

수면무호흡 환자 대상 양압기 치료 정복



김혜윤

가톨릭관동대 국제성모병원

AGENDA

- Overview of factors involved in CPAP adherence
- Education for PAP treatment
- Proper selection of PAP mask Fitting (Feature and Size)
- CPAP BiPAP titration
- Problem solving



Successful CPAP therapy Journey

Our Goal for PAP treatment

1 More effective treatment with PAP

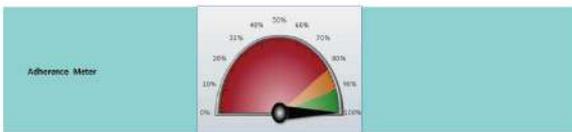
- Optimal titration
- Proper choice of PAP device and mask

2 Increased adherence of PAP treatment

- Understanding of PAP treatment
- Sufficient discipline before PAP treatment
- Personalized management

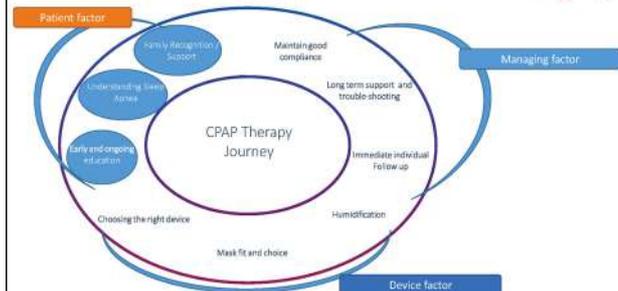
CPAP Therapy Adherence

- How is OSA treatment adherence defined?
 - ≥ 4 hours per night, $\geq 70\%$ of the days monitored or for five out of seven nights (Kribbs¹)
 - normalization of daytime sleepiness, quality of life, and neurocognitive function improvement



1. Kribbs KH, Chrousos NP, Martin LF, et al. (1988) Measurement of adherence to nasal CPAP therapy in obstructive sleep apnea. *Medical Clinics of North America* 62:117-132.

CPAP Therapy Journey



CPAP Adherence Factors

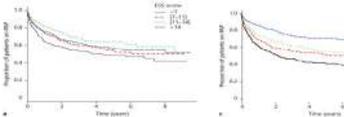


Greater Adherence	Less Adherence
Severe OSA	Mild OSA
Resolution of sleepiness, other symptoms	Young and/or single adult
Co-morbid illness	High PAP level
Early benefit (<7d)	Claustrophobia
Comfortable mask	Ill-fitting mask
Optimal titration	No/limited patient education No/limited physician or family support
Humidifier use	Denial, no 'ownership' of the problem
Wife shares the bed	Lack of understanding
Older patient / female	Skin irritation
Bed partner, physician, staff education/ support	Nasal obstruction
Self-referral	Persistent symptoms
Self-management of chronic illness	Depressive symptoms
Behavioral readiness to change	Lack of self-efficacy
	Dementia, decreased cognition, language barrier
	Lack of health insurance

Non-modifiable factors of CPAP Adherence



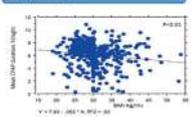
Severity of daytime sleepiness and sleep apnea



Severe OSA Severe symptoms

Respiration 2015,87:121-128

BMI, Obesity



From: *Respirator*, 02 August 2019

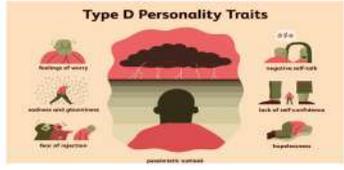
Non-modifiable factors of CPAP Adherence



A Type D personality

- Occurs in 30% of OSA patients
- 50% OF "D" personality types are noncompliant
- Negative emotions
- Social inhibition
- Higher incidence of complaints regarding therapy

Type D Personality Traits



Non-modifiable factors of CPAP Adherence



Social cognitive theory for 'A Type D personality'

Two major factors

- First, a person must believe that the **benefits** of performing the behavior outweigh the costs (i.e. a person should have **more positive** than negative outcome expectancies)
- Second, and perhaps most important, the person must have a **sense of personal agency**, or **self-efficacy** with respect to performing the preventive behavior must believe that he or she has the skills and abilities necessary for performing the behavior under a variety of circumstances."

- 수면 무호흡증 치료에 있어서 많은 치료의 주관자이고 스스로 치료를 할게 나갈 수 있다는 믿음을 갖게 하는 것 (Personal agency)
- 스스로의 행동을 통한 긍정의 경험을 강화시켜 주어, 자기효능감을 높여 시키도록 함.
- 치료를 하지 않았을 때의 결과를 고려할 때, 비양심이 효과를 상영해 줌

Claustrophobia

- A form of specific phobia that entails extreme anxiety and panic elicited by situations in which the individual experiences a sense of being closed in or entrapped.
- Claustrophobia is composed of two "core" fears: fear of restriction, and fear of suffocation.
- Claustrophobia is a common reaction reported in about 15% of all patients.



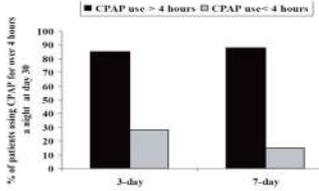
Progressive Mask Desensitization programs have proven successful

First 3 nights are important for PAP adherence



- The early pattern of CPAP adherence is predictive of sustained long-term use
- Emphasis should be placed on **assessing the patient early** after initiating the CPAP therapy (as early as 3 days) and treating or impacting factors that may negatively influence adherence.

Initial Good Adherence
Early Education
Immediate Intervention



Education for PAP treatment

- Do cognitive perceptions influence CPAP use?
 - Yes, Cognitive perceptions influence CPAP use, but only within the context of knowledge of CPAP treatment and treatment use.
- What to educate?
 - What to educate?
 - Risk Perception
 - Symptoms of OSA
 - Functional risk of OSA: Accidents, Memory impairment
 - Health risk of OSA : Cardiovascular risk
 - Treatment outcome expectancies
 - Improvement of specific symptoms with CPAP
 - Common improvements in daily functioning and quality of life with CPAP
 - Treatment self efficacy
 - Challenges of using CPAP during first several nights of use
 - Anticipatory guidance for resolving difficulties with CPAP
 - Resources for support and additional clinical assistance with CPAP

Education for PAP treatment

- How to educate?
 - The approximately 15-min videotape depicted two male blue-collar workers discussing their sleep problems, with one describing what sleep apnea was in common language, what CPAP was, what CPAP felt like on a sensory basis, and how it had helped them.

Shaya Medicine 8 (2008) 171-174

Clinical Guidelines for the Manual Titration of Positive Airway Pressure

All potential PAP titration candidates should receive...

- PAP education
- Hands on demonstration
- Careful mask fitting
- Acclimatization prior to titration

Nasal mask, nasal pillows, full-face/Oronasal mask

- Goals
 - Maximizing comfort
 - Compensating for significant nasal obstruction
 - Minimizing leak prior to the PAP titration.

Size of Mask

Fit range

Cushion Size	% Coverage
S	46.7%
M	43.3%
L	6.5%
XL	1.9%

Population	S	M	L	XL	Weighted Population
Caucasian	47.2%	33.9%	18.9%	0.0%	41.1%
Hispanic	38.3%	40.9%	19.8%	0.0%	39.9%
African American	38.3%	40.9%	19.8%	0.0%	39.9%
Asian	47.2%	33.9%	18.9%	0.0%	41.1%
Weighted Population	41.1%	39.9%	18.9%	0.0%	100%

Nasal Mask Size Comparison

Infinity Seal Cushion Technology - Variable Thickness

Comfort Stability

Thinner areas provide more comfort

Thicker areas provide more stability

Single wall with variable thickness is designed to be easier to fit - no glue

Headgear

What masks do patients prefer?

Comparison of Two Headgear Systems for Sleep Apnea Treatment of Stroke Patients

Fig. 3. (continued) Fig. 4. (continued)

Table 1. Subjective report of ease, comfort and preference of headgear systems: all subjects (n = 20)

	Definitely head frame	Probably head frame	No preference	Probably straps	Definitely straps
Easiest to put on and take off	29 (42%)	1 (3%)	--	--	--
Most comfortable	13 (18%)	--	--	9 (17%)	12 (48%)
Overall preference	17 (25%)	--	--	9 (17%)	9 (27%)

Table 2. Subjective report of ease, comfort and preference of headgear systems: subjects with disability (n = 22)

	Definitely head frame	Probably head frame	No preference	Probably straps	Definitely straps
Easiest to put on and take off	21 (45%)	1 (5%)	--	--	--
Most comfortable	10 (18%)	--	--	7 (14%)	9 (18%)
Overall preference	17 (32%)	--	--	4 (8%)	9 (22%)

Copyright © 2014, Elsevier Ltd.

Soft, easy to use headgear

Durable soft material and foam
Easy to use Velcro tabs

Western Head Chinese Head

Headgear Sizes

- Small
- Small (+FH)
- Standard
- Large

For Her Standard

Improved leakage

Therapy				
Pressure - cmH2O	Median: 8.2	95th percentile: 10.8	Maximum: 10.9	
Leaks - L/min	Median: 14.1	95th percentile: 34.2	Maximum: 52.7	
Events per hour	AI: 2.0	HI: 0.9	AHI: 2.9	
Apnoea Index	Central: 0.2	Obstructive: 0.6	Unknown: 1.1	

Therapy				
Pressure - cmH2O	Median: 9.7	95th percentile: 10.9	Maximum: 10.9	
Leaks - L/min	Median: 7.4	95th percentile: 19.8	Maximum: 31.0	
Events per hour	AI: 1.2	HI: 0.5	AHI: 1.7	
Apnoea Index	Central: 0.4	Obstructive: 0.7	Unknown: 0.0	

Mask Feature

Mask Feature 3 kinds of masks (based on face coverage)

Full Face Mask
Covers the mouth and nose

Full face masks are usually best for people who leak air by mouth as they sleep. For example, they sleep with their mouth open, or their jaw tenses during REM sleep.



Nasal Mask
Covers nose area

Nasal masks combine the minimal design of nasal pillows masks but with slightly more coverage over the nose. They are also designed for a clear field of vision.



Nasal Pillows Mask
Rests under nostrils

Nasal pillows are the least obtrusive and provide the most openness. They are lightweight, unobtrusive and designed to keep the field of vision clear. This type of mask fits snugly and comfortably.

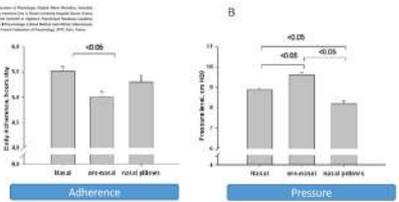


CPAP pressure
depending on Mask type

Mask type and PAP pressure

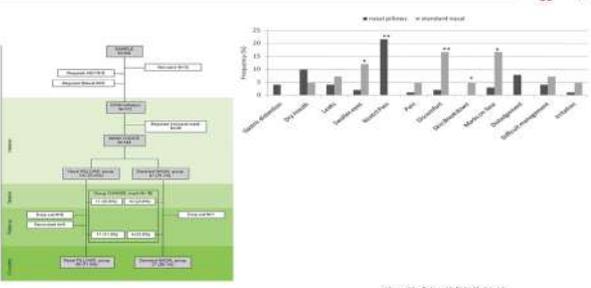
Type of Mask May Impact on Continuous Positive Airway Pressure Adherence in Apneic Patients

Jan Christian Breda¹, Ronald Fankhauser², Anita Diaz-Delella³, Marc Sauer⁴, Frank Moritz⁵, Boris Storch⁶, Yoon Gilgil⁷, Jan-François Bédard⁸, Patrick Lemp⁹, Frédéric Sauer¹⁰, Jean-Louis Pepin¹¹, on behalf of the Scientific Council of the Sleep Society of the French Federation of Pneumology (2019)¹²



Mask Type	Adherence (%)	Pressure (cmH2O)
Full face	~50	~10
Nasal	~45	~12
Nasal pillows	~48	~10

Nasal pillow vs Nasal



Flowchart: Nasal mask vs Nasal pillow. Nasal mask: Full face mask, Nasal mask, Nasal pillows mask. Nasal pillow: Nasal pillows mask, Nasal mask, Full face mask.

Bar chart: Frequency of use for various mask types. Legend: nasal pillows (black), standard nasal (white).

Nasal pillow vs Nasal

The current data suggest that the use of nasal pillows should not be limited to **low-pressure CPAP levels**.

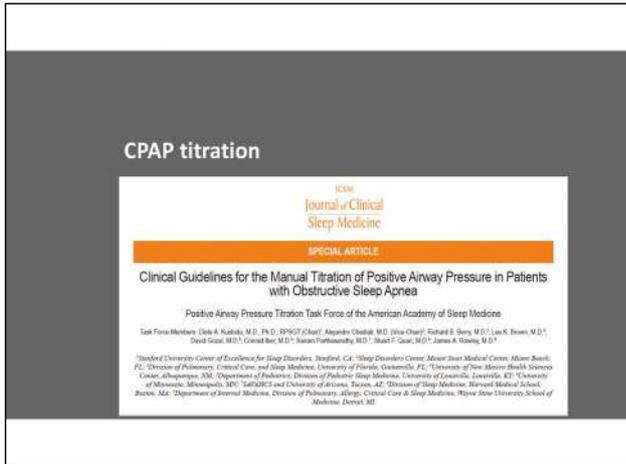
In conclusion, the current data indicate that **nasal pillows could be safely prescribed as first-line interfaces**, as they seem to be efficacious for CPAP titration and long-term treatment, ensuring a good rate of adherence.

Sleep Medicine 41 (2018) 94e99

Nasal Pillow Mask, Pretty simple!

Different style depend on company





Clinical Guidelines for the Manual Titration of Positive Airway Pressure

All potential PAP titration candidates should receive...

- PAP education
- Hands on demonstration
- Careful mask fitting
- Acclimatization prior to titration

Nasal mask, nasal pillows, full-face/Oronasal mask

• **Goals**

- Maximizing comfort
- Compensating for significant nasal obstruction
- Minimizing leak prior to the PAP titration.

General recommendations

- **Recording the airflow signal generated by the PAP device** or estimating airflow by measurement of the pressure difference between the mask and the outlet of the machine using a **pressure transducer**, with or without Square root transformation of the signal, are acceptable methods for detecting Apneas or Hypopneas (consensus)
- Nasal airflow obtained from a thermistor or thermocouple placed under the PAP mask is **not** an acceptable method for detecting Apneas or Hypopneas (consensus).

Conducting CPAP titration Studies

- CPAP should be increased until the following obstructive respiratory events are eliminated (no specific order) or the recommended maximum CPAP is reached: **apneas, hypopneas, RERAs, and snoring** (consensus).
- The Task Force recommends that **SaO2 desaturation-resaturation events** occurring without associated obstructive respiratory events should **not** be considered in the decision to increase CPAP in pediatric and adult patients.

Conducting CPAP titration Studies

- The recommended minimum starting CPAP should be **4cm H2O** in pediatric and adult patients (consensus)
- Methodology to determine CPAP a priori has insufficient evidence, although a higher starting CPAP may be selected for patients with an **elevated body mass index and for retitration studies** (consensus)
- The recommended maximum CPAP should be **15cm H2O for patients <12 years** and **20cm H2O for patients ≥12 years** (consensus).

Full Night CPAP titration

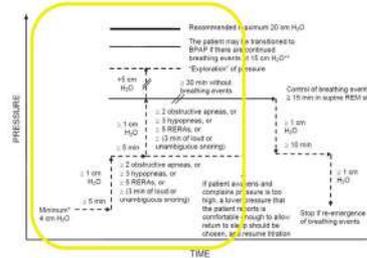
- CPAP should be increased by at least **1cm H2O** with an interval no shorter than **5min**, with the goal of eliminating obstructive respiratory events (consensus).
- CPAP should be increased if at least **1 obstructive apnea** is observed for patients <12 years or if at least **2 obstructive apneas** are observed for patients ≥12 years (Consensus)
- CPAP should be increased if at least **1 hypopnea** is observed for patients <12 years or if at least **3 hypopneas** are observed for patients ≥12 years (Consensus)

Full Night CPAP titration

- CPAP should be increased if at least 3 RERAs are observed for patients <12 years or if at least 5 RERAs are observed for patients ≥12 years (Consensus).
- CPAP may be increased if at least 1 min of loud or unambiguous snoring is observed for patients <12 years or if at least 3 min of loud or unambiguous snoring are observed for patients ≥12 years (consensus)



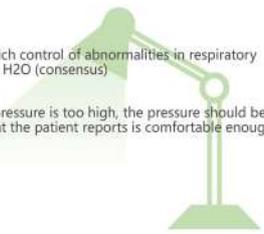
CPAP for >12yr age



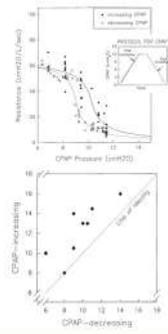
Full Night CPAP titration

"Exploration" of CPAP above the pressure at which control of abnormalities in respiratory parameters is achieved should not exceed 5 cm H2O (consensus)

If the patient awakens and complains that the pressure is too high, the pressure should be restarted at a lower pressure, chosen as one that the patient reports is comfortable enough to allow return to sleep (consensus)



- "Down" titration is not required but may be considered as an option (consensus)
- A "down" titration is recommended due to the "hysteresis" phenomenon during upward titration the PAP level at which flow limitation disappears is 2-5 cm H2O higher than the level at which it reappears during downward titration
- at least one "up-down" CPAP titration (1 cycle) should be conducted during the night.
- It should be conducted when at least 30 min has elapsed without obstructive respiratory events. CPAP should be decreased by more than 1cm H2O with an interval no shorter than 10 min, until there is reemergence of obstructive respiratory events. There is also limited evidence that an "up-down-up" titration protocol should be considered.



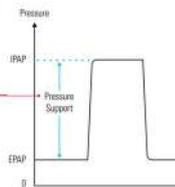
Recommendation: BiPAP (consensus)

- Indications
 - Uncomfortable or intolerant of high CPAP pressure
 - Continued events above 15 cm H2O
- Increase to control apnea, hypopnea, RERA, snoring (no specific order)
- Starting minimum pressure 8/4 (higher for obese or retitration)



BiLevel Positive Airway Pressure (BiPAP)

- BiPAP has Two pressure settings-
 - Inspiratory Positive Airway Pressure (IPAP)
 - Expiratory Positive Airway Pressure (EPAP)
- Pressure Support (PS)=IPAP-EPAP
- Max IPAP 20 cm H2O for <12, 30 for ≥12
- Min PS for OSA pt- 4cmH2O
- Max PS for OSA pt- 10cmH2O



Recommendations for BiPAP titration

- If the patient is **uncomfortable or intolerant of high pressures** on CPAP, the patient may be tried on BPAP.
- If there are **continued obstructive respiratory events at 15 cm H₂O** of CPAP during the titration study, the patient may be switched to BPAP (consensus).
- The recommended maximum IPAP should be **20 cm H₂O** for patients <12 years or **30 cm H₂O** for patients ≥12 years (consensus).



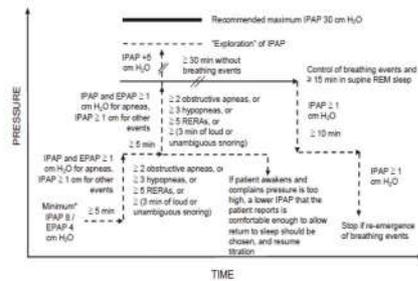
Recommendation: BiPAP

- **Indications for increasing BiPAP**
 - IPAP and/or EPAP at least 1 cm H₂O at intervals of **at least 5 min** depending on type of respiratory event
 - IPAP and EPAP when at least 1 OA is observed in children, or at least **2 OA** are observed in adults
 - IPAP when at least 1 OH is observed in children, or at least **3 OH** are observed in adults
 - IPAP when at least 3 RERAs observed in children, or at least **5 RERAs** are observed in adults
 - IPAP when at least 1 min snoring in children, or at **3 min snoring** observed in adults

Recommendation: BiPAP

- **"Exploration"** of IPAP above the pressure after control of abnormalities in respiratory parameters should not exceed 5 cm H₂O
- If the patient awakens and complains of excessive pressure, the pressure should be restarted at a pressure the patient finds comfortable
- **"Down"** titration may be considered as an option
 - After 30 minutes of control
 - 1 cm H₂O no more than every 10 min until events recur
- Decrease IPAP or change to ST mode should be considered if treatment-emergent central apneas occur

Manual Titration of BiPAP for >12yr age OSA pt

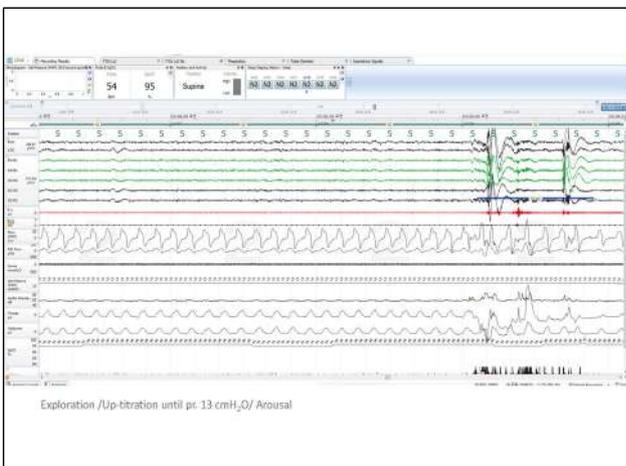
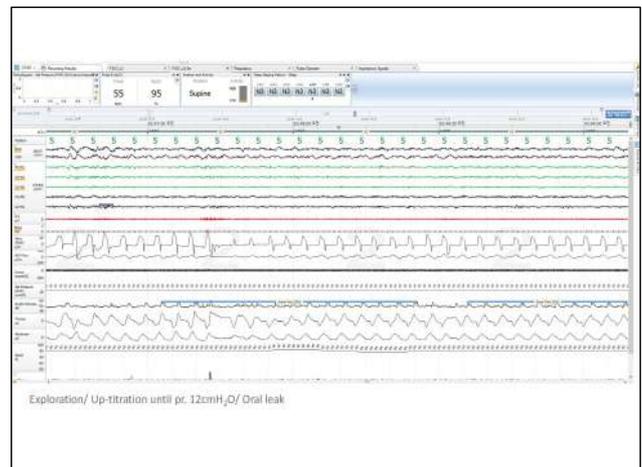
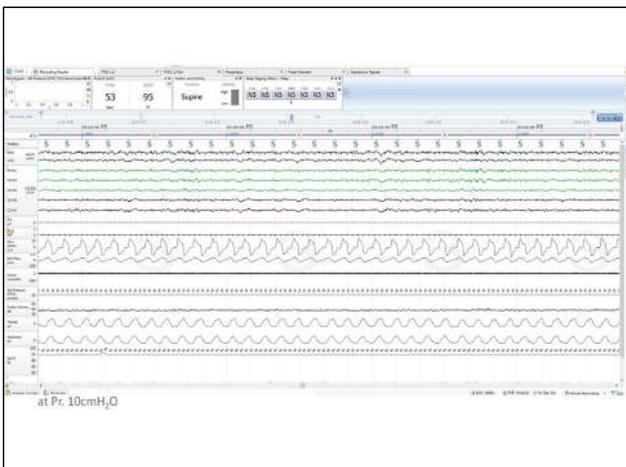
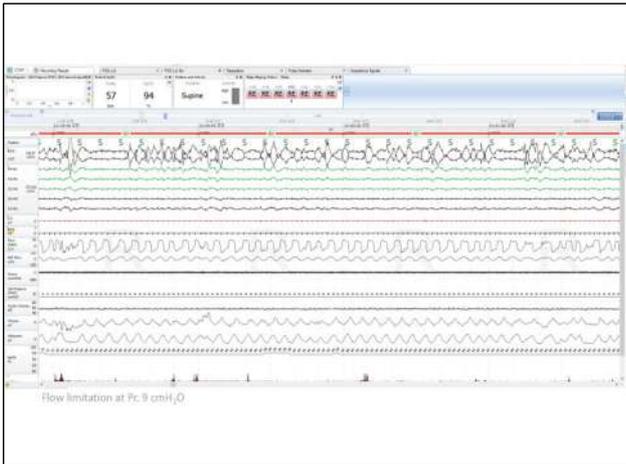


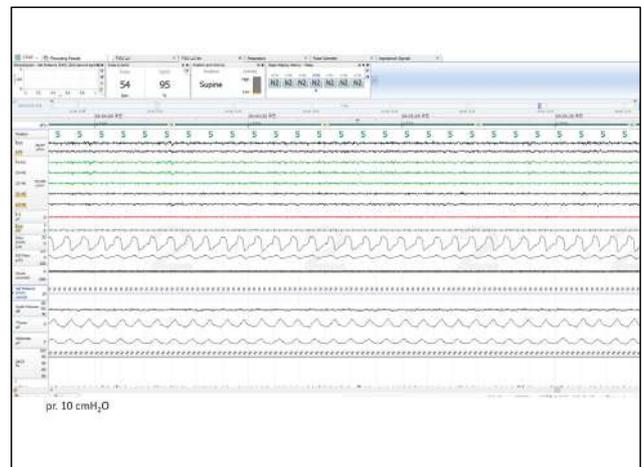
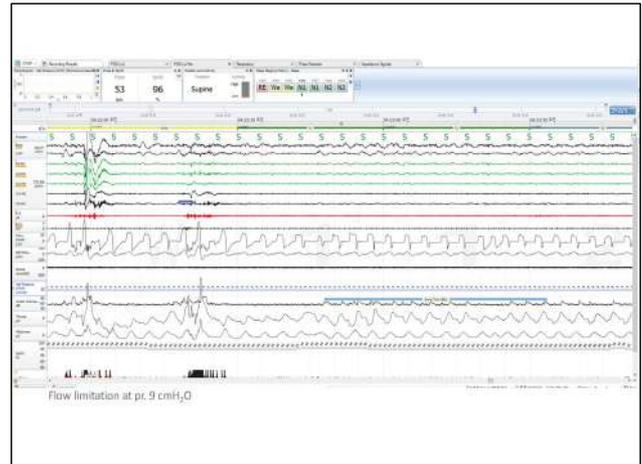
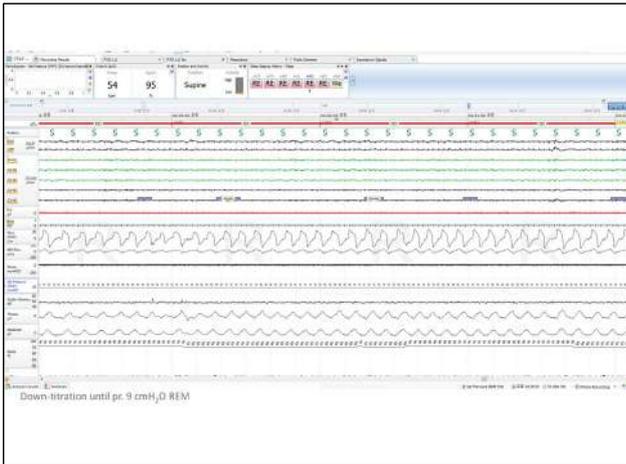
PAP Therapy Outcomes Grading

Optimal	<ul style="list-style-type: none"> • RDI < 5, for ≥ 15 minutes • Should contain "S" (supine) REM sleep • No continually interrupted by Spontaneous Arousals or awakenings
Good	<ul style="list-style-type: none"> • RDI ≤ 10 (or reduction 50% when baseline RDI < 15) • Should contain "S" (supine) REM sleep • No continually interrupted by Spontaneous Arousals or awakenings
Adequate	<ul style="list-style-type: none"> • RDI > 10 (but reduction ≥75% of baseline RDI)
Unacceptable	<ul style="list-style-type: none"> • Does not meet any of the previous discusses grades

Real world PAP titration with case reviews







Use the pressure relief technology

How it works
 EPR provides three comfort settings. Each comfort setting correlates to an exact drop-in pressure relief.

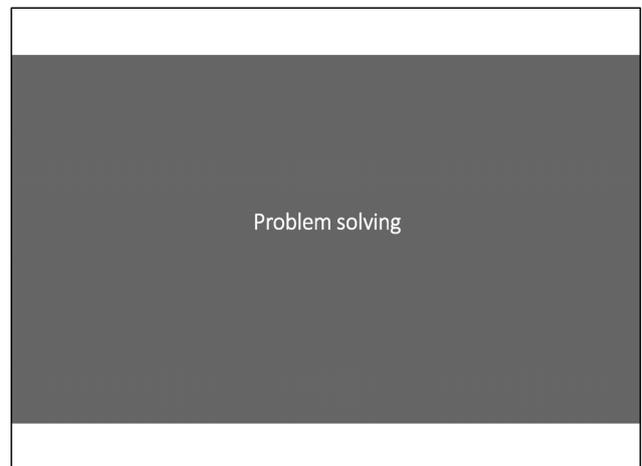
- EPR Level 1: Mild reduction (1 cm H₂O)
- EPR Level 2: Medium reduction (2 cm H₂O)
- EPR Level 3: Maximum reduction (3 cm H₂O)

When EPR is turned on, our Easy Breathe technology will provide enhanced comfort by delivering a smoother, more natural pressure and predictable levels of pressure relief.

C-Flex Pressure Relief Technology
 C-Flex pressure relief technology makes these three more comfortable for reducing pressure at the beginning of exhalation and returning to therapeutic pressure just before inhalation. The level of pressure relief varies based on the user's respiratory flow and what the three C-Flex settings has been selected.

Spinal Pressure Relief

Downward pressure relief at three selected settings



Other issues associated with Mask

- "입막이 해서 숨을 내릴 수가 없다."
- "나를 짓누르는 것 같다."
- "기계소리도 큰데, 마스크에서 바람세는 소리가 거슬린다."
- "입막이 너무 높다"
- "그냥, 못할 것 같아요!"
- "이걸 (마스크) 평생 써야함? 나는 못해요."



Nasal Mask Issue ?? Red Mark on Face



Main headline goes here



Gel Nasal Pad
Gecko™

Bimalar facial rashes why?



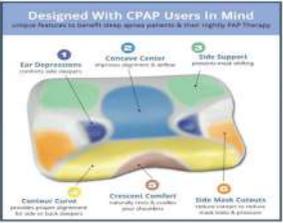
ResMed AirFit F20 for Her



COMPLIANCE AIDES



Pillow for patients with CPAP

Designed With CPAP Users In Mind

- Ear Depressions:** prevent side pressure
- Chin Support:** prevent mouth opening
- Side Mask Cradles:** prevent mask from sliding
- Crescent Comfort:** prevent mask from sliding
- Chinrest Curve:** prevent mask from sliding

What is it ?



Summary of Problem solving

Problem	Possible causes	Possible solutions
Nasal irritation/ Congestion	Dry air Chronic rhinitis Nasal allergies	Heated humidification Nasal decongestants Nasal steroids Antihistamines
Dry throat and/or mouth	Dry air Mouth leak	Heated humidification Chin strap Full face mask
Painful pressure in ears	High airway pressure Nasal congestion	Verify PAP level Reduction of EAP Nasal decongestants Nasal steroids
Gastroic bloating and/or chest discomfort	Air swallowing High airway pressure	Decreased PAP level Trial of automatically titrated or bilevel PAP
Discomfortable	Anxiety Mask interface	Desensitization Anxiety Optimize mask fit
Nasal pressure sores	Poor mask fit	Readjust head gear Change mask size or style Apply skin protector

Summary of Problem solving

Problem	Possible causes	Possible solutions
Eye irritation	Mask air leak	Readjust head gear Change mask size or style Reassess patient education on mask fit
Skin chafes	Improperly adjusted head gear	Readjust head gear Change mask size or style
Skin irritation	Sensitivity to mask interface Improperly adjusted head gear Heat rash	Readjust head gear Lower temperature on headgear Heat using nasal pillows or skin protector
Air leak	Excessive mask/head gear wear Poor mask fit Improperly adjusted head gear Excessive air pressure	Replace mask and/or head gear Readjust head gear Verify pressure setting Consider pressure change Consider auto or bilevel mode
	Facial hair interface	Treat with nasal pillows Shave Hair wax