

Wisconsin Sleep Society 2nd Annual Conference

"Navigating a Sleep Center of Excellence"



Wisconsin Sleep Society

Helping the CPAP-Intolerant Patient to Become Tolerant with Oral Airway Devices

Dan Taché, DMD, DABDSM

Conflict of Interest Disclosures

Speaker: Daniel E. Taché, DMD, DABDSM

☐ 1. I do not have any potential conflicts of interest to disclose, OR

☒ 2. I wish to disclose the following conflicts of interest:

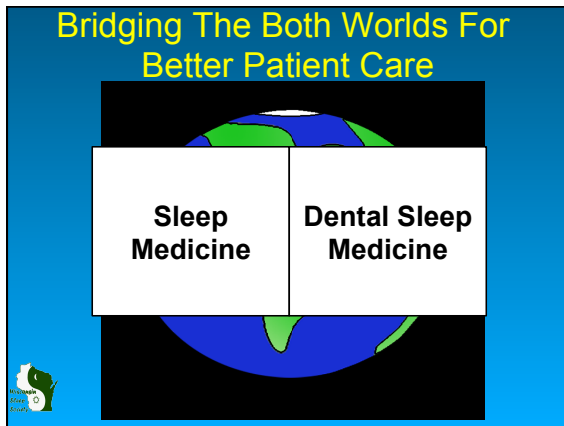
Type of Potential Conflict	Details of Potential Conflict
Grant/Research Support	
Consultant	
Speakers' Bureaus	
Financial support	
Other	Immediate Past-President of Wisconsin Sleep Society

☐ 3. The material presented in this lecture has no relationship with any of these potential conflicts, OR

☐ 4. This talk presents material that is related to one or more of these potential conflicts, and the following objective references are provided as support for this lecture

- 1.
- 2.









Graduate Studies

IV.A.2.b).(1).i)

IV.A.2.b).(1).ii)

treatment strategies in sleep disorders incorporating:

approaches for obstructive sleep apnea, including nasal CPAP, bilevel and other modes of PAP, maxillofacial and upper airway surgery, **oral appliances**, and position education; (Outcome)

in Sleep Medicine

Page 13 of 30



Can We Improve Adherence and Comfort By Through Cooperation?



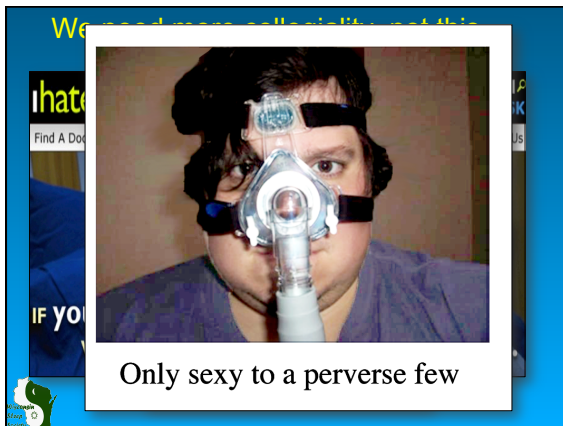

CPAP

**OAT + PAP
(Combination)**



CPAP-Intolerance



CPAP Compliance

ORIGINAL ARTICLE

Long-term compliance with continuous positive airway pressure in patients with obstructive sleep apnea

Norman Wolkove MD FRCP, Marc Baltzan MD FRCP DABSM, Hany Kamel MD, Richard Dalbusin MD FRCP, Mark Palayew MD FRCP

Norman W. MD FRCP, Long-term compliance with continuous positive airway pressure in patients with obstructive sleep apnea, Can Respir J Vol 15 No 7 October 2008

CPAP Compliance

- Although many patients with OSA derive subjective benefit from, and adhere to treatment with CPAP...
- a significant proportion of those so diagnosed either do not initiate or eventually abandon therapy

Norman W. MD FRCP, Long-term compliance with continuous positive airway pressure in patients with obstructive sleep apnea, Can Respir J Vol 15 No 7 October 2008

CPAP Compliance

Continuous Positive Airway Pressure Treatment and Adherence in Obstructive Sleep Apnea

Ellyn E. Matthews, PhD, RN, AOCNP, Mark S. Aloia, PhD, CBM^{1,2,*}

KEYWORDS

- Obstructive sleep apnea
- Continuous positive airway pressure
- Treatment adherence • Health psychology
- Behavioral medicine

Sleep Med Clin 4 (2009) 473–485

Sleep Med Clin 4 (2009) 473–485



NON-ADHERENCE STATISTICS

- Despite (CPAP) effectiveness, overall treatment adherence remains suboptimal.
- It is estimated that 15% to 30% of patients do not accept CPAP treatment from the onset
- Approximately 25% of patients discontinue PAP within the first year.



Sleep Med Clin 4 (2009) 473–485

Type of Mask May Impact on Continuous Positive Airway Pressure Adherence in Apneic Patients

- Oronasal masks negatively impact on CPAP adherence
- patients on oronasal masks show high prevalence of non-adherence
- nasal mask preferred as the first option



Borel JC, et al. (2013) Type of Mask May Impact on Continuous Positive Airway Pressure Adherence in Apneic Patients. PLoS ONE 8(5)

What Contributes To Compliance Or Non-compliance Of CPAP Use?

I. Compliant patients: Disease severity
 – Patients who experience more severe daytime

Compliance to CPAP was significantly increased after nasal surgery

 CAO M., Stanford University Sleep Disorders Clinic 3/05/2008

 **Continuous Positive Airway Pressure Delivery Interfaces For Obstructive Sleep Apnoea In Adults**

Comparing nasal mask Vs. nasal pillows:

- patients using nasal pillows showed better adherence
- nasal pillows were also associated with fewer overall adverse effects
- complete face mask or oronasal mask showed notably lower adherence
- face mask can not be recommended as a first line interface due to markedly lower adherence
- **Nasal pillows is the preferred interface in almost all patients**

 Chai CL, et al. Continuous Positive Airway Pressure Delivery Interfaces For Obstructive Sleep Apnoea. Cochrane Database of Systematic Reviews 2006, Issue 4.

Eccovision™ Airway Acoustics





What is Airway Acoustics ?

Ecovision Rhinometer & Pharyngometer™
PC Based Technology: WOOD Laboratories

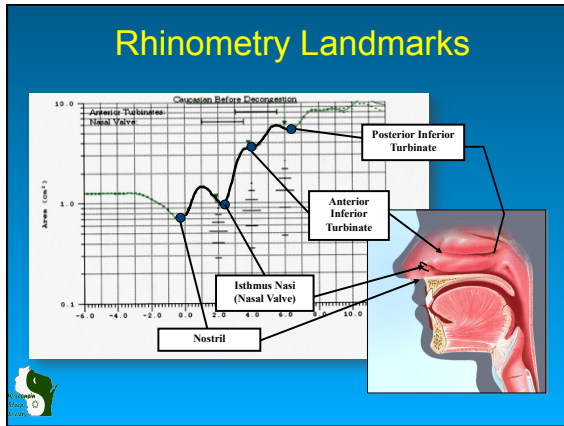
- Two Wave Tubes
 - Rhinometer
 - Measures Nasal Cavity
 - Pharyngometer
 - Measures Oral Cavity
- Distance: cm
- Cross-section: cm^2
- Volume: cm^3
- Nasal resistance: calculated estimate

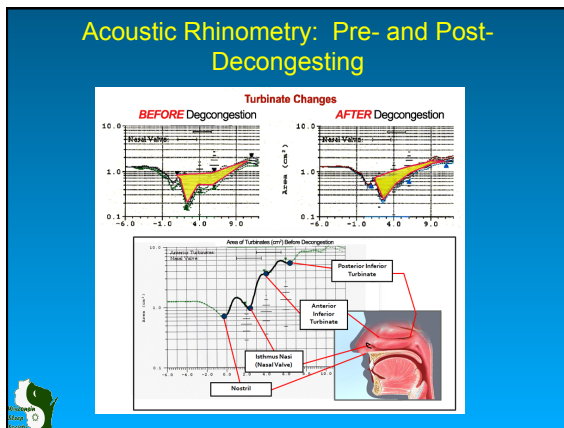
Rhinometer: Acoustic Rhinometry

Acoustic Rhinometry

- Accurate measurement of Nasal Patency
- Accurately identifies resistive areas of high upper airway (HUAR)

- Morris LG, Sellar J, Burschtein OE, Steward DL, Jacobs JB, Lee KC. Acoustic rhinometry predicts tolerance of nasal continuous positive airway pressure: A pilot study. *American Journal of Rhinology* 2006;20:133-37.
- Hilberg O, Jackson A, Swift D, Pedersen O. Acoustic rhinometry: evaluation of nasal cavity geometry by acoustic reflection. *Journal of applied physiology* 1989;66(1):295-303.
- Silkoff P, Chakravorty S, Chapnik J, Cole P, Zamel N. Reproducibility of acoustic rhinometry and rhinomanometry in normal subjects. *American Journal of Rhinology* 1999;13(2):131-35.



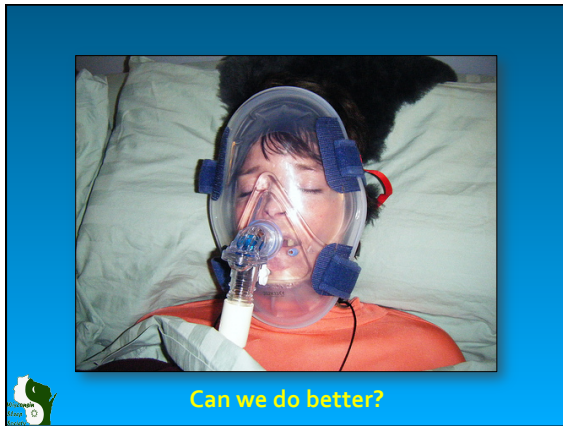


Acoustic Rhinometry: Helpful with the CPAP-Intolerant patient

High Upper Airway Resistance (HUAR)

- common finding with CPAP-Intolerant patient
- another potential explanation for the "intolerance"
- Why don't we treat this *OBVIOUS* problem before offering complete face mask or pronasal mask when patient displays intolerance due to HUAR?

Morris LG, Settler J, Burschtin OE, et al. Acoustic Rhinometry Predicts Tolerance Of Nasal Continuous Positive Airway Pressure: A Pilot Study. American Journal Of Rhinology 2006;20:333-37.







**These intraoral devices...
what are they called?**

MAD
MAS
MRD
OATs, etc.



**Mandibular Advancement
Device (MAD) Therapy**

- Design Characteristics
- Mechanism Of Action
 - Efficacy
 - Compliance



**There are 3 basic kinds of dental
appliances that are used in treatment
of Snoring and O.S.A.**



Devices that use a flange to "stiffen" and elevate soft palate



Devices that pull the tongue forward
("Tongue Retaining Devices")



Devices that reposition the mandible
(which are the most popular)



Devices That REPOSITION The Mandible

- Most effective are TITRATABLE
- Best ones allow for gradual ADVANCEMENT & DEPRESSION of mandible
- Allow for some LATERAL movement of the jaw



The TAP Series: TAP 3



The Dorsal Appliance



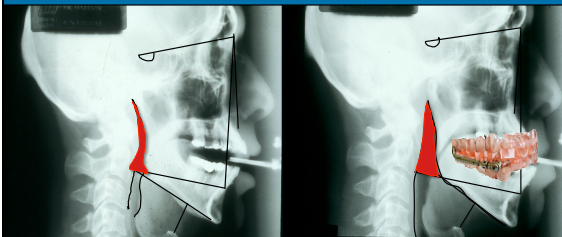
The Herbst® Appliance



Mechanism Of Action



How Do MADs work?



Effects Of Mandibular Advancement On Airway Curvature And Obstructive Sleep Apnoea Severity

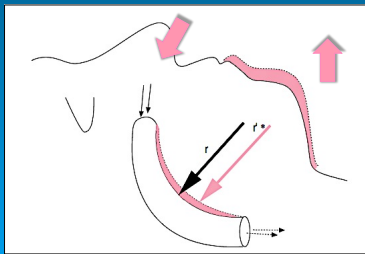
Mandibular Advancement:

1. Enlarges velopharynx (VPx)
 2. Reduces curvature of VPx
- These changes have a favorable effect on airflow dynamics



Tsuki S., et al, Effects Of Mandibular Advancement On Airway Curvature And Obstructive Sleep Apnoea Severity. Eur Respir J 2004; 23: 263-268

Reduced VPx curvature = improved nasal breathing



Mandibular **advancement** decreases the curvature of anterior wall of VPx

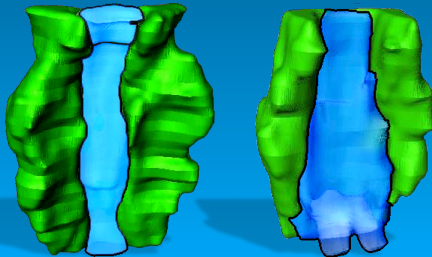


Tsuki S., et al, Effects Of Mandibular Advancement On Airway Curvature And Obstructive Sleep Apnoea Severity. Eur Respir J 2004; 23: 263-268

Effects Of Mandibular Advancement On Airway Volume

Pre-Advancement

Post-Advancement



Schwab et al, AJRCCM 168; 522-530, 2003

Oral Airway Therapy

- Efficacy
- Adherence



OAT Efficacy

OSA Severity	% Success	Rate
Mild	76%	41/50
Moderate	61%	50/82
Severe	40%	27/68

Definition of success: AHI <10 and/or <50% of AHI per PSG.



Almeida, Fernando R, et al. "Effect of a titration polysomnogram on treatment success with a mandibular repositioning appliance." *Journal of clinical sleep medicine*. JCSM: official publication of the American Academy of Sleep Medicine 5.3 (2009): 398.

Oral Appliance Therapy(OAT): Compliance=Excellent

**Compliance with Oral Appliance Therapy
Evaluated by Questionnaire**

Schmidt-Nowara (1991):	75% after mean 7 mos.
Clark (1993):	50% after 3 years
Eveloff (1994):	93% after mean 2 years
Ichioke (1995):	86% after 5 years
Menn (1996):	70% after mean 3.4 years
Pancer (1999):	86% after 350 days
Yoshida (2000):	90% after mean of 3.5 years
Clark (2000):	60% after 1 year 48% after 2 years



OAT Efficacy: CPAP Vs. OAT

Oral appliances for obstructive sleep apnoea (Review)

Lim J, Lasserson TJ, Fleetham J, Wright JJ



THE COCHRANE COLLABORATION®

This is a register of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in The Cochrane Library 2005, Issue 3
http://www.cochranelibrary.com

Lim J, Lasserson TJ, Fleetham J, Wright JJ. Oral appliances for obstructive sleep apnoea. Cochrane Database Syst Rev 2005;1.

Complexity And Efficacy Of Mandibular Advancement Splints (MAS): Understanding Their Mode Of Action

- MAS and CPAP have a similar impact on daytime sleepiness and quality of life.
- Despite MAS being inferior to CPAP in reducing the AHI... higher compliance to MAS likely translates into a similar adjusted AHI and effectiveness.

Almeida FR. Complexity And Efficacy Of Mandibular Advancement Splints: Understanding Their Mode Of Action. J Clin Sleep Med 2011;7(5):447-8

Blood Pressure Reduction CPAP vs. OA

Analysis 2.17. Comparison 2 Oral appliance versus continuous positive airways pressure Outcome 17 - Blood Pressure Outcomes - Crossover Studies.

Review: Oral appliance for obstructive sleep apnea
Comparison: 2 Oral appliance versus continuous positive airways pressure
Outcome: 17 Blood pressure outcomes - crossover studies

Study or subgroup	Oral appliance N	CPAP N	mean (SD)	mean (SD) 95% CI	mean (SD) 95% CI
1 Mean 24-hr arterial pressure					
2 Mean 24-hr systolic BP Barnes 2004	80	80	-0.4 (1.3412)		-0.40 [-3.66, 2.46]
3 Mean 24-hr diastolic BP Barnes 2004	80	80	-0.4 (1.0812)		-0.40 [-2.48, 1.68]
4 Mean diurnal arterial pressure					
5 Mean nocturnal arterial pressure					
6 Mean nocturnal diastolic Barnes 2004	80	80	-3.7 (1.3504)		-2.70 [-5.06, -0.34]

-40 -5 0 5 10
Favours OA Favours CPAP

Lim J, et al. Oral appliances for obstructive sleep apnoea. Cochrane Database Syst Rev 2005;1.

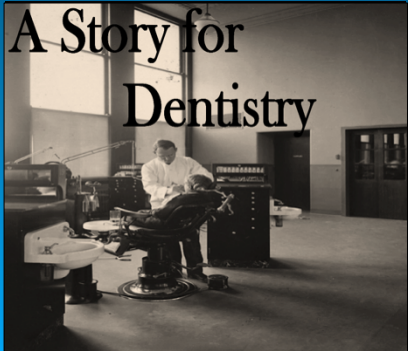
SUMMARY: OAT vs. CPAP (mild-moderate OSA)

- Outcomes indicate that **CPAP should be preferred to OAT treatment.**
- A clear **patient preference for OAT** indicates that CPAP should *not* be considered ideal in the treatment of OSAHS.

 Hoekema A., Stegenga B., deBont LGM., CROBM May 2004 vol. 15 no. 3 137-155

Combination & Hybrid Therapy

A Story for Dentistry





Improving CPAP Adherence with OAT

- Combination Therapy
- Hybrid Therapy



Combination & Hybrid Therapy Defined

Combination Therapy:

- CPAP user wears OAT device while wearing CPAP but is independent of the interface (i.e. NOT connected)

Hybrid Therapy:

- CPAP user wears intraoral device concurrently with CPAP but not attached to interface (eg: nasal pillows; mask)



Indications for Combination & Hybrid Therapy

1. **Indication:**

- emergence of central sleep apnea (CSA) due to increasing PAP pressure
- difficulty in reducing AHI due to mask leaks from excessive pressure
- discomfort from straps or allergies to straps

2. **Benefit:**

- improved mask stability due to being connected to the jaws/cranium
- reduced CPAP pressure needed to stabilize airway
- less mandibular advancement needed for greater reduction in respiratory indices



Combined Oral Appliance And Positive Airway Pressure Therapy For Obstructive Sleep Apnea: A Pilot Study

Abstract

- The high efficacy of continuous positive airway pressure (CPAP) in treating obstructive sleep apnea (OSA) is limited by poor compliance often related to pressure intolerance.
- Mandibular advancement devices (MADs) are proven alternative therapy albeit, less effective than CPAP



El-Solh AA, Motheennazima B, Akinusi ME, Churder PM, Lallomara AM. Combined oral appliance and positive airway pressure therapy for obstructive sleep apnea: a pilot study. Sleep and Breathing 2011;15(3):203-08.

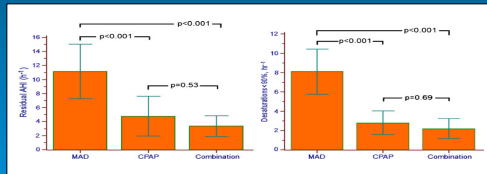
Combined Oral Appliance And Positive Airway Pressure Therapy For Obstructive Sleep Apnea: A Pilot Study

"A combination of nasal CPAP and MAD may provide another option for CPAP-intolerant patients with incomplete response to MAD."



El-Solh AA, Motheenmazima B, Akinusi ME, Churder PM, Laforama AM. Combined oral appliance and positive airway pressure therapy for obstructive sleep apnea: a pilot study. *Sleep and Breathing* 2011;15(1):203-08.

Combined Oral Appliance And Positive Airway Pressure Therapy For Obstructive Sleep Apnea: A Pilot Study



- the combination of CPAP and MAD device clearly reduced the optimal CPAP pressure by 29% while changing the AHI by 86% from baseline



El-Solh AA, Motheenmazima B, Akinusi ME, Churder PM, Laforama AM. Combined oral appliance and positive airway pressure therapy for obstructive sleep apnea: a pilot study. *Sleep and Breathing* 2011;15(1):203-08.

Combined OAT And Positive Airway Pressure Therapy For OSA

Historical Overview



The TAP®-It begins: Dallas Rehabilitation Institute 1993

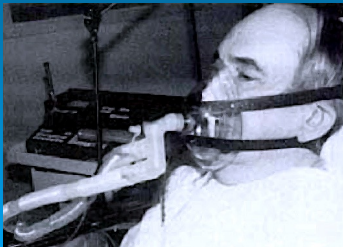


Joseph Vraslas MD

1993

The Problem: Polio/Respirators
Constant Volume Ventilators: **45 cmw !!!**

The Lyon Mask: Developed by
Respiratory Therapists



W. Keith Thornton: TAP®-PAP Developer



W. Keith Thornton DDS

"I determined that not only could I improve the mask but improve the whole technology using Dental techniques."

Meet Dorothy



Dorothy

Generally, in people with neuromuscular disorders who are having breathing problems, the main problem is hypoventilation

Who would not be inspired to help?



What can we do to help?



First:

- Separate their mouth guard and advance the mandible
- Dropped pressure to 22 cmw

Then:

- Stainless steel rod on the upper section of appliance with a "swivel"

Early designs



Other early attempts/some success!

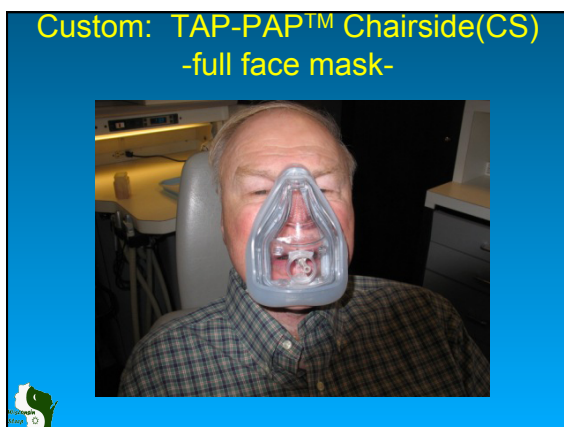


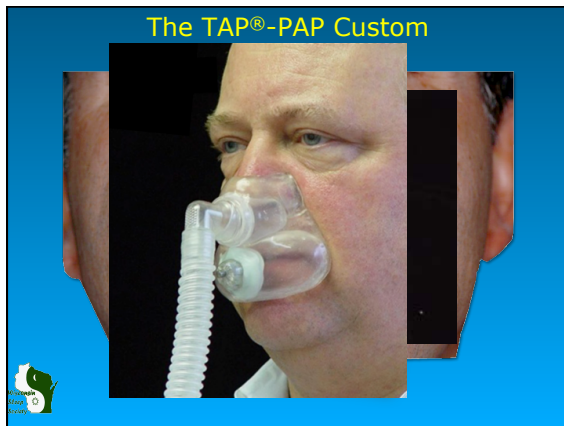
Custom and Non-custom Interface Products for Enhanced Combined Therapy with a MRD

- CPAP PRO® Attachment Interface
- The TAP®-PAP CS (Chairside)
- The TAP®-PAP Custom
- TAP-PAP Nasal Pillows (NP)





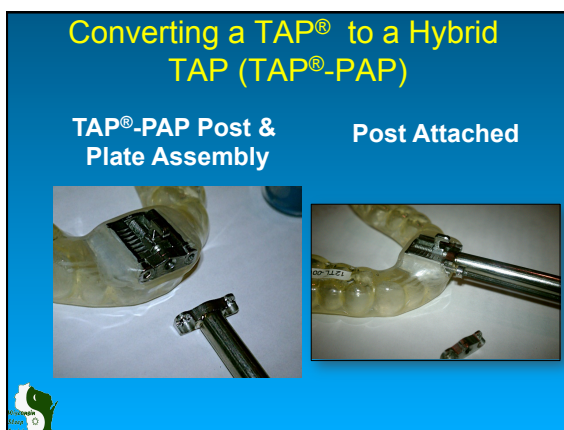














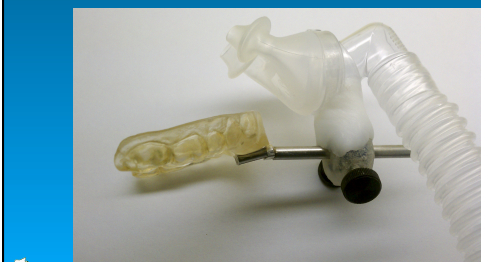
TAP-CPAP Nasal Pillows Complete



TAP-PAP CS



TAP-PAP CSSIDE VIEW



TAP-PAP CS IN PLACE-NO STRAPS
"VERY COMFORTABLE"



Support post in place; nasal
pillows stabilized

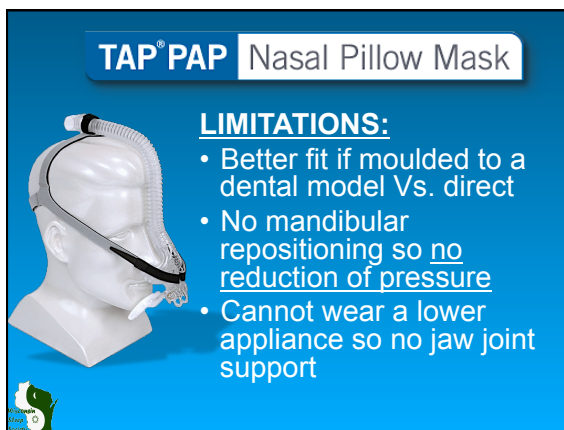


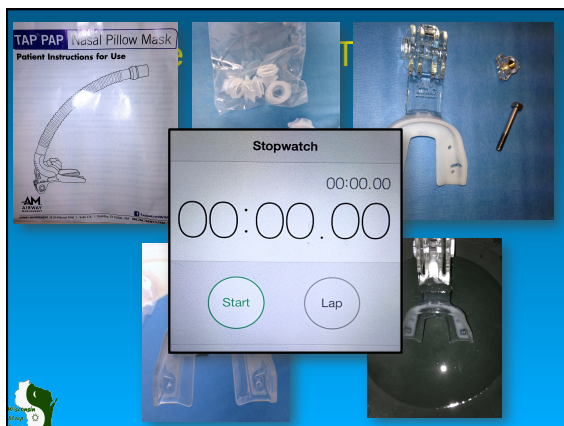
Off-the-shelf-hybrid interface

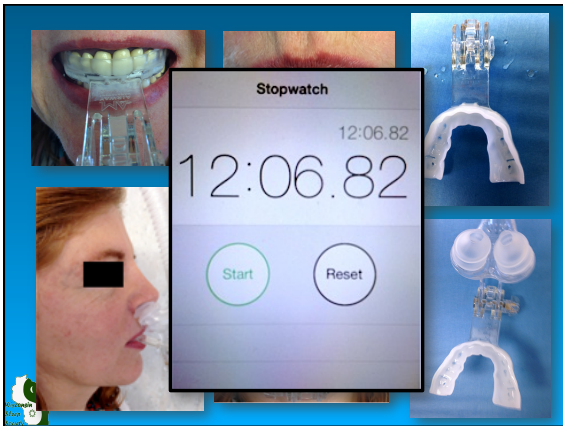
TAP® PAP Nasal Pillow Mask

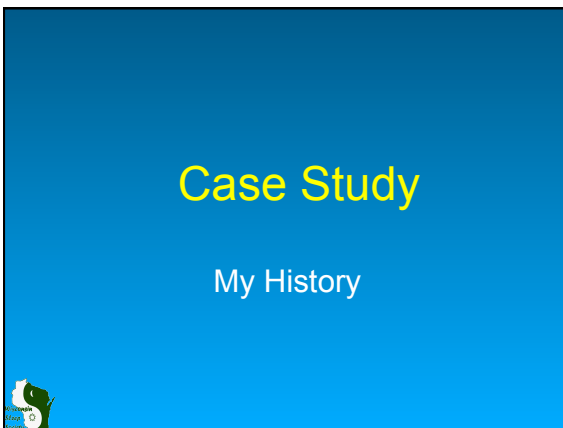














Fully titrated MAD



AHI was reduced from 22.9 to appx. 14

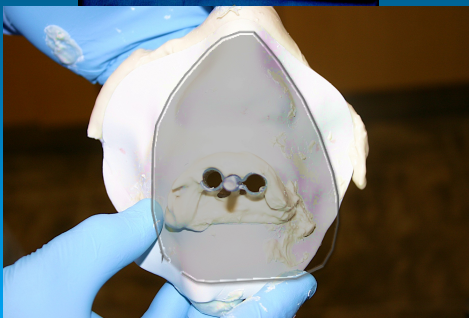


...what I did...

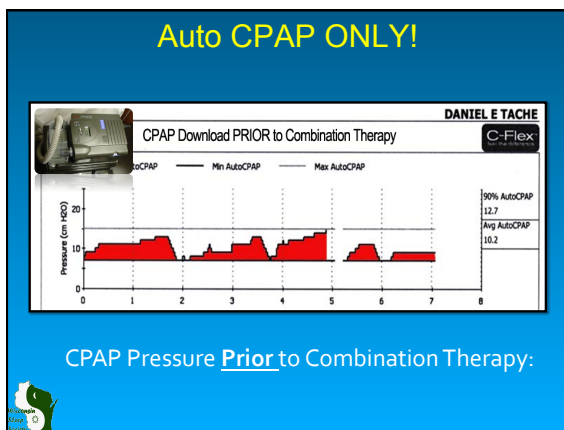
“Hybrid” Therapy

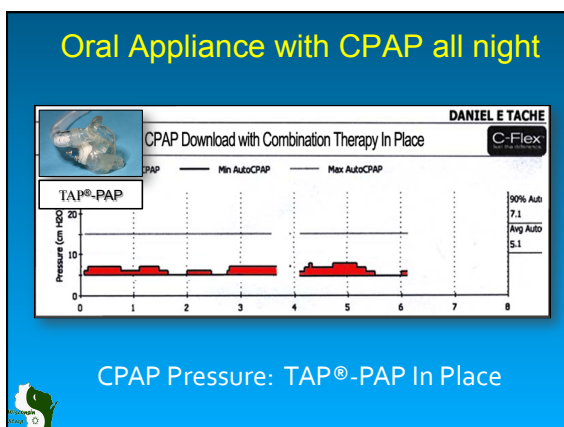


Making the Mouldage

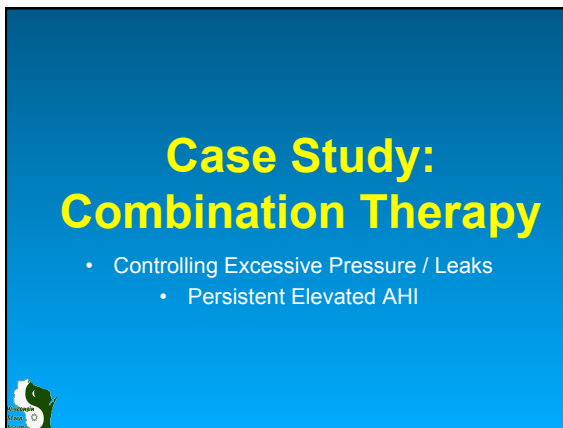


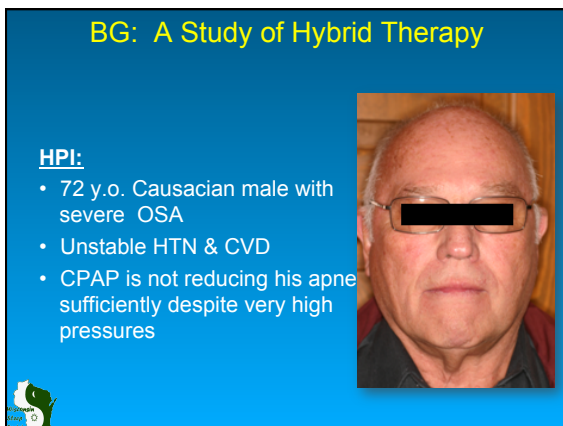










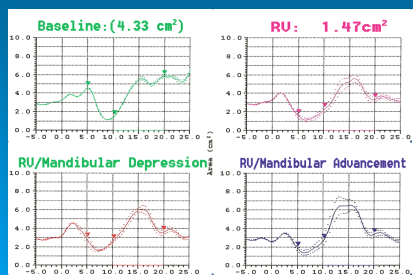


BG: Sleep Report Reveals...

- Current setting of his BiPAP are as follows:
- Pressure range= 21.0/17 cmw
- With BiPAP, apnea index remains elevated at **42.5!**



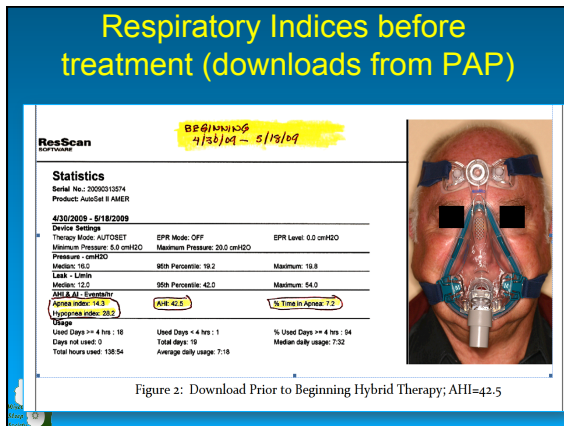
Acoustic Pharyngometry (APh)

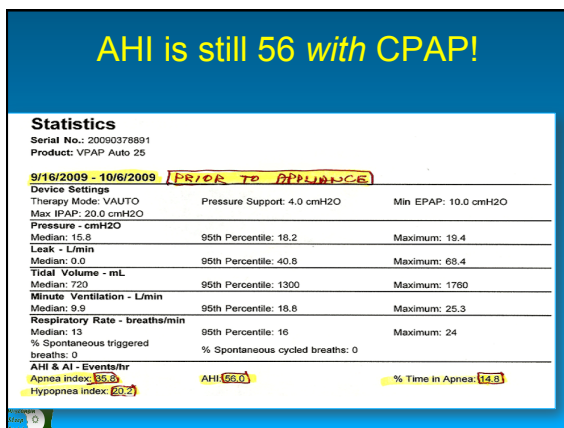


Acoustic airway analysis suggests that he should respond well to both advancement and depression.

The George Gauge Bite

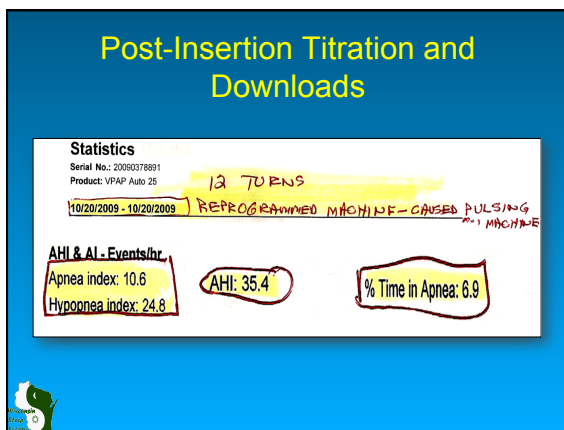


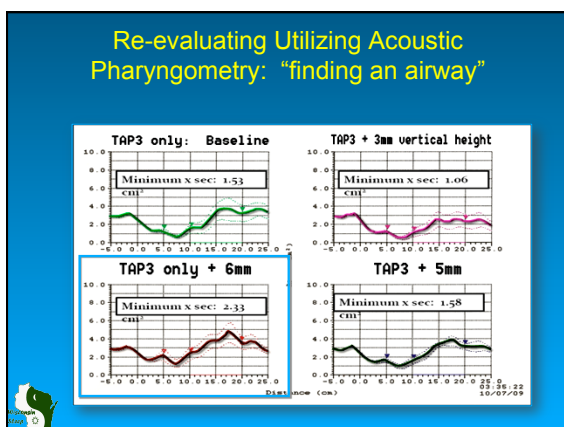




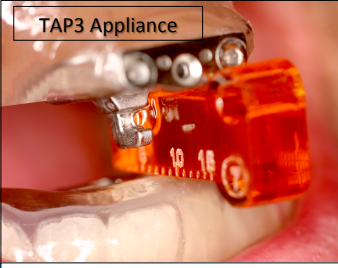








Re-evaluate our airway to look for a direction



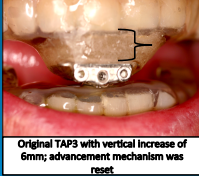
TAP3 Appliance

6 mm Vertical Titration Key (Airway Metrics VTK) in place; airway stability evaluated with Pharyngometer

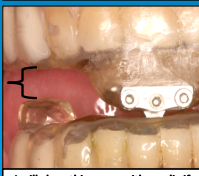
TAP 3 is modified (+ 6mm of vertical)



BG with relined TAP3 (+6mm).



Original TAP3 with vertical Increase of 6mm; advancement mechanism was reset



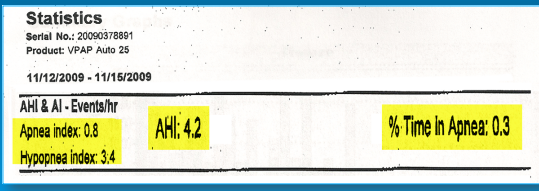
I will close this space with acrylic if we are successful

Successive downloads following the change in VDO

Statistics
 Serial No.: 20090378891
 Product: VPAP Auto 25
 11/1/09 TO 11/1/09 14 TURNS
 11/2/2009 - 11/8/2009 11/3/09 15 TURNS

AHI & AI - Events/hr
 Apnea index: 1.0
 Hypopnea index: 8.6
 AHI: 9.6
 % Time in Apnea: 0.4

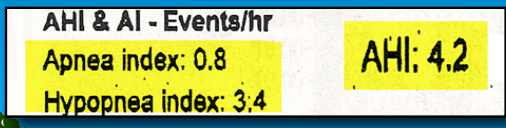
With the passage of a little time, more improvement



Statistics
 Serial No.: 20090378891
 Product: VPAP Auto 25
 11/12/2009 - 11/15/2009

AHI & AI - Events/hr		
Apnea index: 0.8	AHI: 4.2	% Time in Apnea: 0.3
Hypopnea index: 3.4		

Success:
 Completing our work: add posterior contact

AHI & AI - Events/hr
 Apnea index: 0.8
 Hypopnea index: 3.4

AHI: 4.2

A happy outcome!

Where Do You Find Trained Dentists?

American Academy of Sleep Medicine
2012
Member
All of
7-9755
-9761
DIPLOMATE
www.aasnm.com



Some final thoughts

- Consider referring for Combination Therapy (ComT), those patients who are having problems with excessive CPAP pressures
- Consider referring for ComT those patients who display the emergence of central or mixed apnea associated with excessive CPAP pressure in lieu of simply reducing PAP pressure and thereby reducing PAP efficacy
- Consider referring for Hybrid Therapy (HT) when patients' apnea is well-controlled however patients are having problems with toleration of straps or intolerance stems from mask leaks
- Take time to provide adequate training for sleep techs what are the best early training how to adjust commonly used oral airway therapy devices and dental sleep medicine today