

It's Good To Breathe Well at Any Age,
All the Time

SeattleSleepEd@gmail.com

Steve Carstensen DDS FAGD
Diplomate, American Board of Dental Sleep Medicine
Premier Sleep Associates, Bellevue, WA

OSA

Adult

Pediatric

Mild: AHI 5 - 15

Yes

Moderate: 15 - 30

No

Severe: > 30

Pediatric Obstructed Airway

Differs from Adult SDB

Signs and Symptoms

Pathogenesis

Diagnosis

Treatment

Outcomes

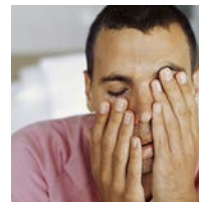
Adult OSA Treatment Goals

Address Chief Complaint

Snoring

Gasping, Choking

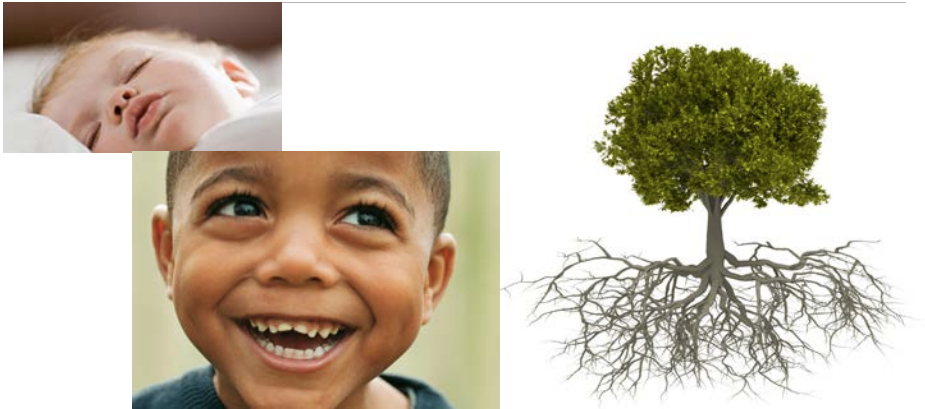
Excessive Daytime Sleepiness



Manage Chronic Disease

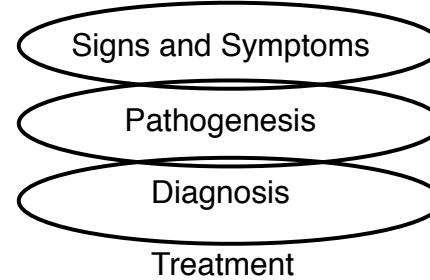
HTN, Mood, Diabetes, CV Risk

Pediatric Obstructed Airway Treatment Goals



Pediatric Obstructed Airway

Today



Finding Adult Patients at Risk



Children are Not Just Little Adults

OSLER'S DISCOVERY (1892)

At night the child's sleep is greatly disturbed, the respirations are loud and snorting and there is sometimes prolonged pauses followed by deep noisy inspirations. The child may wake up in a paroxysm of shortness of breath. In long standing cases the child is very stupid looking, responds slowly to questions, and may be sullen and cross.

How Many Children?

7 of 10 children under 10 sleep poorly



1 in 20 – 100 children will have Obstructive Sleep Apnea



Observer Reports

The distinctive symptoms of OSA in children are **remarkably scarce** and usually require a **high level of suspicion** or alternatively, require systematic implementation of explorative screening questions to enable their detection.

Obstructive Sleep Apnea In Children: A Critical Update
Hui-Leng Tan, David Gozal, and Leila Kheirandish-Gozal
Nat Sci Sleep. 2013; 5: 109–123.

Observer Reports

high level of suspicion

Obstructive Sleep Apnea In Children: A Critical Update
Hui-Leng Tan, David Gozal, and Leila Kheirandish-Gozal
Nat Sci Sleep. 2013; 5: 109–123.

Even children with risk factors and diagnosable disease have long periods of normal sleep

Pediatric Obstructive Sleep Apnea Syndrome
Eliot S. Katz, MD, Carolyn M. D'Ambrosio, MD

Parent Observation

	+	-
PARENT ?AIRE	31	69
SLEEP STUDY	57	43
DIFF	-26%	+25%

Nasal Breathing, 24/7, eliminating oral breathing, is the only valid 'Finish Line' in treatment of pediatric SDB

Towards Restoration of Continuous Nasal Breathing as the Ultimate Treatment Goal in Pediatric Obstructive Sleep Apnea
Christian Guilleminault and Shannon S Sullivan

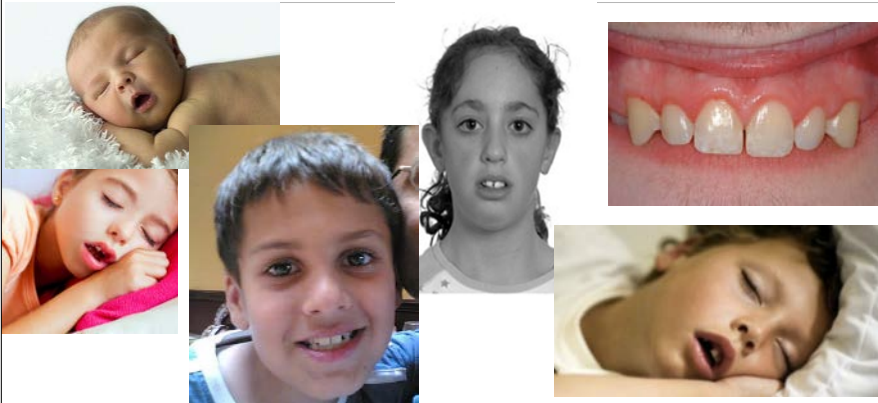
Finding Connor Deegan

"Finding Connor Deegan."

-Valerie Deegan



Behavior Observation - Mouthbreathing



BEARS Questionnaire

B edtime	child have trouble going to bed or falling asleep?
E xcessive Daytime Sleepiness	child sleepy or groggy? Tired, moody, 'out-of-it'?
A wakening During the Night	with trouble going back to sleep?
R egularity + Duration of Sleep	How many hours? Is this Enough?
S noring	Does my child make any sleep sounds? Any stopping, choking, or gasping?

Is child Irritated or angry?

Body Mass Index above average?

I'm Sleepy

Pediatric OSA Screener

Does child Snore?

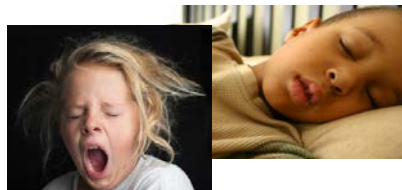
Does child have Labored breathing while sleeping?

Ever notice a stop in child's breathing during sleep?

Does child have Enlarged tonsils and/or adenoids?

Does child have Problems with concentration?

Does child Yawn or is tired/sleepy during the day?



Behavioral Clues



Poor Growth

Fussiness

Inconsolability

Behavioral Clues



Poor Learning

Daydreaming

Inattention/Hyperactivity

Behavioral Clues



Sleepy in Class

Affective Disorders

Chronic Poor Sleep

daytime tiredness

difficulties with focused attention

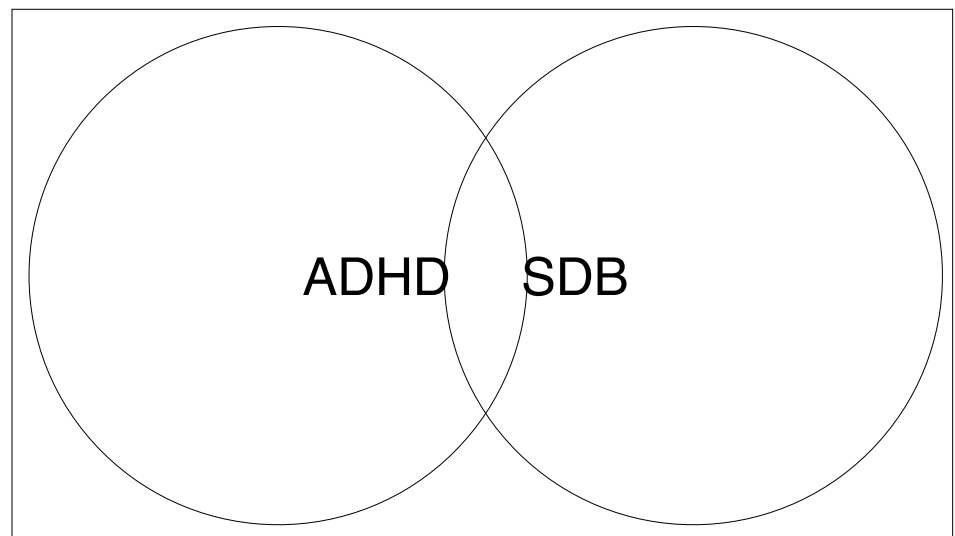
low negative emotion threshold irritability

easy frustration

difficulty modulating impulses

Seminars in Pediatric Neurology, Mar 1996.

March 2, 2019



ADHD

Hyperactive – Impulsive

Fidgety

Constant Talking, Constant Motion

Impatient

Unrestrained Emotions



ADHD

Inattentive

Easily Distracted

Bored

Daydreaming

Difficulty Completing Tasks

Can't Focus



ADHD

Most Kids Have Both Behaviors



ADHD and SDB

1113 Children with Both ADHD and SDB

1405 Controls

“medium relationship between ADHD symptoms and SDB”

Attention Deficit Hyperactivity Disorder And Sleep Disordered Breathing In Pediatric Populations: A Meta-analysis.
Sleep Med Rev. 2013 Dec 24

ADHD and SDB

Patients with ADHD symptomatology should receive SDB screening.

Treatment of comorbid SDB should be considered before medicating the ADHD symptoms if present.

Attention Deficit Hyperactivity Disorder And Sleep Disordered Breathing In Pediatric Populations: A Meta-analysis.
Sleep Med Rev. 2013 Dec 24

SDB and Depression

“Depressive symptoms are higher in SDB children.

Treating SDB might reduce pharmacotherapy, improve sleep patterns, and promote health”

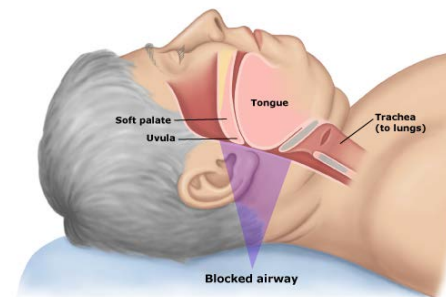
The Relationship Between Depressive Symptoms And Obstructive Sleep Apnea In Pediatric Populations: A Meta-analysis.
J Clin Sleep Med. 2013 Nov 15

ADHD Treatment



Airway Collapse at Any Age

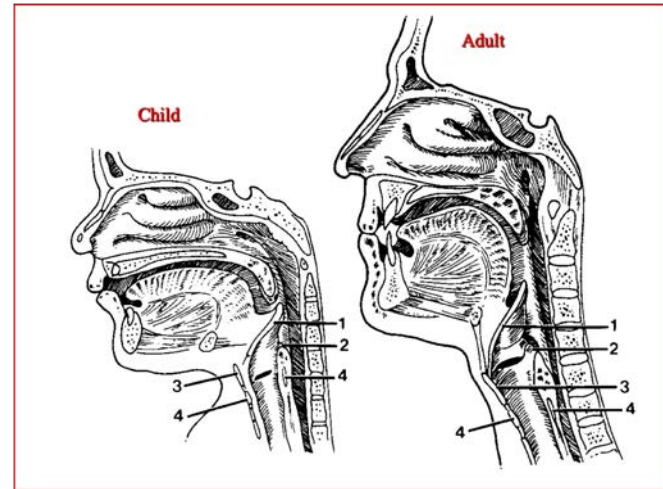
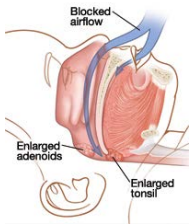
Response to Pressure Change in a Flexible Airway



Airway in Children

It's Still a Pressure Change in a Flexible Airway

Variables: Resting Muscle Tone
Dynamic Response to Pressure Changes
Airway Anatomy
Obesity

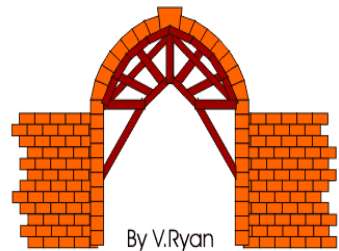


The Most Common Etiology





But It's Not Just Soft Tissue

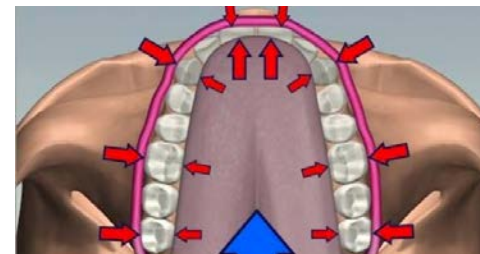


Arch With a Proper Scaffold



Arch With No Scaffold

Scaffold for the Upper arch



Barry Raphael DDS

Tongue Not In the Palate



What Can Dentists Do?

Identify the problem early

6

birth

post puberty

Growth Episodes

Tongue

Muscular Hydrostat

Muscular Structures Without Bones

Connective Tissue Keeps Volume Constant

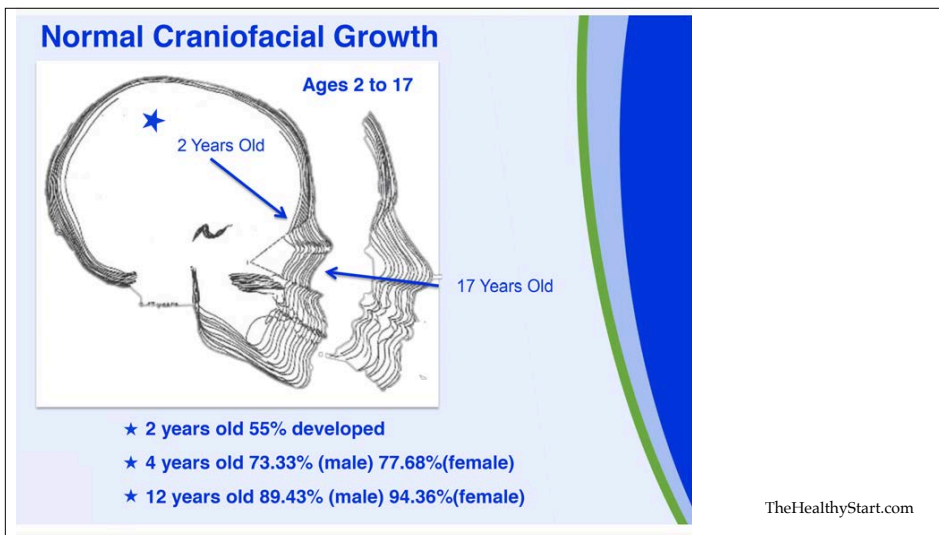
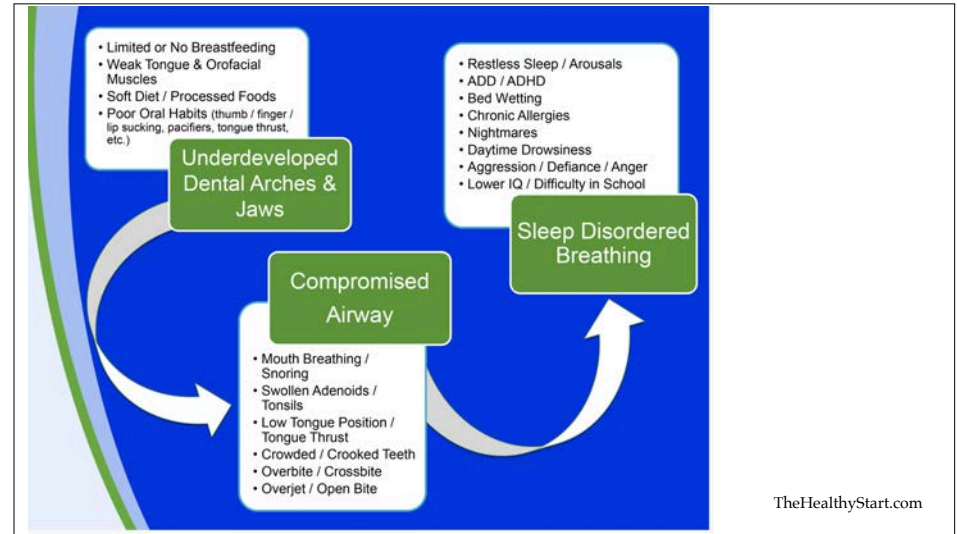
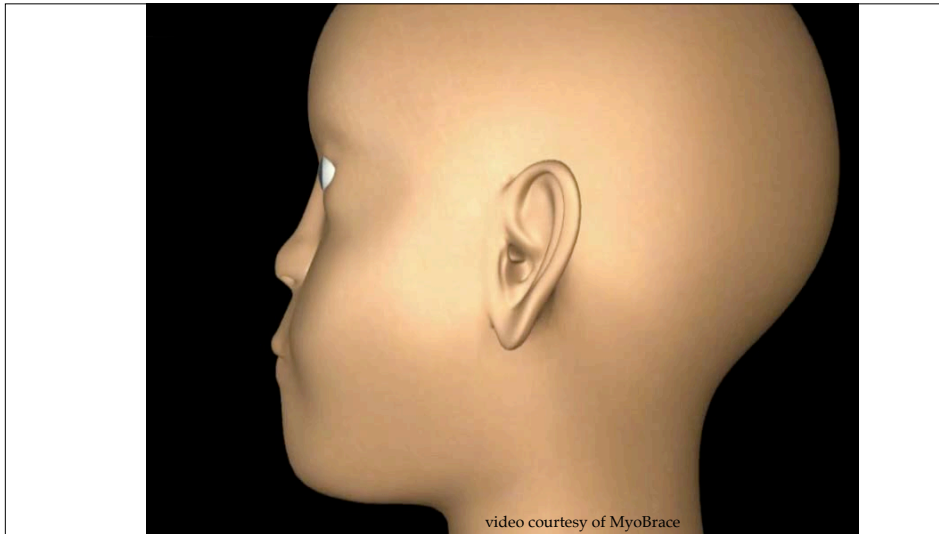
During Muscle Contractions

Bone vs. Muscle

Correct Tongue position and Swallowing

The correct tongue position

EFFECTS of MOUTH BREATHING



Prevalence of Crossbite and Class 2 Patients

90 children 5 - 10 yrs age with SDB risk
Assessed by Otolaryngologist and Orthodontist

15% posterior cross bite 4.8% overjet >7mm

Don't think all SDB kids have skeletal malocclusion

Piska BT, Lee J, Chadha NK. Prevalence of malocclusion in children with sleep-disordered breathing. Journal of Dental Sleep Medicine. 2017;4(2):41-44.

Does 4-Bicuspid Extraction Cause OSA?

The absence of four premolars (one from each quadrant), and therefore a presumed indicator of past "extraction orthodontic treatment," is not supported as a significant factor in the cause of OSA.

J Clin Sleep Med. 2015 Dec 15;11(12):1443-8. doi: 10.5664/jcsm.5284.
Evidence Supports No Relationship between Obstructive Sleep Apnea and Premolar Extraction: An Electronic Health Records Review.
Larsen AJ1, Rindal DB2, Hatch JP1, Kane S2, Asche SE2, Carvalho C3, Rugh J1.

Does 4-Bicuspid Extraction Cause OSA?

Wrong Question.

- ★ 2 years old 55% developed
- ★ 4 years old 73.33% (male) 77.68%(female)
- ★ 12 years old 89.43% (male) 94.36%(female)

Right Question

What Can I Do Now to
Grow Enough Bone for
Airway AND Teeth?

Maxillary Bone Growth

Sutural Growth continues to age 10

Intramembranous Ossification

Enlargement of the Maxillary Sinus

Alveolar Process Development

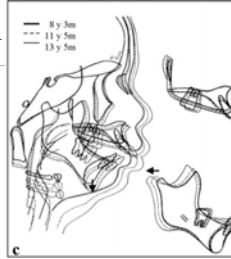
Development and Growth of the Maxilla Dr. Heba Mahmoud Elsabaa. Oral Biology text 2012

Mandibular Bone Growth

Meckle's Cartilage

Growth centers near condyle, lingual foramen and mandibular symphysis

Intramembranous and Chondroid growth also



Growth of the mandible and biological characteristics of the mandibular condylar cartilage
Itaru Mizoguchi Naoko Toriya Yuya Nakao [Japanese Dental Science Review](#) Volume 49, Issue 4, November 2013, Pages 139-150

Birth - 4 Years



4 - 6 Years Overjet

Before



LG - FEMALE (5Y 4M) - INIT. EVALUATION

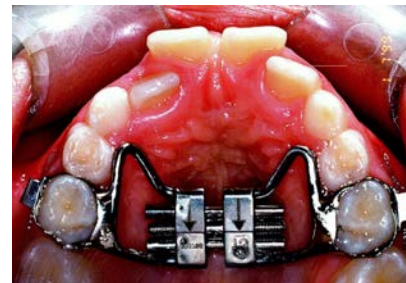
After



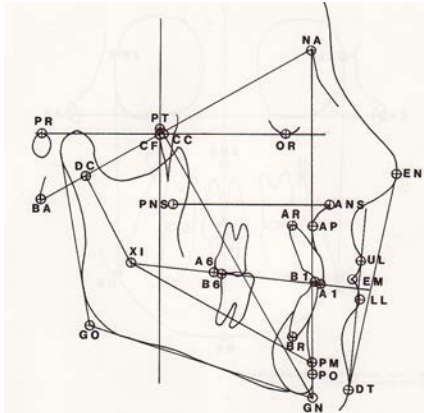
LG - FEMALE POST RET. 57 MOS. (TOTAL 6Y 9M) (2Y 1M)



4 - 6 Years



Cephalometric Norms



Do not reflect Growth Potential

Childhood Sleep-Disorder
Breathing: A Dental Perspective
Kevin L. Boyd and Stephen H. Sheldon

ISBN: 978-1-4557-0318-0; PII: B978-1-4557-0318-0-00034-6; Author: Sheldon & Kryger & Ferber & Gozal;

Why Be Concerned with Childhood OSA?

Clinical Consequences

ADHD

Pulmonary Hypertension

Cardiomegaly

Failure to Thrive and Growth Retardation

Heavy Use of Healthcare / Higher Morbidity

Cardiovascular

Elevated Arterial Pressure

Pulmonary Hypertension

Cardiomegaly

Endothelial Dysfunction



Metabolic Disorders

Obesity and Breathing-Disrupted Sleep
interact to increase the severity and
morbid consequences of each other

Cognitive and Behavioral

Intelligence	Hyperactivity
Memory	Agression
Executive Function	Inattentive Behaviors
Academic Performance	

Be A Good Doctor

If the Signs and Symptoms Can't Be Explained by the Anatomy, Keep Looking and Refer

Congenital Craniofacial Anomalies, Genetic Syndromes, Neuromuscular Disorders, Allergies, Asthma, GERD

“The **Evidence** linking sleep pathology to symptoms of **hyperactivity**, inattention, and other neurobehavioral deficits is **robust and convincing** yet replete with **contradictions**.”

Dillon, J, Chervin, R *Principles and Practices of Pediatric Sleep Medicine*

Seldom is there so **much agreement** on the scope and significance of a problem with so **little consensus** on its **meaning** and mechanism”

Dillon, J, Chervin, R *Principles and Practices of Pediatric Sleep Medicine*

Treatment of SDB in Children

Risk Factors for Childhood OSAS

No. 1 Risk Factor: Adenotonsillar Hypertrophy

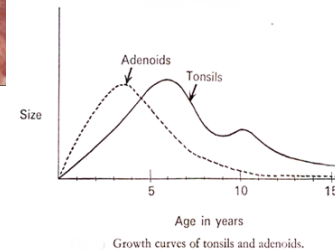
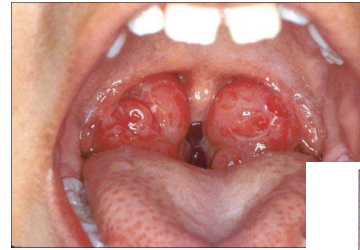
No. 2 Risk Factor: Adenotonsillar Hypertrophy

No. 3 Risk Factor: Adenotonsillar Hypertrophy

Then comes everything else

so says Carol Rosen, MD

Treatment of SDB in Children



Treatment of Pediatric SDB



Role of Adenotonsillectomy in the Management of Pediatric Obstructive Sleep Apnea: Findings from the **Childhood Adenotonsillectomy (CHAT) Study**

Marcus CL et al. *N Engl J Med*.2013;368(25):2366-2376.

Primary Outcomes: Cognitive and Executive Functions
Secondary Outcomes: PSG, behavior, OSAS Symptoms, QOL

397 Children ages 5 – 9

Early AT surgery (n = 194)

Watchful Waiting (n = 203)



Children ages 5 – 9

AHI > 2

Tonsillar hypertrophy

No ADHD Meds

Mostly Healthy except for tonsillitis

No severe hypoxia



453 children began the study

397 children completed

Early AT surgery (n = 194)

Watchful Waiting (n = 203)

17 serious adverse events

7 in early AT

9 in WW

1 before they started



Primary Outcomes:

Attention / Executive Function

Not Improved

Secondary Outcomes:

Behavior

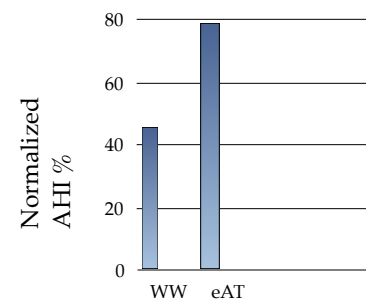
QOL

PSG Results - AHI/O2

Improved



What about AHI?



...at 7 months

What about the other 20%?

What about after 7 months?

High Level of Suspicion

Muscle Tone Differs in POSAS

Obesity Affects Residual Apnea

Growth and Development Issues

Neurological Injury / Deficit

**Must Stay
Observant!**



CPAP?



PAP Efficacy

No RCTs

Observational studies show
improvement in 85% of children

Marcus, et al. J Peds 1995

PAP Adherence

56 Children in a study

Mean Use: 2.8 hours per night, +/- 2.7 hours

Maternal Education was greatest predictor

Marcus et al. J Clin Sleep Med 2012

PAP for Kids

How Many Hours of Therapy Needed is Unknown

Lots of Side Effects

Oxygen supplement by itself is ineffective, except
in some infants

Nothing's Free

Midface Hypoplasia

PAP complication for kids

More severe < 3 years

Total Face mask works Better



Excellent Summary of Assessing Children's Sleep

Sleep Prosthodontics: A New Vision for Dentistry

Jeffrey S. Rouse, DDS

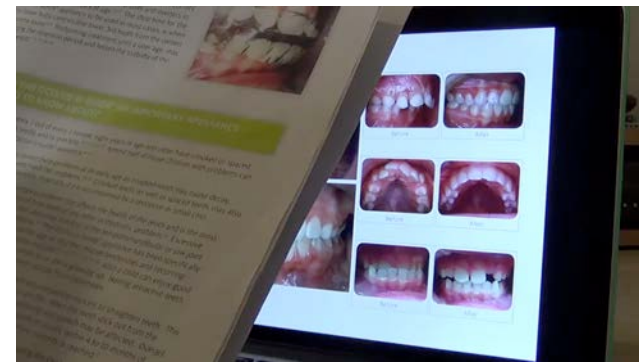
inside dentistry | July 2013 | www.insidedentistry.net

Treatment of SDB in Children



video courtesy of The Healthy Start

Early Intervention



video courtesy of The Healthy Start

Orthodontists



The American Association of Orthodontists (AAO) recommends that all children get a check-up with an orthodontist at the first recognition of the existence of an orthodontic problem, but no later than age 7. Few patients will need to begin treatment that young, but there are some who will benefit from early intervention. For these patients, treatment is likely to consist of guiding the growth of the jaws so that the permanent teeth are in good positions as they come in.

Orthodontists



The American Association of Orthodontists (AAO) recommends that all children get a check-up with an orthodontist at the first recognition of the existence of an orthodontic problem, **but no later than age 7.** Few patients will need to **begin** treatment **that young**, but there are some who will benefit from early intervention. For these patients, treatment is likely to consist of guiding the growth of the jaws so that the permanent **teeth are in good positions** as they come in.

Resources for Growth and Development



LearnAirwayOrtho.com

myobrace®

Whealthystart™



Face Focused
orthodontics & dentofacial orthopedics®
for children & adults
William M Hang DDS MSD



Diagnosis
Begins
With
Observation

PSG for Children



Limitations of PSG for Children

Sensor Size

Facility Access

Technologists trained for adults

HST for Children



Limitations of HST for Children

Sensor Size

Adult failure rate 25%

Algorithms designed for adults

American Academy of Sleep Medicine Position Paper for the Use of a Home SAT for the Diagnosis of OSA in Children

Use of a home sleep apnea test is not recommended for the diagnosis of obstructive sleep apnea in children. The ultimate judgment regarding propriety of any specific care must be made by the clinician, in light of the individual circumstances presented by the patient, available diagnostic tools, accessible treatment options, and resources.

Kirk V, Baughn J, D'Andrea L, Friedman N, Gallon A, Garetz S, Hassan F, Wrede J, Harrod CG, Malhotra RK. American Academy of Sleep Medicine position paper for the use of a home sleep apnea test for the diagnosis of OSA in children. *J Clin Sleep Med*.2017;13(10):1199–1203.

Oximetry as P-OSA Screener

50 children with PSG studies



Home Sleep Recorders

Oximetry Studied Separately

Álvarez D, Alonso-Álvarez ML, Gutiérrez-Tobal GC, Crespo A, Kheirandish-Gozal L, Hornero R, Gozal D, Terán-Santos J, Del Campo F. Automated screening of children with obstructive sleep apnea using nocturnal oximetry: an alternative to respiratory polygraphy in unattended settings. *J Clin Sleep Med*. 2017;13(5):693–702.

Oximetry as P-OSA Screener

ODI3 - number of desats 3% below mean

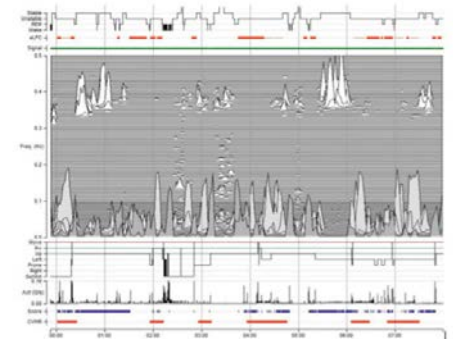
100hz sampling



With Cutoff of 1 event/hr, 85.5% accuracy with Oximetry

Álvarez D, Alonso-Álvarez ML, Gutiérrez-Tobal GC, Crespo A, Kheirandish-Gozal L, Hornero R, Gozal D, Terán-Santos J, Del Campo F. Automated screening of children with obstructive sleep apnea using nocturnal oximetry: an alternative to respiratory polygraphy in unattended settings. *J Clin Sleep Med.* 2017;13(5):693-702.

Sleep Quality Assessment



Two Big Benefits

Not a Sleep Apnea Test

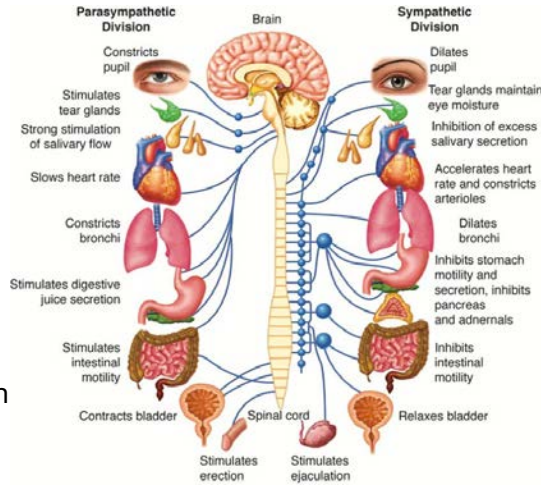
FDA Clearance for Sleep Quality

FDA Clearance for Sleep Quality

New Conversations

Non Threatening to MDs

ANS and Sleep



The variables:

- Heart Rate
- Breathing Rate and Depth
- Blood Pressure

NREM

	Stable	Unstable
Heart Rate	High Frequency Coupling (HFC)	Low Frequency Coupling (LFC)
Breathing Rate and Depth	Steady	Variable
Blood Pressure	Steady	Variable
	Dips	Steady

Unstable

High Frequency Coupling (HFC)

Adrenergic Hormones

Low Frequency Coupling (LFC)

Stable

Unstable

Parasympathetic

Dominant

Sleep

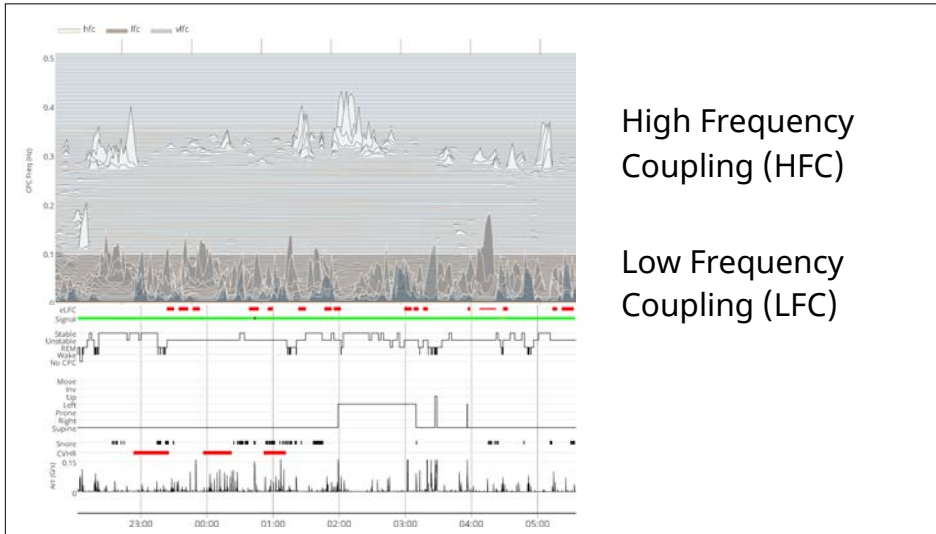
Stable

Adrenergic Hormones

Sympathetic

Dominant

Sleep



High Frequency Coupling (HFC)

Low Frequency Coupling (LFC)

Limitations of Diagnosis

131 Board Certified Sleep Docs
Pediatric Training

“...patients with a craniofacial morphology consistent with pediatric OSAS (retrusive chin, steep mandibular plane, vertical direction of growth and a tendency toward Class II malocclusion) ...

When accompanied by a history of snoring, inability to breathe through the nose, significant allergies, asthma or obesity,

the dentist should refer the patient to an otolaryngologist for assessment.”

Craniofacial Morphological Characteristics
In Children With Obstructive Sleep Apnea Syndrome
A systematic review and meta-analysis
JADA 144(3) March 2013

March 2, 2019

How do Academies interpret evidence?

American Academy of Pediatrics American Academy of Pediatric Dentistry American Academy of Sleep Medicine	}	Study first. Cut Later.
American Academy of Otolaryngology-Head & Neck Surgeons (AAOHNS)	}	Cut! Cut! Cut!

Observer Reports

The distinctive symptoms of OSA in children are remarkably scarce and usually require a high level of suspicion or alternatively, require systematic implementation of explorative screening questions to enable their detection.

Obstructive Sleep Apnea In Children: A Critical Update
Hui-Leng Tan, David Gozal, and Leila Kheirandish-Gozal
Nat Sci Sleep. 2013; 5: 109-123.

high level of suspicion

Mamas,

Don't Let Your Babies Grow Up to Be

Snorers!

