



TARGETED AND MECHANICAL THERAPIES FOR OSA



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Targeted and Mechanical Therapies for Obstructive Sleep Apnea From Anatomical Phenotyping to Surgery, PAP and NIV

Why Do We Need More Than CPAP?

CPAP remains the standard first-line therapy for most OSA patients

Long-term effectiveness depends strongly on adherence

Some patients cannot tolerate or accept PAP

Residual OSA may persist despite apparently adequate therapy

Anatomical and physiological phenotypes differ substantially

Treatment should increasingly be mechanism- and patient-specific

A Mechanism-Based Approach

OSA Is Not a Single Disease

Phenotype

Anatomical factors

Nasal obstruction

Palatal collapse

Lateral pharyngeal wall collapse

Tongue-base obstruction

Craniofacial restriction

Physiological factors

High loop gain

Low arousal threshold

Poor pharyngeal dilator muscle responsiveness

Reduced upper-airway muscle activity

Clinical implication:

Identify the dominant mechanism → Select the appropriate treatment

The Treatment Spectrum

Behavioral / Weight Management



Positional Therapy



Oral Appliance



PAP Therapy



Targeted Therapy Hypoglossal nerve stimulation



Upper-Airway Surgery



Maxillomandibular Advancement



Bariatric Surgery / Weight-Loss Therapy



NIV for Selected Patients

Who Is a Candidate for Non-PAP Therapy?

Consider alternative or adjunctive therapy when:

PAP is refused or poorly tolerated

Persistent symptoms despite adequate PAP

Significant anatomical abnormality is present

OSA is strongly positional

Mild-to-moderate OSA is suitable for oral appliance therapy

A specific upper-airway collapse pattern is identified

The patient prefers a non-PAP treatment after informed discussion

Key principle:

Treatment selection should be based on OSA severity + anatomy + phenotype + patient preference.

Positional Therapy Best suited for:

Positional OSA

Supine-predominant OSA

Mild-to-moderate disease in selected patients

Therapeutic options

Vibratory positional trainers

Back-position avoidance devices

Sleep-position modification

Limitations

Variable long-term adherence

Recurrence when positional
dependence decreases

Less appropriate for severe
non-positional OSA

Oral Appliance Therapy

Mandibular Advancement Device (MAD)

Mechanism

Advances the mandible



Increases upper-airway caliber



Reduces pharyngeal collapsibility

Best candidates

Mild-to-moderate OSA

CPAP intolerance or preference for an alternative

Adequate dentition

Favorable craniofacial anatomy

Important

Custom, titratable devices are preferred

When Anatomy Becomes the Target

Think Beyond the AHI

Ask three questions:

1. Where does the airway collapse? Nose Palate Lateral pharyngeal wall Tongue base Epiglottis
2. Is the collapse single-level or multilevel?
3. Is the collapse surgically or mechanically modifiable?

Tools

Physical examination

Cephalometry / imaging in selected cases

Drug-Induced Sleep Endoscopy (DISE)

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What does DISE provide?

Dynamic assessment of upper-airway collapse

Assess:

- Site of obstruction

- Degree of collapse

- Configuration of collapse

 - Multilevel obstruction

- Tongue-base / epiglottic collapse

 - Particularly useful before:

 - Upper-airway surgery

 - Hypoglossal nerve stimulation

- Complex multilevel interventions

surgical Therapy:

When Should We Consider It?

Consider surgical evaluation when:

- PAP is refused or poorly tolerated

- PAP adherence is inadequate despite optimization

- A clinically significant anatomical obstruction is present

- There is a correctable craniofacial or upper-airway abnormality

- The patient prefers a definitive anatomical

- intervention Surgical planning should be:

- Patient-specific + anatomy-directed + phenotype-based

Upper-Airway Surgery: Match the Procedure to the Target

- | | |
|---------------------------------|---|
| ■ Anatomical target | ■ Surgical options |
| ■ Nasal obstruction | ■ Septoplasty, turbinate surgery |
| ■ Tonsillar obstruction | ■ Tonsillectomy |
| ■ Palatal collapse | ■ Palatal surgery / UPPP |
| ■ Lateral wall collapse | ■ Expansion sphincter pharyngoplasty |
| ■ Tongue-base obstruction | ■ Tongue-base reduction / advancement |
| ■ Epiglottic collapse | ■ Epiglottic surgery in selected patients |
| ■ Maxillomandibular restriction | ■ MMA |
| ■ Multilevel collapse | ■ Multilevel surgery |

Principle: Treat the site of collapse — not simply the AHI.

Palatal Surgery

UPPP and Modern Palatal Procedures

Traditional UPPP

Removes/reconstructs obstructing palatal tissue

Targets retropalatal obstruction

Modern techniques

Expansion sphincter pharyngoplasty

Lateral pharyngoplasty

Relocation pharyngoplasty

Other tissue-preserving techniques

Why the evolution?

OSA is often a lateral-wall + palatal problem, not simply an elongated uvula.

Tonsillectomy:

A Special Surgical Phenotype Particularly relevant when:

- Marked tonsillar hypertrophy

- Enlarged tonsils contribute substantially to airway obstruction

- Oropharyngeal obstruction is predominantly tonsillar

- Key concept The larger the tonsillar contribution to obstruction, the more rational the surgical target.

- In selected adults: Tonsillectomy may be an effective primary surgical intervention

Tongue-Base Obstruction

When the Tongue Is the Target

Potential approaches

Lingual tonsillectomy

Tongue-base reduction

Radiofrequency reduction

Transoral robotic surgery in selected centers

Genioglossus advancement

Particularly important in:

Retrolingual obstruction

Multilevel OSA

Retrognathia

Persistent OSA after palatal surgery

Maxillomandibular Advancement MMA:

A Skeletal Solution to a Pharyngeal Problem

Mechanism

Advancement of:

Maxilla

Mandible



Anterior enlargement of the pharyngeal airway



Reduction in upper-airway collapsibility

Consider particularly in:

Craniofacial restriction

Retrognathia

Severe OSA

Multilevel obstruction

Persistent OSA after other interventions

Hypoglossal Nerve Stimulation

A True Targeted Therapy

Concept

Hypoglossal nerve stimulation



Activation of upper-airway dilator muscles



Anterior movement of the tongue



Improved airway patency during sleep

Candidate selection is critical Typically consider:

Moderate-to-severe OSA

PAP intolerance or failure

Appropriate upper-airway anatomy

Appropriate BMI range according to device/label and local criteria

Absence of unfavorable complete
concentric palatal collapse on DISE

PAP Is Still the Mechanical Standard

PAP (Positive Airway Pressure)

CPAP (Continuous positive airway pressure)

APAP(Automatic positive airway pressure)

BPAP(Bilevel positive airway pressure)

Mechanism Positive pressure

↓ Splints the upper airway open ↓

Prevents repetitive collapse

Key point

PAP treats the mechanical consequence of airway collapse regardless of the precise anatomical site.

CPAP vs APAP vs BPAP Modality

Main concept

Typical role CPAP Fixed continuous pressure Standard OSA therapy

APAP Automatically adjusts pressure Selected uncomplicated OSA

BPAP Different IPAP/EPAP pressures Selected patients requiring pressure support Important

BPAP is not routinely superior to CPAP for uncomplicated OSA.

When Does NIV Enter the Picture?

OSA + Something More Consider NIV/BPAP when OSA is accompanied by:

Obesity hypoventilation syndrome

Sleep-related hypoventilation

Neuromuscular disease

Chest-wall disorders

Chronic ventilatory failure

Significant hypercapnia requiring ventilatory support

Think:

CPAP → treats upper-airway obstruction

NIV → treats obstruction + ventilatory insufficiency

The Practical Treatment Algorithm

Step 1 — Confirm OSA and assess severity



Step 2 — Optimize: Weight + sleep position + nasal factors + comorbidities



Step 3 — PAP therapy CPAP / APAP



Step 4 — If PAP fails or is unacceptable: Oral appliance / positional therapy / targeted intervention



Step 5 — Identify the anatomical target Clinical examination $\pm$ DISE



Step 6 — Select targeted therapy Surgery / HNS / MMA



Step 7 — If hypoventilation is present Consider BPAP/NIV

Take-Home Messages

1. OSA is heterogeneous — one treatment does not fit every patient.
2. CPAP remains the reference mechanical therapy.
3. Treatment should be guided by anatomy, phenotype and patient preference.
4. DISE can help identify dynamic patterns of upper-airway collapse.
5. Modern surgery is increasingly anatomy-directed and multilevel.
6. Hypoglossal nerve stimulation provides a targeted neuromodulatory option for selected patients.
7. NIV is particularly relevant when OSA is accompanied by hypoventilation or ventilatory failure.



thank you for attention