

Pediatric Obstructive Sleep apnea

An update ... What else is there to know?

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Disclosure

No Financial Relationships

Pediatric Obstructive Sleep Apnea (OSA):

1. **One or more clinical symptoms:** snoring, labored, paradoxical or obstructed breathing **behavioral problems or aggressive behavior,** during sleep, excessive sleepiness, growth impairment, **learning problems**

2. **One or both on polysomnogram**
 - a. **Apnea-Hypopnea Index >1**
 - Apnea :** cessation of airflow for two breaths
 - Hypopnea:** decrease in airflow by 30% with a drop in O₂ by 3% or an associated arousal
 - b. **PCO₂ greater than 50mm Hg for more than 25% of the sleep time** + snoring, paradoxical thoracoabdominal movement or flattening of the the nasal airway pressure waveform



Pediatric OSA Severity

- AHI 1-5 mild OSA

- AHI 5-10 moderate OSA

- AHI >10 severe OSA or SaO₂ nadir <80%



OSA Sequela: Why we care

- Neurocognitive deficits
- Behavioral issues
- Growth Failure

- Systemic Hypertension
- Pulmonary hypertension, core pulmonale and right heart failure

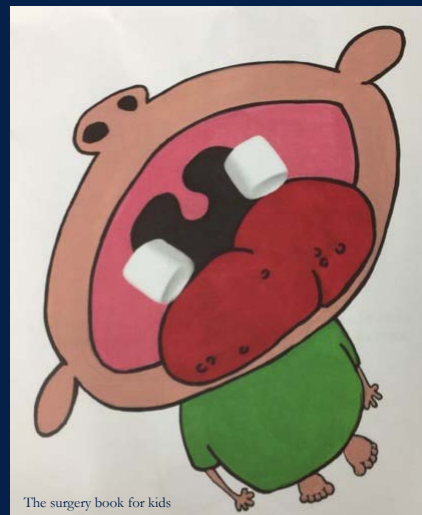
- Increased use of health care resources

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Ehsan & Ishman 2016
Marcus et al 2013
Lee et al 2016

2/13/2018



Pediatric
OSA? →



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Adenotonsillectomy Failure

- 20-40% pediatric patients will will have persistent OSA
- 53-88% of obese children will have persistent OSA

Andersen, Holm & HomOe Int Journal Pediatric Otorhinolaryngology 2016
7 Ehsan & Ishman 2016
Marcus et al 2013


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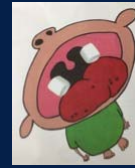
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Sleep Disordered Breathing

- Snoring
- Upper airway resistance syndrome
- Mild obstructive sleep apnea
- Moderate obstructive sleep apnea
- Severe obstructive sleep apnea

Adenotonsillectomy:
CHAT 2013



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Childhood Adenotonsillectomy Trial

Multi-Institutional study that randomly assigned 464 children with obstructive sleep apnea to surgery versus watchful waiting.

Table 2. Outcome Measures.^a

Outcome	Normative Mean	Watchful Waiting		Early Adenotonsillectomy		Effect Size [†]	P Value
		Baseline	Change from Baseline to 7 Mo	Baseline	Change from Baseline to 7 Mo		
Primary outcome							
NEPSY attention and executive-function score [‡]	100±15	101.1±14.6	5.1±13.4	101.5±15.9	7.1±13.9	0.15	0.16
Secondary outcomes							
Conners' Rating Scale score [§]							
Caregiver rating	50±10	52.6±11.7	-0.2±9.4	52.5±11.6	-2.9±9.9	0.28	0.01
Teacher rating		55.1±12.8	-1.5±10.7	56.4±14.4	-4.9±12.9	0.29	0.04
BRIEF score [¶]							
Caregiver rating		50.1±11.5	0.4±8.8	50.1±11.2	-3.3±8.5	0.28	<0.001
Teacher rating		56.4±11.7	-1.0±11.2	57.2±14.1	-3.1±12.6	0.18	0.22
PSQ-SRBD score	0.2±0.1	0.5±0.2	-0.0±0.2	0.5±0.2	-0.3±0.2	1.50	<0.001
PedsQL score ^{**}	78±16	76.5±15.7	0.9±13.3	77.3±15.3	5.9±13.6	0.37	<0.001
Apnea-hypopnea index — no. of events/hr ^{††}							
Median	NA	4.5	-1.6	4.8	-3.5	0.57	<0.001 ^{‡‡}
Interquartile range		2.5 to 8.9	-3.7 to 0.5	2.7 to 8.8	-7.1 to -1.8		


10 Marcus et al 2013

Childhood Adenotonsillectomy Trial

Watchful Waiting Group

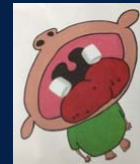
Of the 203 patients that were randomized to watchful waiting, **46%** had resolution of their AHI after 7 months.

Sleep Disordered Breathing

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- Snoring
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 - Moderate obstructive sleep apnea
 - Severe obstructive sleep apnea

Does it have to be surgery?

Adenotonsillectomy:
CHAT 2013



Non surgical Treatment Options for Pediatric Obstructive OSA

- Watchful Waiting
- Medical Management
 - Nasal steroid sprays
 - Montelukast
- Orthodontic evaluation
- Weight loss
- Non invasive positive pressure ventilation

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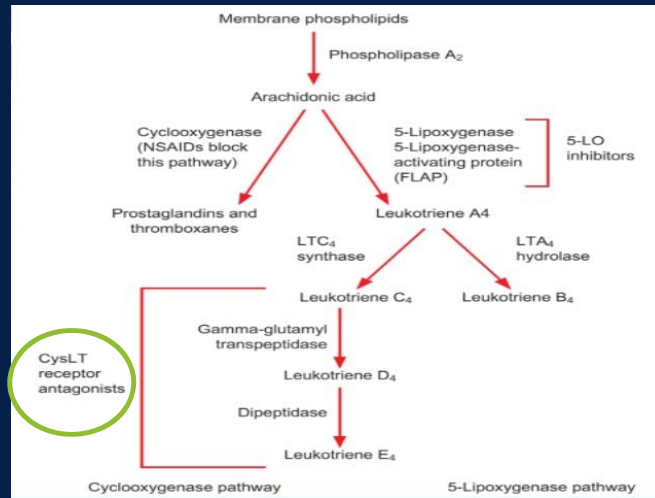
Non surgical Treatment Options for Pediatric Obstructive OSA

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Montelukast



Goldbert et al 2013
Kar et al 2016

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Montelukast

- Goldbart et al 2012: Improved AHI and decreased adenoid size in 23 children randomized to receive 12 week course of montelukast versus 23 children that received placebo.
- Kheirandish-Gozal et al 2014:
 - 80% of 836 children avoided surgery with a 12 week course of montelukast AND nasal steroid spray.
 - 62% of 445 children had normalization of sleep study.
- Kheirandish-Gozal et al 2016: Improved AHI 28 children randomized to receive 16 week course of montelukast versus no change in AHI in 29 that received placebo.

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Non surgical Treatment Options for Pediatric Obstructive OSA

- Watchful Waiting
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Orthodontic Evaluation

- Transverse maxillary deficiency (high arched and/or narrow palate)




Gracco et al 2017

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Orthodontic Evaluation

- Dental crowding
 - Malocclusion
- 
- Narrow nasal cavity
 - Narrow nasopharynx
 - Affect mandibular growth and thus retroglossal airway

Gracco et al 2017

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Rapid Maxillary Expansion



Gracco et al 2017

Camacho et al 2016
21 McNamara et al 2015


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Rapid Maxillary Expansion

Camacho et al 2016: Meta-analysis. 17 studies with 314 pediatric patients

- < 3 year follow up:
 - AHI decreased from 8.9 to 2.7 (314 patients)
 - Oxygen saturation nadir increased from 87% to 96% (90 patients)

- >3 year follow up:
 - AHI decreased from 7.1 to 1.5 (52 patients)

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Rapid Maxillary Expansion

Camacho et al 2016: Metanalysis. 17 studies with 314 pediatric patients

TABLE III.
Pre- and Post-Rapid Maxillary Expansion Outcomes Based on Prior Adenotonsillectomy and Tonsil Size.

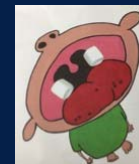
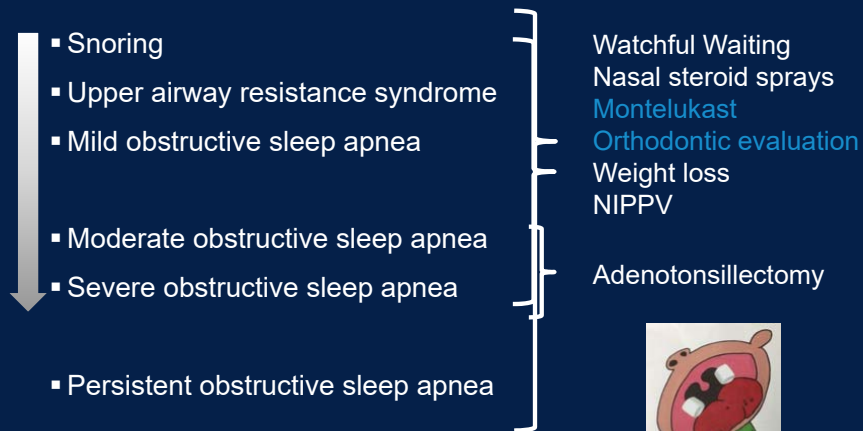
Tonsil Status	Pre-RME AHI	Post-RME AHI	AHI % Change	P
No tonsils, n = 46	4.0 ± 4.0	0.6 ± 0.4	-85%	<.0001
Mixed: no or small tonsils, n = 60	16.3 ± 2.5	0.8 ± 1.3	-95%	<.0001
Small tonsils, n = 71	12.1 ± 4.0	3.3 ± 4.8	-73%	<.0001
Large tonsils, n = 33	11.4 ± 11.6	4.5 ± 3.6	-61%	.002
Mixed: small or large tonsils, n = 45	6.0 ± 6.0	2.2 ± 1.6	-63%	<.0001

Small tonsils = grade 1; large tonsils = grades 2-4; Mixed = not substratified in the studies.
AHI = apnea-hypopnea index; RME = rapid maxillary expansion.

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Sleep Disordered Breathing



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Alternative Surgical options for Pediatric Obstructive OSA

- Drug Induced Sleep Endoscopy
- Lingual Tonsillectomy
- Supraglottoplasty
 - Turbinate Surgery
 - Septoplasty
 - Lateral pharyngoplasty, UPPP
 - Partial glossectomy, tongue base reduction
 - Tongue base suture suspension
 - Mandibular distraction
 - Genioglossus advancement
 - Tracheotomy

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Drug Induced Sleep Endoscopy (DISE)

- Indications
 - Persistent OSA after adenotonsillectomy
 - When size of tonsils and adenoids are not concordant with severity of OSA
 - Co-morbidities: i.e. Down Syndrome, craniofacial anomalies, neuromuscular disorders
- Controversies: Anesthesia
 - Variety of anesthetics used
 - No anesthesia mimics REM sleep
 - Use of anesthesia in kids

26 Wilcox et al 2017



Sleep Laryngomalacia

- Arytenoid redundancy and prolapse during DISE



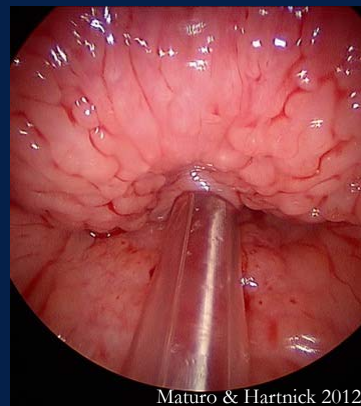
- Treatment: Supraglottoplasty

27 Wilcox et al 2017
Mccaffer et al 2017


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Lingual Tonsillar Hypertrophy

- Prominent lymphoid hyperplasia at the tongue base

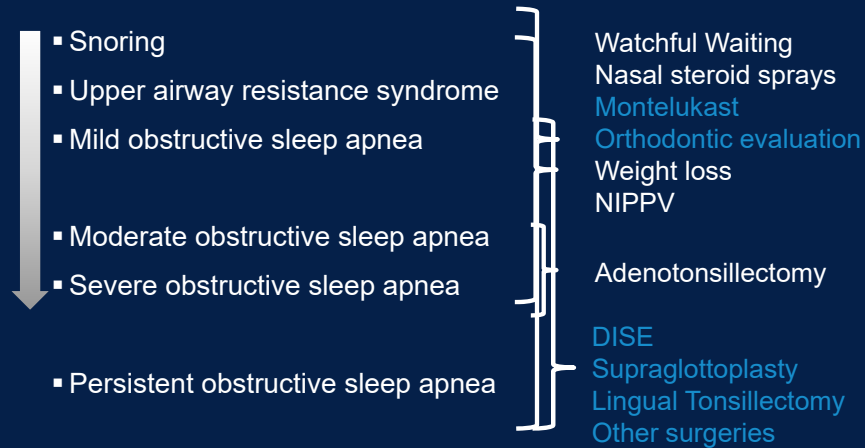


- Treatment: Lingual tonsillectomy

28 Wilcox et al 2017
Rivero & Durr 2017


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Sleep Disordered Breathing



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