who are overweight or obese.
• Eating in line with circadian phase seems healthier than eating outside circadian phase
Circadian Rhythm and Health: Time Restricted Feeding

A

Food access

Normal diet

Ad libitum

Time-restricted

NA

NT

Light

Dark

Time (h)

H

Body Composition

Weight (g)

0

10

20

30

40

50

60

NA

NT
Ten-Hour Time-Restricted Eating Reduces Weight, Blood Pressure, and Atherogenic Lipids in Patients with Metabolic Syndrome

Michael J. Wilkinson, 1,3 Emily N.C. Manoogian, 2,3 Adena Zadourian, 1 Hannah Lo, 1 Savannah Fakhouri, 2 Azarin Shoghi, 2 Xinran Wang, 2 Jason G. Fleischer, 2 Saket Navlakha, 2 Satchidananda Panda, 2,4,* and Pam R. Taub 1,*
• N = 19

• 10 hour feeding phase

• 10 week intervention, recording food intake via an app

• Actigraphy, continuous glucose monitoring, bloods, weights
<table>
<thead>
<tr>
<th>Weight, BMI, Body Fat, and Blood Pressure</th>
<th>Baseline (mean (SD))</th>
<th>TRE (mean (SD))</th>
<th>Change in TRE Baseline (mean (SD))</th>
<th>Percent Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily eating interval&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.13 (1.13)</td>
<td>10.78 (1.18)</td>
<td>−4.35 (1.32)</td>
<td>−29%</td>
<td>8.847E−11</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>97.84 (19.73)</td>
<td>94.54 (18.38)</td>
<td>−3.30 (3.20)</td>
<td>−3%</td>
<td>0.00028</td>
</tr>
<tr>
<td>BMI (kg/m&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>33.06 (4.76)</td>
<td>31.97 (4.44)</td>
<td>−1.09 (0.97)</td>
<td>−3%</td>
<td>0.00011</td>
</tr>
<tr>
<td>Percent body fat (%)</td>
<td>36.62 (4.18)</td>
<td>35.61 (4.02)</td>
<td>−1.01 (0.91)</td>
<td>−3%</td>
<td>0.00013</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>109.14 (11.21)</td>
<td>104.68 (14.79)</td>
<td>−4.46 (6.72)</td>
<td>−4%</td>
<td>0.0097</td>
</tr>
<tr>
<td>Visceral fat rating</td>
<td>16.68 (5.97)</td>
<td>16.11 (5.89)</td>
<td>−0.58 (0.77)</td>
<td>−3%</td>
<td>0.004</td>
</tr>
<tr>
<td>Systolic BP (mmHg)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>127.88 (8.89)</td>
<td>122.76 (13.35)</td>
<td>−5.12 (9.51)</td>
<td>−4%</td>
<td>0.041</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>78.47 (8.74)</td>
<td>72.00 (10.75)</td>
<td>−6.47 (7.94)</td>
<td>−8%</td>
<td>0.004</td>
</tr>
</tbody>
</table>
Behavioral Interventions

• **Weight Loss**
  This should be standard of care for overweight and obese OSA patients

• **Avoid supine sleep... DEVICES**

• Avoid alcohol and sedatives

• Allow adequate time for sleep
• Many therapies have limited evidence
  • Trials are small, non-randomized

• Often have the assumption that adherence will be better than CPAP

• Variety of surgeries, oral appliances with different operator skill

• Limited outcome data beyond AHI
Position Therapy

Philips NightBalance
We’re on your side
Comparing treatment effects of a convenient vibratory positional device to CPAP in positional OSA: a crossover randomised controlled trial

Yingjuan Mok,¹,² Alvin Tan,¹,³ Pon Poh Hsu,¹,³ Audrey Seow,⁴ Yiong Huak Chan,⁵ Hang Siang Wong,¹,² Yvonne Poh,⁴ Keith K H Wong⁶

Figure 3  Patient treatment adherence. CPAP, continuous positive airway pressure; PT, positional therapy.
Non PAP Therapies

• Behavioral

• Oral Appliances

• Upper Airway Surgery

• Other Devices
Start above the oropharynx if needed...
Oral appliances

- Not one device
- Variable efficacy
  - Variable practitioner skill
  - Hard to predict good response
  - Less data re: outcomes compared to PAP
- Not insignificant side effects
  - TMJ discomfort, dental misalignment, and salivation
Review

Oral Appliance Therapy for Obstructive Sleep Apnoea: State of the Art

Kate Sutherland \(^1,2,\ast\) and Peter A. Cistulli \(^1,2\) \(\text{ID}\)

\(^1\) Sleep Research Group, Charles Perkins Centre and Northern Clinical School, Faculty of Medicine and Health, University of Sydney, Sydney, NSW 2006, Australia; peter.cistulli@sydney.edu.au

\(^2\) Department of Respiratory Medicine, Royal North Shore Hospital, Sydney, NSW 2065, Australia

\(\ast\) Correspondence: kate.sutherland@sydney.edu.au

Received: 1 November 2019; Accepted: 27 November 2019; Published: 2 December 2019
Oral appliances
Health Outcomes of Continuous Positive Airway Pressure versus Oral Appliance Treatment for Obstructive Sleep Apnea
A Randomized Controlled Trial

Craig L. Phillips¹,², Ronald R. Grunstein²,³, M. Ali Darendeliler⁴, Anastasia S. Mihailidou⁵,⁶, Vasantha K. Srinivasan⁴, Brendon J. Yee²,³, Guy B. Marks²,⁷, and Peter A. Cistulli¹,²

Kind of data you would like to have
122 entered acclimatisation phase

62 acclimatised to CPAP then MAD
- 7 early withdrawals
  - 1: Time commitments
  - 1: Not compliant
  - 1: Unable to tolerate CPAP and wished to withdraw
  - 1: Serious Adverse Event
55 completed acclimatisation
- 2 weeks washout
  - 56 completed CPAP first
  - 2 weeks washout
  - 56 completed MAD last
  - 56 completers
108 completers

60 acclimatised to MAD then CPAP
- 2 early withdrawals
  - 1: Time commitments
  - 1: Broken tooth & time
58 completed acclimatisation
- 54 completed MAD first
- 2 early withdrawals
  - 1: Personal reasons & time
  - 1: Not compliant with protocol
52 completers

110 entered treatment phase

Moderate to severe OSA
PAP More effective at reducing the AHI
Compliance higher with oral appliance

Reduction in Epworth Sleepiness Scale about the same
OA similar to CPAP

• Effective AHI close

• Both lowered BP in those with HTN

• Which therapy should you try first?
  • Variable response?
  • Payor?
Predictors of response

- Less severe OSA as assessed by the AHI
- Lower CPAP holding pressure
- Younger
- Less Obese
- Women

4. Factors Related to Oral Appliance Efficacy and Prediction Methods

The uncertainty around the level of AHI reduction achieved following OA therapy has remained a clinical barrier to the implementation of OAs in routine clinical practice. A clinical prediction method has been a focus of much research, but this ‘holy grail’ remains elusive. A complexity in comparing prediction studies is the variation in treatment response definitions. Many studies have started to
Recent News

2021 Annual Meeting Call for Topics and Speakers
Submit suggestions for topic ideas or speakers for the 2021 AADSM Annual Meeting

Dr. David Schwartz Named

Membership
Join the American Academy of Dental Sleep Medicine and gain access to exclusive educational resources, practice management support, networking opportunities and more.

- Login Now
- Member Benefits and Join
Surgical Treatment Options

• Nasal operation
• Tonsillectomy
• Uvulopalatopharyngoplasty (UPPP)
• Laser-assisted uvulopalatopharyngoplasty (LAUP)
• Radiofrequency tissue volume reduction
• Palatal implants
• Genioglossal advancement
• Maxillomandibular advancement
Uvulopalatopharyngoplasty (UPPP)
Best results with most radical surgeries
Surgical Treatment Options

• Some similar predictors of success: more mild OSA, less obesity, obvious upper airway abnormality
  • “Kissing tonsils”

• Similar shortcomings as OA therapy research

• Co-evaluation with ENT colleague
Non PAP Therapies

• Behavioral

• Oral Appliances
  Trying to create larger/stiffer airway
  Few good trials

• Upper airway Surgery
  Patient selection/procedure/operator specific

• Other Devices
Nasal Valves

Provent Therapy, Ventus Medical
Nasal valves act during expiration

**Inspiration**
- Valve open
- Normal breathing

**Expiration**
- Valve closed, increased resistance
- Creates positive pressure
What (we think) nasal valves do

RANDOMIZED TRIAL OF NOVEL EPAP DEVICE FOR TREATMENT OF OSA

A Novel Nasal Expiratory Positive Airway Pressure (EPAP) Device for the Treatment of Obstructive Sleep Apnea: A Randomized Controlled Trial

Richard B. Berry, MD1; Meir H. Kryger, MD2; Clifford A. Massie, PhD3
Winx

No longer available
Hypoglossal Nerve Stimulator therapy

Strollo NEJM 2014
Upper-Airway Stimulation for Obstructive Sleep Apnea

Patrick J. Strollo, Jr., M.D., Ryan J. Soose, M.D., Joachim Kornhuber, M.D., Nico de Vries, M.D., Jason Cornelius, M.D., Oleg Fisch, M.D., Ronald D. Hanson, M.D., Tapan A. Padhya, M.D., David P. Cogan, M.D., M. Boyd Gillespie, M.D., B. Tucker Woodson, M.D., Paul H. Vanყ, M.D., Mark G. Goetting, M.D., Olivier M. Vanderveken, M.D., Ph.D., Lennart Knaack, M.D., and Kingman P. Strohl, M.D., for the Upper Airway Stimulation Therapy for Obstructive Sleep Apnea (UASTE) Study Group

A

Apnea-Hypopnea Index

<table>
<thead>
<tr>
<th>Score (events/hr)</th>
<th>Therapy-maintenance group (N=23)</th>
<th>Therapy-withdrawal group (N=23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>31.3</td>
<td>30.1</td>
</tr>
<tr>
<td>Month 12</td>
<td>7.2</td>
<td>7.6</td>
</tr>
<tr>
<td>Randomized, therapy-withdrawal trial</td>
<td>8.9</td>
<td>25.8</td>
</tr>
</tbody>
</table>
Figure S3. AHI Changes in Responders and Non-responders

BMI<32

Cost
Upper Airway Muscle Training

Cite this article as: BMJ, doi:10.1136/bmj.38705.470590.55 (published 23 December 2005)

Research

Didgeridoo playing as alternative treatment for obstructive sleep apnoea syndrome: randomised controlled trial

Milo A Puhan, Alex Suarez, Christian Lo Cascio, Alfred Zahn, Markus Heitz, Otto Braendli
Improvements in AHI, ESS
Outline

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  Anatomy is the underlying problem
• How good is CPAP anyway?
  PAP works, adherence getting better
• Non PAP therapies
  Variable response
• Another way to think about OSA Pathogenesis (and non PAP therapy)
Pathophysiology
Obstructive Sleep Apnea

Pathogenesis of sleep apnea

- Poor upper airway muscle response
- High loop gain
- Small, collapsible upper airway
- Low arousal threshold

Obstructive Sleep Apnea
A new model that includes Effect Modification

Upper airway passive anatomy

- Open
  - No OSA
    (High LG – CSA?)
    (Low AT – insomnia?)
- Closed
  - OSA

Exposure

Effect modifiers

Outcome

Owens SLEEP 2015
Non anatomical traits are important in some people

Upper airway passive anatomy

Open

Vulnerable Anatomy

Loop gain
Arousal threshold
Upper airway gain

Closed

Exposure

Effect modifiers

No OSA

OSA

Outcome
Anatomy is important in everyone

- Worse Anatomy
- Better Anatomy

Vulnerable anatomy – could go either way

Always have OSA

Never have OSA

AHI (Apnea Severity)

Pcrit (cmH₂O)
Physiology may help:

• Understand the cause of OSA in an individual (or group of people)

• Choose a primary treatment for OSA?

• Predict the improvement with non PAP anatomical therapy (e.g. surgery, oral appliance)

• Predict adherence to therapy?
Targeting the underlying problem

• Arousal Threshold
  • Sedative hypnotics (eszopiclone, trazodone)
  • ?Behavioral therapy

• Loop Gain
  • Oxygen
  • Acetazolamide

• Upper airway muscles
  • HGNS
  • Drugs?
Targeting the underlying problem

Low Arousal Threshold  Not Low Arousal Threshold

Eckert Clin Sci 2011
The Combination of Supplemental Oxygen and a Hypnotic Markedly Improves Obstructive Sleep Apnea in Patients with a Mild to Moderate Upper Airway Collapsibility

Bradley A. Edwards, PhD; Scott A. Sands, PhD; Robert L. Owens, MD; Danny J. Eckert, PhD; Shane Landry, PhD; David P. White, MD; Atul Malhotra, MD; Andrew Wellman, MD, PhD

The Combination of Atomoxetine and Oxybutynin Greatly Reduces Obstructive Sleep Apnea Severity
A Randomized, Placebo-controlled, Double-Blind Crossover Trial

Luigi Taranto-Montemurro, Ludovico Messineo, Scott A. Sands, Ali Azarbarzin, Melania Marques, Bradley A. Edwards, Danny J. Eckert, David P. White, and Andrew Wellman

Sleep 2016

2019
Can physiology **predict** those who respond to oral appliances and surgery?
Can physiology predict those who respond to oral appliances and surgery?

Figure 3—The importance of nonanatomical traits is dependent on anatomy.
Can physiology **predict** those who respond to oral appliances and surgery?

**Perfect prediction**

Model without physiology predicted 4 individuals to have AHI 20-30 events/hour.

Model with physiology did a much better job.

Things like unstable ventilator control predict failure.
Endotype may predict adherence

Evidence that lean, low arousal threshold patients do not adhere to CPAP
Prevalence, Associated Clinical Features, and Impact on Continuous Positive Airway Pressure Use of a Low Respiratory Arousal Threshold Among Male United States Veterans With Obstructive Sleep Apnea

Andrey Zinchuk, MD\textsuperscript{1,*}; Bradley A. Edwards, PhD\textsuperscript{2,3,*}; Sangchoon Jeon, PhD\textsuperscript{4}; Brian B. Koo, MD\textsuperscript{6}; John Concato, MD\textsuperscript{1,6}; Scott Sands, PhD\textsuperscript{5}; Andrew Wellman, MD, PhD\textsuperscript{7}; Henry K. Yaggi, MD, MPH\textsuperscript{7}

Figure 3—Regular CPAP use among male United States Veterans with low and high ArTH, stratified by obesity (n = 889).

<table>
<thead>
<tr>
<th>BMI (kg/m\textsuperscript{2})</th>
<th>Low ArTH / Total (n)</th>
<th>Odds Ratio (95% CI)</th>
<th>Wald $\chi^2$ P</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 30</td>
<td>99 / 181</td>
<td>0.39 (0.21, 0.73)</td>
<td>0.003</td>
</tr>
<tr>
<td>$\geq$ 30</td>
<td>233 / 708</td>
<td>1.05 (0.77, 1.45)</td>
<td>0.758</td>
</tr>
</tbody>
</table>
HIGHLIGHTED TOPIC | Upper Airway Control and Function: Implications for Sleep-Disordered Breathing

The classical Starling resistor model often does not predict inspiratory airflow patterns in the human upper airway

Robert L. Owens,1 Bradley A. Edwards,1 Scott A. Sands,1 James P. Butler,1 Danny J. Eckert,1,2 David P. White,1 Atul Malhotra,1,3 and Andrew Wellman1
Airflow Shape Is Associated With the Pharyngeal Structure Causing OSA

Pedro R. Genta, MD; Scott A. Sands, PhD; James P. Butler, PhD; Stephen H. Loring, Eliot S. Katz, MD; B. Gail Demko, DMD; Eric J. Kezirian, MD, MPH; David P. White, Andrew Wellman, MD, PhD

Does the flow pattern tell you where the problem is?
Outline

• (Brief) Obstructive Sleep Apnea Pathogenesis
  Anatomy is the underlying problem

• How good is CPAP anyway?
  PAP works, adherence getting better

• Non PAP therapies
  Variable response

• Another way to think about OSA Pathogenesis (and non PAP therapy)
  Some exciting stuff to come