

MASTERING PEDIATRIC DENTAL SLEEP MEDICINE

Dentist Role for Children and Adult with Sleep Disordered Breathing

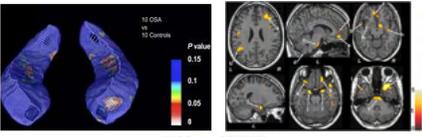
Audrey Yoon DDS MS

Clinical Professor
 Stanford University, Sleep Medicine Clinic
 Diplomate, American Board of Orthodontics
 Diplomate, American Board of Dental Sleep Medicine




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My Journey into the Sleep



Perinatal intermittent hypoxia alters γ -aminobutyric acid: a receptor levels in rat cerebellum

Eung-Kwon Paek^{1,2}, Audrey J. Yoon¹, Bhoomika Aheja¹, Gary W. Lau¹, Daniel D. Nguyen¹, Yong Kim¹, Ronald M. Harper¹

¹Stanford University, ²USA School of Medicine, United States
 *Pediatric Neurology, United States



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The Father of Sleep



Rapid Eye movement (REM)

“The paper I wrote on REM sleep was rejected five times before it was finally accepted for publication.”
 --William Dement, 1957s.

William Charles Dement
 (July 29, 1928 – June 17, 2020)
 World 1st sleep Clinic and Lab at Stanford
 Discovered 5 stages of Sleep
 Establish Full Sleep Study (Polysomnography)
 Invented AHI (Apnea-Hypopnea Index)
 Founder of American Academy of Sleep Medicine




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The Father of Sleep




Christian Guilleminault
 (1938–9 July 2019)
 * Obstructive Sleep Apnea Syndrome
 * Pediatric Sleep Apnea
 * Upper Airway Resistance Syndrome
 * AHI (Apnea-Hypopnea Index)
 * World Association Sleep Medicine




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Professional Experience

Clinical Professor
 Sleep Medicine division
 Department of Psychiatry and Behavioral Sciences
 Stanford University, School of Medicine

Now we have “dental sleep medicine specialty clinic”





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Professional Experience

Director : Dental Sleep Medicine Clinic
 Department of Orthodontics
 University of the Pacific, Arthur A. Doguni School of Dentistry

Now we have “dental sleep medicine clinic” under orthodontic department



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Professional Experience

Director : Dental Sleep Medicine Clinic

Department of Orthodontics
University of the Pacific, Arthur A. Doguni School of Dentistry

Now we have "dental sleep medicine clinic" under orthodontic department

Now we have "Sleep Disorder Screening" as part of a new pt exam for all university pt

Sleep Questionnaire is mandatory !

Sleep Disorder Course for Undergrad Dental Students as part of curriculums



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Pacific Dental Sleep Medicine Fellowship for orthodontist



Clinical Experience
Experience/ learn clinical skills

- Oral appliance
- DOME/MMA Surgery
- Craniofacial development
- Growth Modification

Research
Establish evidences
Leading SDB researching centre



Education
Class / Course

How to read Sleep Study
Understand pathophysiology
Understand Sleep Study

Multidisciplinary Approach
Work with Stanford Sleep Medicine and Sleep Surgery
Establish network
How to communicate and work as a team

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World DentoFacial Sleep Society

<https://dentofacialsleep.org/>



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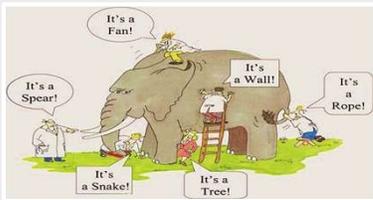
Why Sleep ?

- Increasing level of awareness of sleep apnea and related health issues
- Role of dental and orthodontic professionals in screening and treating sleep apnea patients



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Sleep Breathing Disorder: Where are we ?



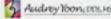


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2018 ADA Policy
Dentistry's Role in Sleep Related Breathing Disorders



- **Screen patients** for SRBD as part of a comprehensive medical and dental history
- **Recognize** symptoms such as sleepiness, choking, snoring or witnessed apneas and an evaluation for risk factors such as obesity, retrognathia, or hypertension
- **Refer** as needed to appropriate physicians for proper diagnosis.

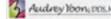


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2018 ADA Policy
Dentistry's Role in Sleep Related Breathing Disorders



- **In children**, screening through history and clinical examination may identify signs and symptoms of **deficient growth and development**, or other **risk factors** that may lead to **airway issues**. If risk for SRBD is determined, intervention through **medical/dental referral** or evidenced based **treatment may be appropriate** to help treat the SRBD and/or develop and optimal physiologic airway and breathing pattern.



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Policy on Obstructive Sleep Apnea (OSA)

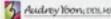


Latest Revision 2021

How to Cite: American Academy of Pediatric Dentistry. Policy on Obstructive Sleep Apnea (OSA). The Reference Manual of Pediatric Dentistry. Chicago, IL: American Academy of Pediatric Dentistry; 2021:13-42.

■ AAPD Guideline - Policy Statements

- **Screen patients** for snoring and sleep-related breathing disorders, OSA
- Assess the **tonsillar pillar** area for hypertrophy
- Assess **tongue** positioning
- Recognize **obesity**
- **Recognize craniofacial anomalies may be associated with OSA**
- **Refer** to an appropriate medical provider (ENT, Sleep physician, pulmonologist)
- **Consider non-surgical intraoral appliances** after a complete orthodontic/craniofacial assessment of the patient's growth and development **as part of a multi-disciplinary approach**



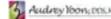
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AAO White Paper: Obstructive Sleep Apnea and Orthodontics

White Paper: Obstructive Sleep Apnea and Orthodontics

XIV. Executive Summary

1. It is strongly recommended that orthodontists be familiar with the signs and symptoms of OSA.
2. It is strongly recommended that orthodontists screen patients with regard to the signs and symptoms of OSA. A thorough history and clinical examination are critically important in that they establish the presence of pre-existing conditions, a basis for diagnosis, the need for referral, and a baseline for evaluating the effects of treatment.
3. It is strongly recommended that the orthodontist refer patients with risk factors for OSA to a physician for further evaluation and a definitive diagnosis. A sleep medicine physician is preferred.
4. It is recommended that the orthodontist refer pediatric patients with nasal obstruction or adenotonsillar hypertrophy to an otolaryngologist.
5. It is recommended that the orthodontist refer adult patients to an otolaryngologist when nasal obstruction or adenotonsillar hypertrophy is present.



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AAO White Paper: Obstructive Sleep Apnea and Orthodontics

White Paper: Obstructive Sleep Apnea and Orthodontics

XIV. Executive Summary

6. The decision for an orthodontist to participate in the treatment of OSA is a choice that should be made based on interest as well as training, skills, experience, laws, standards of care, and insurance coverages applicable to the orthodontist.
7. If involved in the treatment of OSA, an orthodontist should monitor oral appliance treatment efficacy.
8. An orthodontist may elect to manage adverse side effects of oral appliance therapy.
9. No orthodontic treatments have been shown to cause or increase the likelihood of OSA. Rather, some forms of orthodontic treatment have been shown to be important in the treatment of OSA.
10. Interdisciplinary treatment of OSA helps to serve the best interests of patients with OSA.



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Evaluation of Current Screening and Treatment Patterns for Pediatric Obstructive Sleep Apnea Among Practicing Pediatric Dentists in the United States: A Pilot Study

Pediatric Dent 2016 Oct 15;38(5):393-397.

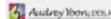
ASKED 6,017 active AAPD members (Pediatric Dentists) : 7 % response rate

RESULTS:

- 43.2% of respondents were **uncomfortable or very uncomfortable** screening for OSA/SDB
- 61.4% indicated no formal training in OSA/SDB during residency

CONCLUSIONS:

- While awareness of OSA and SDB is high among pediatric dental specialists, **educational opportunities are limited, routine screening is not standard, and treatment is not commonly provided.**




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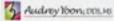
The Prevalence of Pediatric Dentists Who Screen for OSA
Journal of Dental Sleep Medicine 2017;4(1):5-10

RESULTS:

- 70 % of pediatric dentists do some form of screening for OSA
- Young Pediatric dentists (< 5 yrs practice) vs Old Pediatric Dentists (> 30 yrs practice) = **82 % vs 60 %**
- Western States vs Northeast States = **82 % vs 60 %**
- 72 % pediatric dentist report **lack of confidence** regarding their capability for OSA screening.

CONCLUSIONS:

- The need for pediatric dentists to become more aware of OSA screening.
- The screening tools need to be improved more accurately and confidently.**



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Understanding Pediatric SDB
: Children is not small adult 



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Nighttime Symptoms of SDB

- Snoring (> 3 nights/wk), Noisy Breathing
- Breathing Pauses/ Gaspings
- Restless Sleep :toss & turn, position changes
- Paradoxical chest and abdominal motion
- Sleeping in odd positions (such as hyperextended neck) in order to open the airway or sleep sitting up
- Night Sweats - indicate increased effort to breathe
- Recurrent Nightmares or night terrors
- Bruxism
- Bed Wetting – Nocturnal Enuresis





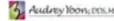



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Daytime Symptoms of SDB

- Sleepiness and Fatigue
- Difficulty to wake up
- Mouth breathing – Dry mouth, inflamed gingiva
- Cognitive and Behavioral Issue— irritability, crankiness, frustration, mood changes, hyperactivity, and difficulty paying attention. ADHD ?
- Learning and Academic Challenges - poorly in school, labeled as “slow” or “lazy”
- Frequent tonsils, adenoids, ear infections, nasal obstruction
- Frequent headaches
- Stunted growth





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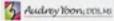
OSAS : A child is not just a small adult

Clinical Manifestations

- Weight / BMI : 20 % obese, 60% normal weight in children vs 60 % obese, 21 % normal weight in adult with OSAS
- Tonsil size : 76 % hypertrophic tonsil in children vs 18 % hypertrophic tonsil in adult with OSAS




Obstructive Sleep Apnea Syndrome: A Child is not Just a Small Adult
 Ji Ho Choi, MD, PhD, Eun Joong Kim, MD, June Choi, MD, PhD, Annals of Otolaryngology, Rhinology & Laryngology
 May 30, 2017 Research Article doi:10.1177/0008488616681011901008



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OSAS : A child is not just a small adult

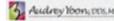
Most common and serious signs and symptoms

- Children**
 Snoring > Mouth breathing > Restless sleep > Nasal obstruction
 > Witness apnea > Difficulty with morning arousal
- Adult**
 Snoring > Witness apnea > Restless sleep > Mouth breathing > Daytime fatigue > Daytime sleepiness

Significant differences : witnessed apnea, daytime sleepiness, morning headache, daytime fatigue, memory reduction




Obstructive Sleep Apnea Syndrome: A Child is not Just a Small Adult
 Ji Ho Choi, MD, PhD, Eun Joong Kim, MD, June Choi, MD, PhD, Annals of Otolaryngology, Rhinology & Laryngology
 May 30, 2017 Research Article doi:10.1177/0008488616681011901008



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Pediatric OSA : More than Index

ARTICLES | JULY 01 1976

Sleep Apnea in Eight Children

Christian Guilleminault, Frederic L. Eshaghy, K. Blair Swenson, William C. Dement

Annals of the NY Academy of Sciences 1976; 271: 23-30.

TABLE I

CLINICAL SYMPTOMS AND NUMBER OF APNEIC EPISODES PER NIGHT OF CHILDREN WITH SLEEP APNEA

Patient	Sex	Age	Day-time Somnolence	Snoring	Recent Enuresis	Decreased School Performance	Morning Headache	Mood & Behavioral Disturbance	Weight Change	Hypertension	Total Apneic Periods*
1	M	8	+	+	+	+	+	+	+	+	78
2	F	14	+	+	+	+	+	+	+	+	674
3	M	12	+	+	+	+	+	+	+	+	816
4	M	9	0	+	Intermittent	0	0	0	0	+	418
5	M	6	0	+	0	0	0	0	0	+	103
6	M	5	+	+	+	+	+	+	+	+	129
7	M	11	+	+	+	+	+	+	+	+	696
8	M	7	0	+	+	0	0	+	+	+	122

*Total apneic periods: number of apneic episodes occurring during one nocturnal sleep period.

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Nocturnal enuresis

Putative mechanisms for pathogenesis of enuresis in patients with SDB

ADH = antidiuretic hormone
ANP = atrial natriuretic peptide
BNP = brain natriuretic peptide

- Dampening effects of OSA on arousal responses
- Changes in bladder pressure
- Secretion of the hormones involve in fluid regulation

Obstructive sleep-disordered breathing, enuresis and combined disorders in children: chance or related association? *Swiss Med Wkly*. 2017;147:w14400. Marco Zaffanello et al

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Attention Deficit Hyperactivity Disorder and SDB

Sleep Medicine Reviews 18 (2014) 349–356

Contents lists available at ScienceDirect

Sleep Medicine Reviews

journal homepage: www.elsevier.com/locate/smrv

CLINICAL REVIEW

Attention deficit hyperactivity disorder and sleep disordered breathing in pediatric populations: A meta-analysis

Karim Sedky^{a,*}, David S. Bennett^b, Karen S. Carvalho^b

- ADHD symptoms are related SDB
- ADHD symptoms improve after adenotonsillectomy
- Patient with ADHD symptom should receive SDB screening
- Treatment of SDB should be considered before ADHD medication

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OSAS : A child is not just a small adult

Polysomnographic Findings

Fig 1. Proportion of slow-wave sleep in control children, children with obstructive sleep apnea syndrome (OSAS), and adults with OSAS. There was substantial difference ($p < 0.001$) in proportion of slow-wave sleep between children with OSAS and adults with OSAS, but no difference ($p = 0.916$) between control children and children with OSAS. Asterisk — $p < 0.05$ (analysis of variance and Tukey's post hoc test).

Fig 2. Distribution of apnea-hypopnea index in children and adults with OSAS. In children with OSAS, apnea-hypopnea index was significantly higher ($p = 0.003$) during rapid eye movement (REM) sleep than during non-REM sleep, whereas there was no such difference ($p = 0.834$) in adults with OSAS. Asterisk — $p < 0.05$ (paired t -test).

Obstructive Sleep Apnea Syndrome: A Child is not Just a Small Adult
Ji-Bin Cheng, MD, PhD, Bao-Jiang Guo, MD, Jun-Jing Chen, MD, PhD, *Annals of Otology, Rhinology & Laryngology*
May 30, 2017 Research Article <https://doi.org/10.1177/000348941611901002>

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OSAS : A child is not just a small adult

■ Airway is growing !

- Craniofacial growth
- Skeletal growth
 - Cranial Base
 - Nasomaxillary Complex
 - Mandible
- Pharyngeal growth
- Soft Tissue growth
- Brain/ Neural Tissue growth

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Pediatric SDB : What is Missing link ?

- Too much attention on AHI for treatment decision
 - **AHI not is perfect metric**
- Multiple Factors playing role at the same time
 - Anatomical, physiological, behavioral
- Poor Phenotyping and understanding all factors involved
- Offering similar treatment to all
 - One size fits all
 - Trial and Error method

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Understanding Phenotype of Pediatric SDB

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Pediatric SDB: Clinical Phenotypes

■ ADHD Type (Type 1 OSA)

- Upper Airway Resistance Syndrome or Mild OSA
- Typically, non-obese
- Not much desaturations
- Anatomical Factor

■ Excessive Sleepy Type (Type 2 OSA)

- Obese, moderate-severe OSA



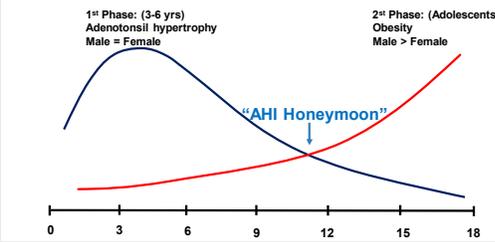
Type 1
ADHD Type

Type 2
Excessive Sleepy Type

Childhood Obstructive Sleep Apnea: One or Two Distinct Disease Entities? *Sleep Med Clin*, 2007, Sep; 2(3): 433-444.
 Shah Davag, Leila Kheirandish-Gozal, and David Gozal

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Pediatric Sleep Disordered Breathing has 2 phases



1st Phase: (3-6 yrs)
Adenotonsil hypertrophy
Male = Female

2nd Phase: (Adolescents)
Obesity
Male > Female

"AHI Honeymoon"

Chang SJ et al. *Korean J Pediatr*. 2010;53:863-871
 Greenfield M et al. *Int J Pediatric Otorhin*. 2003;67:1055-1060

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Understanding Pathophysiology

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4 Key Pathophysiologic Traits



- 1. Impaired Anatomy (Collapsible Upper Airway)** - PCrII 100%, but variable degree of impairment
- 2. Ineffective upper dilator muscle (Poor Muscle Response)** 38%
- 3. Low Respiratory Arousal Threshold (Premature Arousal)** 37%
- 4. Respiratory control instability (High Loop Gain)** 35%

D.J. Eckert, Phenotypic approaches to obstructive sleep apnoea. New pathways for targeted therapy. *Sleep Medicine Reviews* 37, 2018, 45-59

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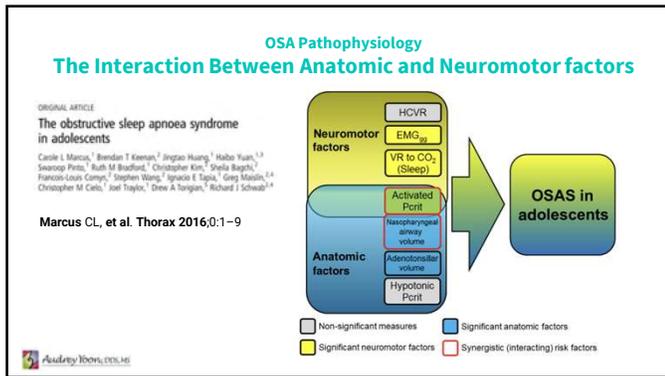
4 Key Pathophysiologic Traits



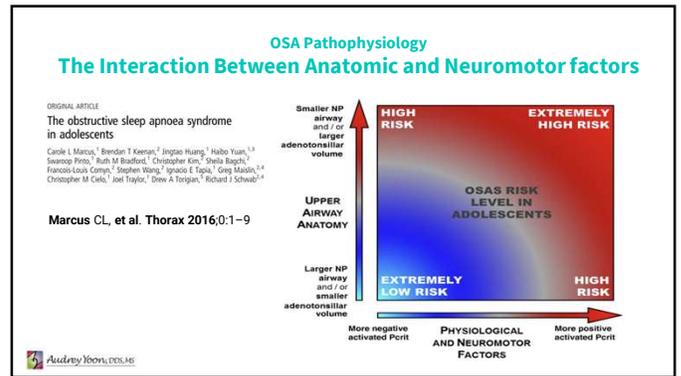
- 1. Impaired Anatomy (Collapsible Upper Airway)** 100%, but variable degree of impairment
Tx: CPAP, Oral Appliances, Upper Airway Surgery, Weight Loss, Respiratory Therapy, Growth Modification Tx
- 2. Ineffective upper dilator muscle (poor Muscle Response)** 38%
Tx: Hypoglossal Nerve Stimulation, UA muscle Training, Drugs
- 3. Low Respiratory Arousal Threshold (Premature Arousal)** 37%
Tx: Certain Hypnotics
- 4. Respiratory control instability (High Loop Gain)** 35%
Tx: Oxygen, Carbon Dioxide, Acetazolamide

D.J. Eckert, Phenotypic approaches to obstructive sleep apnoea. New pathways for targeted therapy. *Sleep Medicine Reviews* 37, 2018, 45-59

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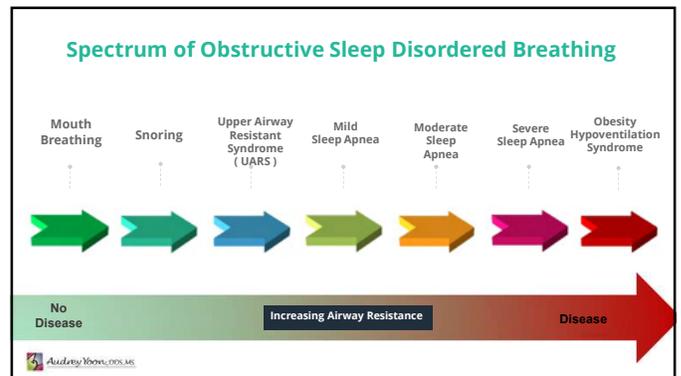
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Pathophysiology of OSA is multifactorial.
-> we need multidisciplinary approach

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DENTAL/ORTHODONTIC IMPACT OF DELAYED TREATMENT

- Knowing that SDB can induce craniofacial anomalies, which further increase the risk of SDB, at least in some children, is a clear incentive to detect and treat SDB children as early as possible
- Continuation of the SDB leads to a worsening of the craniofacial pattern year by year

Praud JP, Dorion D. Pediatric Pulmonol 2008; 43: 837-843
Kikuchi M. Sleep Breath 2005; 9: 146-158

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Growth Modification for SDB Principal

- GOALS
 - Maximize the Growth Potential
 - Achieve Nasal Breathing
 - Change the direction of growth more favorable
- ❖ Age appropriate, right timing
- ❖ Targeted treatment / phenotyping
- ❖ Understand the growth and development
- ❖ Consider functional approach/treatment

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"Typical Adenoid faces showing mouth breathing, flattened noses, and protruding eyes"
 In Gulick and Ayres, *Medical Inspection of the schools, 1917* (2nd ed) p 170

"Mouth Breathing means Adenoids; Adenoid mean deadened Intellects"
 In Gulick and Ayres, *Medical Inspection of the schools, 1917* (2nd ed) p4

Adenoid Inspection in the Chicago, N. J., schools

https://nyamcenterforhistory.org/2015/03/10/adenoids-and-american-school-hygiene-in-the-early-20th-century/

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Snoring in kids linked to behavioral problems

Comments fully available at ScienceDirect

Sleep Medicine Reviews
Journal homepage: www.elsevier.com/locate/smrv

CLINICAL REVIEW
 Neurocognitive outcomes of children with sleep disordered breathing: A systematic review with meta-analysis

Bethazie Menzies^{a,*}, Arthur Teeg^b, Mary Burns^c, Susnicka Lab^d

^aSchool of Psychology, University of Sydney, Sydney, Australia
^bDepartment of Oral Medicine, Sydney Children's Hospital (Sydney) & School of Women's and Children's Health, University of New South Wales, Sydney, Australia

Practice points

1. Sleep disordered breathing in children was associated with deficits across all cognitive domains: intelligence, attention-executive function, memory, language and visual spatial skills.
2. Children with primary snoring experience comparable and sometimes higher levels of cognitive deficits to children with obstructive sleep apnea.
3. Body mass index is a factor that increases poor cognitive outcomes in children with sleep disordered breathing. Hence, weight management may alleviate neurocognitive deficits.

■ Children with primary snoring has similar or higher level of cognitive deficits to children with OSA

■ Robust evidence of multiple neurocognitive impairments in children with Primary Snoring

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Snoring in kids linked to behavioral problems

ARTICLE | APRIL 01 2012

Sleep-Disordered Breathing in a Population-Based Cohort: Behavioral Outcomes at 4 and 7 Years ✓

Karen Bonuck, PhD; Katherine Freeman, DrPH; Ronald D. Chervin, MD; Linshi Xu, PhD

Volume 129, Issue 4
 April 2012

PEDIATRICS

- Longitudinal study with 11,000 children. Effects of sleep-disordered breathing (SDB) symptom trajectories from 6 mo to 7 yrs on subsequent behavior.
- Children with trouble breathing during sleep from 6 mo + were more likely to have behavioral or emotional problems by age 7
- Early-life SDB symptoms had strong, persistent statistical effects on subsequent behavior in childhood. Findings suggest that SDB symptoms may require attention as early as the first year of life.

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Vertical growth pattern : Mouth Breather (Clockwise growth pattern)

Tongue push forward Mouth Breathing : Mouth open Open Bite Long Face Vertical Growth

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Mouth Breather vs **Nasal Breather**

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Why Pediatric Sleep / Growth Modification ?

- Medical Treatment is not always successful or indicated for pediatric patient with OSA
- Dentists may provide valuable alternative and adjunctive treatment options for pediatric OSA

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Journal Pre-proof

Contents lists available at ScienceDirect

Sleep Medicine

Journal homepage: www.elsevier.com/locate/sm

Editorial

Pediatric obstructive sleep apnea: beyond adenotonsillectomy

Albino J. Machado Júnior^a, Agilene N. Gomes^a
^aDepartment of Orthodontics, Head and Neck Surgery, University of Campinas (UNICAMP), Campinas, São Paulo, Brazil

and, consequently, leading to airway collapse. At present, the treatment of choice worldwide for OSAS during childhood is adenotonsillectomy (AT). AT procedures account for 15% of all pediatric surgery carried out in the United States [2].

However, newer studies have shown that even after AT, 60%–70% of children experience residual OSAS. A recent meta-analysis showed that the short-term results from AT were divergent, and that AT did not provide any significant long-term benefit [3,4].

Therefore, the following minimally invasive coadjuvant treatments have recently been proposed: (1) rapid maxillary expansion (RME), (2) use of oral appliances (OA) and (3) myofunctional therapy (MT) [7,10,12–14].

In conclusion, OSAS during childhood leads to physical and neuropsychomotor impairment. As such, it needs to be recognized and treated early in order to avoid or mitigate its deleterious consequences and allow children to develop properly. Thus, it becomes the task of healthcare professionals to research and disseminate new forms of therapy for treating childhood OSAS.

AcademyLibrary.com

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Malocclusion can be a sign of other medical conditions

Orthodontic Treatment

Surface Meaning : Malocclusion
 (Narrow, high arch maxilla
 Retrognathic mandible
 Vertical Growth Pattern,
 Openbite)

Deeper Meaning : Nasal Obstruction
 Mouth Breathing
 Abnormal Tongue Postures
 Sleep Disordered Breathing
 TMJ disfunction
 Myofunctional Disfunctions

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Understanding Malocclusion

Airway affects development of malocclusion

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Dr Audrey Yoon

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Zone of Equilibrium : Neutral Zone

The forces of tongue pressing outward are neutralized by the forces of the cheeks and lips
Chewing, speaking, swallowing and Breathing

Marc Geissberger. *Esthetic Dentistry in Clinical Practice*. John Wiley & Sons, 2013. ISBN 9781118694930.

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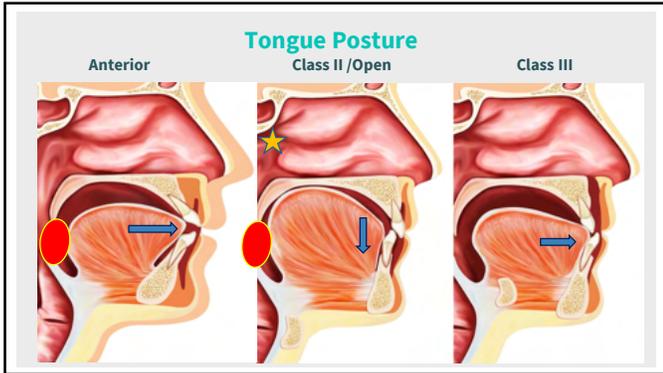
Zone of Equilibrium : Neutral Zone

Tongue Posture

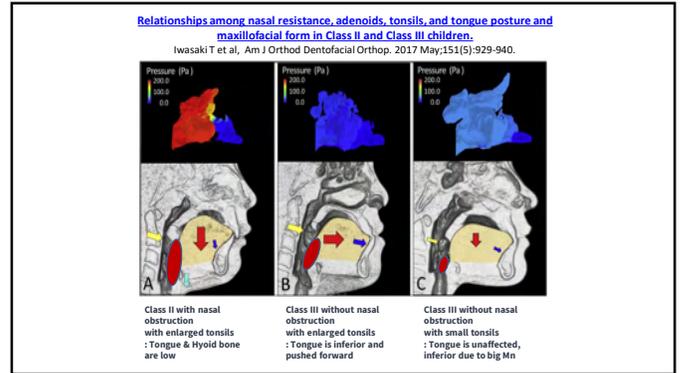
Relates to Habits, Tongue Tie, Mouth breathing, Nasal Blockage, Adenoids and tonsils, Allergies and Asthma

Narrow, high arch palate

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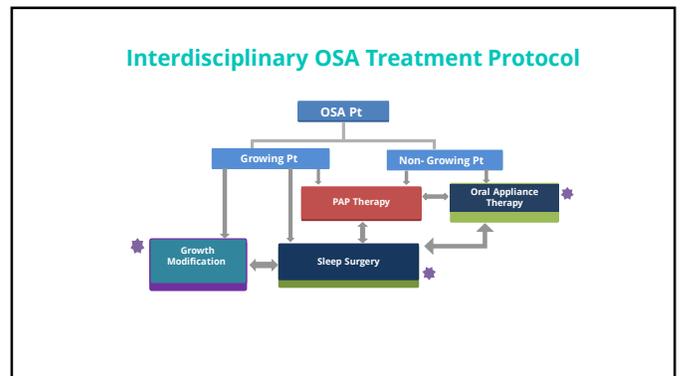
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Key to Pediatric SDB

- 1) Recognize risk factors **Early**
- 2) Treatment for a long Stability : **Structure and Function**
 - Maximize growth potential
 - Improve muscle tone and response
 - Orofacial growth modification

* **Ultimate goal of Pediatric SDB**
Nasal Breathing + Promote positive orofacial growth

- Lip together, Tongue on the palate
- 100% Nasal Breathing → Promote positive orofacial growth

Asadrey Dora, DDS, MS

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Understanding Timing of Growth Modification

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Growth Modification for Ped SDB

Understand Growth and Development
: Age appropriate, right timing

The graph shows the percent of adult size for various tissues over time. Lymphoid tissue reaches 100% by age 10. Neural tissue reaches 100% by age 15. Maxillary and Mandibular tissues reach 100% by age 20. Genial tissue reaches 100% by age 20.

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Pediatric Growth and Development

Timeline of dental stages: Age 0 (Preschool Primary Dentition), Age 5-6 (School Early Mixed dentition), Age 9-10 (School Late Mixed Dentition), Age 11-12 (Adolescence Permanent Dentition), Age 15-16 (Post-adolescence).

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Pediatric Growth and Development

Strategies include: Ant. Cranial Base Nasal Expansion, Nasomaxillary Adv. Midfacial Advancement, TAD anchored Orthopedic, Conventional Maxillary Expansion (Transverse), TAD assisted Maxillary Expansion (MARPE), Peak Man. Growth Stimulate Man. Growth, TAD for Man. Autorotation, Adenoid Tonsillectomy, Myofunctional Therapy.

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Sleep Medicine

Pediatric obstructive sleep apnea: beyond adenotonsillectomy

Abstract by Machado Jésser, Agrillo N, Crepin, Department of Otorhinolaryngology, Head and Neck Surgery, University of Campinas (UNICAMP), Campinas, São Paulo, Brazil

and, consequently, leading to airway collapse. At present, the treatment of choice worldwide for OSAS during childhood is adenotonsillectomy (AT). AT procedures account for 15% of all pediatric surgery carried out in the United States [7]. However, newer studies have shown that even after AT, 60%–70% of children experience residual OSAS. A recent meta-analysis showed that the short-term results from AT were divergent, and that AT did not provide any significant long-term benefit [3,4].

Therefore, the following minimally invasive coadjunct treatments have recently been proposed: (1) rapid maxillary expansion (RME) (2) use of oral appliances (OA) and (3) myofunctional therapy (MT) [2,10,12–14].

In conclusion, OSAS during childhood leads to physical and neurodevelopmental impairment. As such, it needs to be recognized and treated early in order to avoid its deleterious consequences and allow children to develop properly. Thus, it becomes the task of healthcare professionals to research and disseminate new forms of therapy for treating childhood OSAS.

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A Roadmap of Craniofacial Growth Modification for Children with Sleep Disordered Breathing: A Multidisciplinary Proposal

Audrey Yoon¹, David Gozal², Cleto Kushida¹, Rafael Pelayo¹, Stanley Liu³, Jasmine Faldut⁴, Christine Hong⁴

¹Division of Sleep Medicine, Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Redwood City, CA, 94063, USA
²Department of Orofacial Sciences, School of Dentistry, University of California, San Francisco (UCSF), San Francisco, CA, 94143, USA
³Department of Child Health, University of Missouri, School of Medicine, Columbia, MO 65201, USA
⁴Division of Sleep Surgery, Department of Otolaryngology, Stanford University, School of Medicine, Redwood City, CA, 94063, USA

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Growth Modification Guidelines

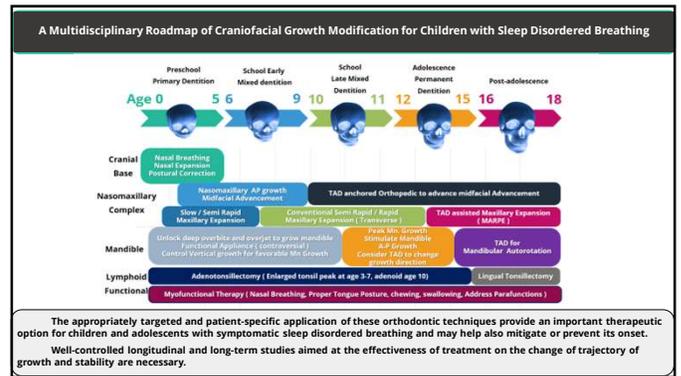
Chronological Age	Developmental Stages				
	0-5	6-9	10-11	12-15	16-18
Dental Stage	Primary Dentition	Early Mixed Dentition	Late Mixed Dentition	Adolescent Permanent Dentition	Permanent Dentition
Skeletal Stage	CS 1	CS 2-3	CS 4-5	CS 5-6	CS 5-6
Characteristics of Skeletal Growth					
Cranial Base	<ul style="list-style-type: none"> Up to 85% cranial and neural growth occurs by age 5 yrs. Cranial Base Flexion determines the frame of facial growth pattern. Elongation at sphenoidosis. 	<ul style="list-style-type: none"> Anterior cranial base growth is complete. Posterior cranial base growth continues. S-N increases by 1 mm per year. Ar-B increases by 1.7 mm per year ages 6-16. 	<ul style="list-style-type: none"> Anterior cranial base growth is complete. Posterior cranial base growth continues. S-N increases by 1 mm per year. Ar-B increases by 1.7 mm per year ages 6-16. 	<ul style="list-style-type: none"> Most growth completed. 	<ul style="list-style-type: none"> Most growth completed.
Nasomaxillary Complex	<ul style="list-style-type: none"> Development by anterior cranial base. Nasal cavity development continues. 	<ul style="list-style-type: none"> Downward and forward growth. Nasal cavity development continues. Maxillary growth in horizontal direction. 	<ul style="list-style-type: none"> Downward and forward growth. Nasal cavity development continues. Maxillary growth in vertical direction. 	<ul style="list-style-type: none"> Downward and forward growth. Nasal cavity development continues. Maxillary growth in vertical direction. 	<ul style="list-style-type: none"> Most growth completed.
Mandible	<ul style="list-style-type: none"> Body length and ramus development. 	<ul style="list-style-type: none"> Increases in body length and ramus development. 	<ul style="list-style-type: none"> Increases in body length and ramus development. Ar post growth 11-13yr. 	<ul style="list-style-type: none"> Increases in body length and ramus development. Ar post growth 11-13yr. 	<ul style="list-style-type: none"> Residual mandibular growth.
Lymphoid Soft Tissues & Tongue	<ul style="list-style-type: none"> Enlarged adenoid/tonsil. Hyoid bone descends, moves slightly anteriorly. Tongue displacement toward oral cavity affects mandibular development. Tongue strength increases rapidly from 2-6.5 yrs. 	<ul style="list-style-type: none"> Enlarged adenoid/tonsil. Hyoid bone descends, moves slightly anteriorly. Increase tongue size. Tongue strength increases slowly. 	<ul style="list-style-type: none"> Adenoid/tonsil size reduced. Tongue size growth complete. Tongue moves inferiorly and forward. Tongue strength increases slowly. 	<ul style="list-style-type: none"> Tongue strength increases slowly. 	<ul style="list-style-type: none"> Hypertrophy of lingual tonsils (after puberty). Tongue strength increases slowly until age 17.
Functional	<ul style="list-style-type: none"> Speech development. Transition from immature swallowing (50% age 6). 	<ul style="list-style-type: none"> Transition from immature swallowing to mature swallowing. 	<ul style="list-style-type: none"> Swallowing maturation complete. 	<ul style="list-style-type: none"> Swallowing maturation complete. 	

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Growth Modification Guidelines

Chronological Age	Developmental Stages				
	0-5	6-9	10-11	12-15	16-18
Dental Stage	Primary Dentition	Early Mixed Dentition	Late Mixed Dentition	Adolescent Permanent Dentition	Permanent Dentition
Skeletal Stage: Central Nervous System Stage	CS 1	CS 1	CS 2-3	CS 4-5	CS 5-6
Strategies for Targeted Therapy					
Goal: Establish nasal breathing and guide favorable growth pattern					
Cranial Base	<ul style="list-style-type: none"> Nasal Breathing Establishment Postural Correction 	<ul style="list-style-type: none"> Nasal Breathing Establishment 	<ul style="list-style-type: none"> Nasal Breathing Establishment 	<ul style="list-style-type: none"> Nasal Breathing Establishment 	<ul style="list-style-type: none"> Nasal Breathing Establishment
Nasomaxillary Complex	<ul style="list-style-type: none"> Expansion and advancement Consider slow maxillary expansion therapy 	<ul style="list-style-type: none"> Rapid maxillary expansion Maxilla advancement with RPE and facemask therapy 	<ul style="list-style-type: none"> Rapid maxillary expansion Maxilla advancement with TAD anchored FRP/MAPE and facemask therapy 	<ul style="list-style-type: none"> TAD anchored maxillary expansion (MARPE) Maxilla advancement with MARPE/facemask Bolton mini-plates 	<ul style="list-style-type: none"> TAD anchored maxillary expansion (MARPE) Limited success: Maxilla advancement with MARPE/facemask Bolton mini-plates
Mandible	<ul style="list-style-type: none"> Unlock deep overbite/overjet to allow mandibular growth Consider myofunctional appliance for tongue posture and forward mandibular growth 	<ul style="list-style-type: none"> Unlock deep overbite/overjet to allow mandibular growth Consider myofunctional appliance for tongue posture and forward mandibular growth 	<ul style="list-style-type: none"> Unlock deep overbite/overjet to allow mandibular growth Functional orthodontic appliances (Class II corrector) to influence mandibular growth direction 	<ul style="list-style-type: none"> Enhance mandibular growth Functional orthodontic appliances to influence Mx growth direction TAD to change growth direction (mandibular autorotation) 	<ul style="list-style-type: none"> Consider TAD for mandibular autorotation Wait for orthognathic surgery
Lymphoid/Soft Tissues & Tongue	<ul style="list-style-type: none"> Adenotonsillectomy Consider myofunctional appliance for tongue 	<ul style="list-style-type: none"> Adenotonsillectomy Consider myofunctional appliance for tongue 	<ul style="list-style-type: none"> Adenotonsillectomy after expansion 	<ul style="list-style-type: none"> Adenotonsillectomy after expansion 	<ul style="list-style-type: none"> Lingual tonsillectomy
Functional	<ul style="list-style-type: none"> Myofunctional therapy 	<ul style="list-style-type: none"> Myofunctional therapy 	<ul style="list-style-type: none"> Myofunctional therapy 	<ul style="list-style-type: none"> Myofunctional therapy 	<ul style="list-style-type: none"> Myofunctional therapy

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JDSM

EDITORIAL <http://dx.doi.org/10.15331/jdsdm.7300>

Paradigm Shift for the DSM Dentist

Jean-François Masse, DMD, MSc, FACD, Diplomate, ABDSM
 Editor-in-Chief, *Journal of Dental Sleep Medicine*
 Université Laval, Québec City, Québec, Canada

Three months ago, Dr. Audrey Yoon and a team of distinguished researchers published a paper in *SLEEP*¹ about growth modification in children suffering from sleep apnea. Their team made a presentation at the American Academy of Orthodontics meeting in April part of the book is devoted to sleep). This book is timely for us as there is already a sense in the general health community that our health system, which heavily rests on curing diseases, is broken and there should be more emphasis put on preventing illness. It is obvious that the

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JDSM

LETTER TO THE EDITOR <http://dx.doi.org/10.15331/jdsdm.xxxx>

Embracing New Paradigms in Pediatric Dental Sleep Medicine: From Controversial to Universal

Audrey Yoon DDS, MS, ABO, D. ABDSM^{1,2}

¹Clinical Professor, Division of Sleep Medicine, Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, USA; ²Clinical Assistant Professor, Department of Orthodontics, Arthur A. Dugoni School of Dentistry at the University of the Pacific, San Francisco, CA, USA

Dear Editor-in-Chief,

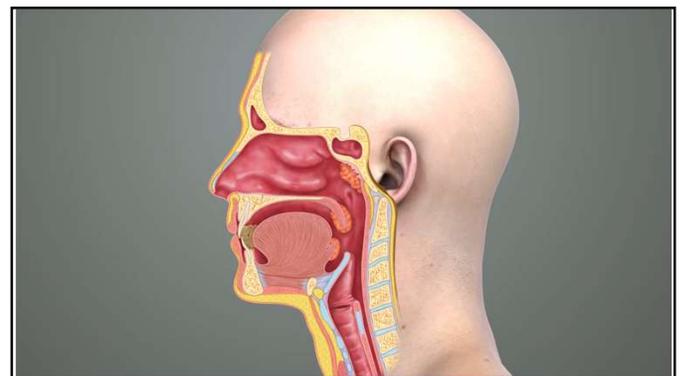
I greatly appreciate your editorial¹ regarding our paper "A Roadmap of Craniofacial Growth Modification for Children With Sleep-Disordered breathing: A healthy discussion will embrace the dentist's role of growth

Considering these developments, we are glad that AADSM proposed and offered a valid forum for discussion to define the future scope of DSM. It is our hope that this healthy discussion will embrace the dentist's role of growth

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How Does Palatal Expansion Improve Sleep Disordered Breathing ?

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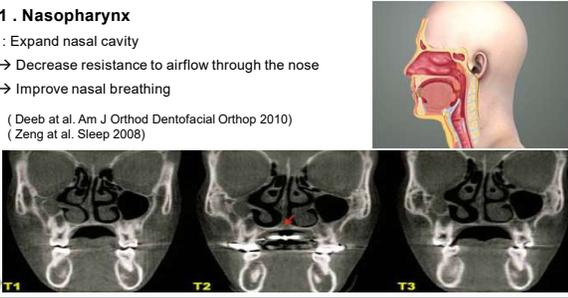
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How Does Palatal Expansions IMPROVE OSA?

1 . Nasopharynx

- : Expand nasal cavity
- Decrease resistance to airflow through the nose
- Improve nasal breathing

(Deeb at al. Am J Orthod Dentofacial Orthop 2010)
(Zeng at al. Sleep 2008)



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How Does Palatal Expansions IMPROVE OSA?

1 . Nasopharynx

- : Expand nasal cavity
- Expand nasal cavity volume
- Expand nasal floor
- Decrease resistance to airflow through the nose
- Improve nasal breathing

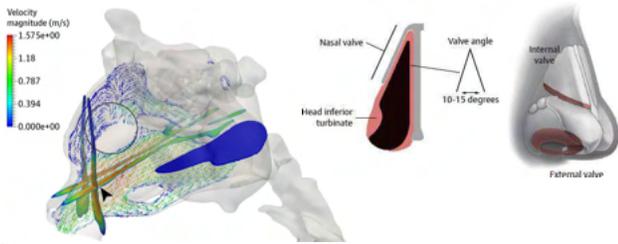
(Deeb at al. Am J Orthod Dentofacial Orthop 2010)
(Zeng at al. Sleep 2008)



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Internal Nasal Valve

The narrowest part of the nasal passageway
It represents 50% of the total airflow resistance



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Sleep and Breathing
International Journal of the Science and Practice of Sleep Medicine

Sleep and Breathing
<https://doi.org/10.1007/s11325-020-02140-y>

ENT • ORIGINAL ARTICLE

Check for updates

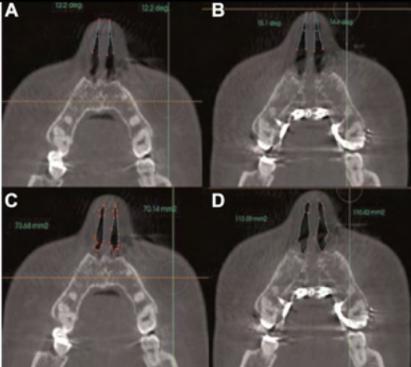
Impact of rapid palatal expansion on the internal nasal valve and obstructive nasal symptoms in children

Audrey Yoon^{1,2} · Mohamed Abdelwahab^{3,4} · Stanley Liu³ · James Oh¹ · Heeyeon Suh² · Michael Trieu³ · Kevin Kang⁵ · Daniela Silva¹

Received: 23 March 2020 / Revised: 15 June 2020 / Accepted: 24 June 2020
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Otolaryngology–
Head and Neck Surgery

Original Research

AMERICAN ACADEMY OF
OTOLARYNGOLOGY–
HEAD AND NECK SURGERY
FOUNDATION

Impact of Distraction Osteogenesis Maxillary Expansion on the Internal Nasal Valve in Obstructive Sleep Apnea

Mohamed Abdelwahab, MD^{1,2}, Audrey Yoon, DDS, MS³, Tyler Okland, MD¹, Sasikarn Poomkonsarn, MD^{1,4}, Chris Gouveia, MD^{1,5}, and Stanley Yung-Chuan Liu, MD, DDS¹

Otolaryngology–
Head and Neck Surgery
1–6
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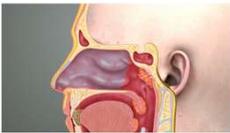


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How Does Palatal Expansions IMPROVE OSA?

2. Oral Cavity : Expand oral cavity

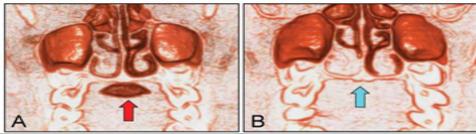
- Create more tongue spaces (esp. roof of the mouth)
- Improve tongue posture



Am J Orthod Dentofacial Orthod. 2013 Feb;143(2):236-45. doi: 10.1016/j.ajodo.2012.09.014.

Tongue posture improvement and pharyngeal airway enlargement as secondary effects of rapid maxillary expansion: a cone-beam computed tomography study.

Iwasaki T¹, Saitoh I, Takemoto Y, Inada E, Katsuno E, Kanomi R, Harauchi H, Yamashita Y



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How Does Palatal Expansions IMPROVE OSA?

2. Oral Cavity : Expand oral cavity

- Improve tongue posture (Advance and raise the tongue into the oral cavity) → Expand posterior airway space

Am J Orthod Dentofacial Orthod. 2013 Feb;143(2):236-45. doi: 10.1016/j.ajodo.2012.09.014.

Tongue posture improvement and pharyngeal airway enlargement as secondary effects of rapid maxillary expansion: a cone-beam computed tomography study.

Iwasaki T¹, Saitoh I, Takemoto Y, Inada E, Katsuno E, Kanomi R, Harauchi H, Yamashita Y

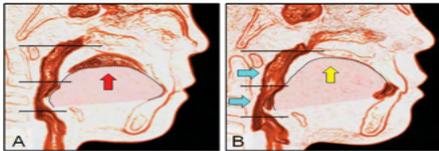


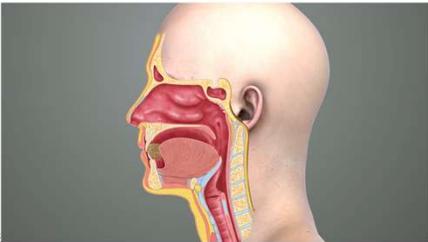
Fig 7. Improvement of low tongue posture and enlargement of the pharyngeal airway after RME in a patient: **A**, before RME, tongue posture is low (red arrow), and the oropharyngeal airway is narrow; **B**, after RME, tongue posture has improved (yellow arrow), and the pharyngeal airway has enlarged (blue arrows).

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How Does Palatal Expansions IMPROVE OSA?

2. Oral Cavity : Expand oral cavity

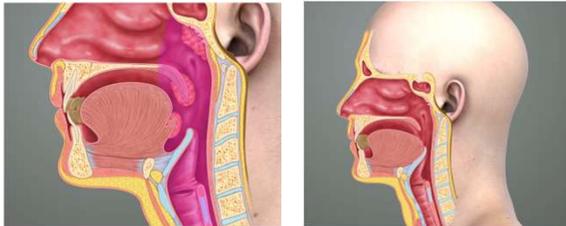
- Improve tongue posture (Advance and raise the tongue into the oral cavity) → Expand posterior airway space



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How Does Palatal Expansions IMPROVE OSA?

3. Pharynx (Collapsibility)



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RME not always changing pharyngeal volume ?

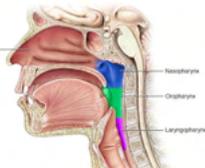
REVIEW ARTICLE <https://doi.org/10.1016/j.jds.2019.07.001>

Rapid Maxillary Expansion Effects on the Upper Airway Dimensions and Function in Growing Patients: An Umbrella Review

Silvia Garzon-Caparras, DDS, MSc¹; Karla Cordero-Hernandez, DDS, MSc, PhD²; Carlos Flores-Mur, DDS, MSc, DSc, FRCD(Ortho)³; Manuel O. Laguarda, DDS, MSc, PhD, FRCD(Ortho)⁴; Carolina Pacheco-Pereira, PhD, MSc, MSc^{1,2}

Conclusions:

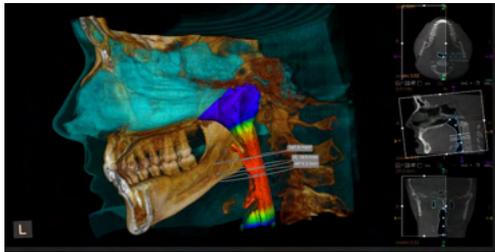
- The methodologic inconsistencies and disagreements especially on the **oropharyngeal dimensional changes after RME** lead to significant **uncertainties about the consistency of the effect of RME changes, especially on the oropharynx region dimensions.**



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Diagnosis- Imaging (CBCT)

Airway Volume : is it reliable ?



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Which Airway is more favorable ?

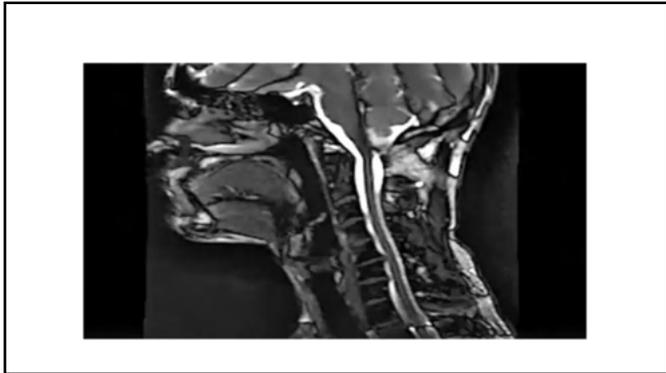
Slide credit: M. Evans DMD

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**Which Airway is more favorable?
Which patient has OSA ?**

Same patient in different position (chin up vs chin down)

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Oropharynx Volume Measurement is *not* a good metric to determine the success

Audrey Ibson, DDS, MS

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CRANIOMAXILLOFACIAL DEFORMITIES / SLEEPDISORDERS / COSMETIC SUR

Does Head and Neck Posture Affect Cone-Beam Computed Tomography Assessment of the Upper Airway?

J Oral Maxillofac Surg :1-13, 2023

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PROTOCOL FOR CBCT SCANS

- Natural head position.
- Horizontal visual axis.
- Close mouth, breathe through nose, place teeth together.
- Swallow once, then rest your tongue where it naturally goes.
- Avoid bite-registration and avoid reaching for chin rest.

Coppelson et al, J Oral Maxillofac Surg :1-13, 2023

Audrey Ibson, DDS, MS

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Table 1. Comparisons of PSG Parameters, intermaxillary molar width, nasal width, pharyngeal airway volume, intraoral airway volume and nasal airway model resistance before DOME and after DOME

	Before DOME			After DOME			Treatment change			P			
	mean	SD	95% CI	mean	SD	95% CI	mean	SD	95% CI				
AHI (events/hr)	17.81	17.56	9.59	26.02	7.82	7.11	4.49	11.14	-9.99	13.65	-16.38	-3.60	< 0.001
ODI (events/hr)	9.67	15.84	2.25	17.08	4.92	5.88	2.16	7.67	-4.75	11.91	-10.32	0.82	0.011
AI (events/hr)	5.30	17.53	-2.91	13.50	0.78	2.34	-0.32	1.87	-4.52	15.20	-11.64	2.60	0.012
LOS (%)	88.15	7.21	84.78	91.52	90.90	4.23	88.92	92.88	2.75	5.53	0.16	5.34	0.036
Intermaxillary molar width (mm)	34.97	3.53	33.32	36.63	42.24	3.28	40.70	43.78	7.27	2.45	6.12	8.41	< 0.001
Nasal width (mm)	22.41	2.34	21.31	23.51	26.68	2.33	25.59	27.77	4.27	1.46	3.59	4.96	< 0.001
Pharyngeal airway volume (cm ³)	18.00	5.57	13.39	18.00	18.20	6.19	15.30	21.10	2.21	3.50	0.57	3.54	0.011
Intraoral airway volume (cm ³)	2.41	4.54	0.29	4.53	1.08	3.08	-0.36	2.52	-1.33	2.64	-2.57	-0.09	0.036
Nasal airway model resistance (Pa/cm ² /s)	0.53	0.38	0.35	0.71	0.16	0.10	0.12	0.21	-0.37	0.35	-0.53	-0.20	< 0.001

DOME, distraction osteogenesis maxillary expansion; AHI, apnea-hypopnea index; ODI, oxygen desaturation index; AI, apnea index; LOS, lowest oxygen saturation; 95% CI, 95% confidential interval.

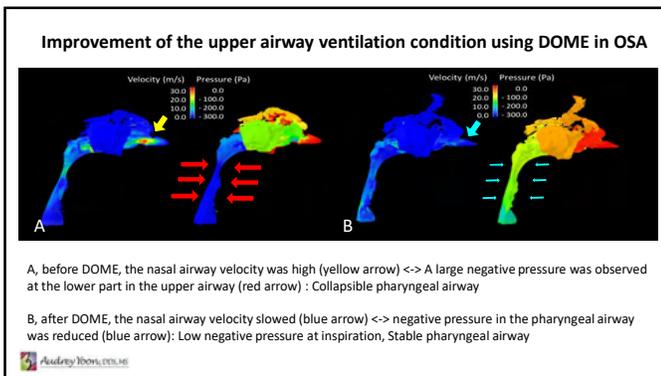
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Table 4. Correlation between sleep data and upper airway ventilation condition before DOME, after DOME, and treatment change

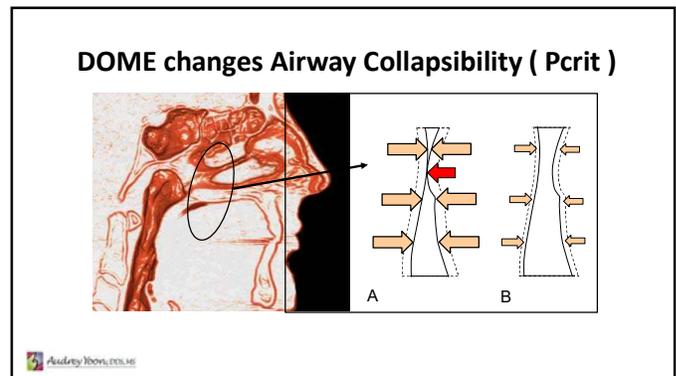
	Pre DOME				Post DOME				Treatment change				
	AHI	ODI	AI	LOS	AHI	ODI	AI	LOS	AHI	ODI	AI	LOS	
nasal velocity (m/s)	r _s	0.85	0.416	0.496	-0.336	0.373	0.333	0.525	-0.355	0.479	0.61	0.294	-0.368
	P	.001**	.008	.026*	.147	.105	.152	.017*	.125	.033*	.002**	.225	.110
nasal pressure (Pa)	r _s	-0.73	-0.371	-0.413	0.380	-0.452	-0.417	-0.443	0.431	-0.437	-0.635	-0.478	0.428
	P	.008**	.108	.071	.098	.045*	.067	.050	.058	.054	.003**	.033*	.060
RA velocity (m/s)	r _s	0.70	0.330	0.195	-0.140	-0.019	0.081	-0.031	-0.073	0.360	0.308	0.420	0.048
	P	.008**	.155	.411	.635	.936	.724	.908	.760	.119	.197	.065	.860
RA pressure (Pa)	r _s	-0.700	-0.519	-0.440	0.429	-0.501	-0.482	-0.454	0.499	-0.455	-0.725	-0.440	0.506
	P	.001**	.019*	.052	.059	.024*	.031*	.045*	.025*	.039*	.000**	.052	.023*
OA velocity (m/s)	r _s	0.485	0.340	0.093	-0.372	0.216	0.020	0.012	0.067	0.365	0.423	0.368	-0.360
	P	.030**	.142	.696	.107	.361	.934	.959	.778	.114	.063	.110	.119
OA pressure (Pa)	r _s	-0.678	-0.498	-0.412	0.398	-0.533	-0.515	-0.466	0.514	-0.425	-0.688	-0.370	0.511
	P	.001**	.025*	.071	.082	.015*	.020*	.038*	.020**	.062	.001**	.109	.021*
HA velocity (m/s)	r _s	0.313	0.146	-0.060	-0.176	0.370	0.146	0.176	-0.060	-0.158	-0.265	-0.121	-0.204
	P	.178	.540	.800	.458	.108	.538	.453	.737	.505	.259	.612	.389
HA pressure (Pa)	r _s	-0.714	-0.510	-0.459	0.400	-0.594	-0.568	-0.581	.556	-0.419	-0.638	-0.376	.491
	P	.001**	.022*	.042*	.081	.006**	.009**	.007**	.011*	.066	.002**	.102	.028*
nasal width (mm)	r _s	-0.126	0.025	-0.064	-0.126	-0.179	-0.192	-0.206	-0.008	-0.399	-0.091	-0.099	-0.041
	P	.597	.916	.787	.595	.450	.418	.384	.972	.082	.702	.677	.864
Intermaxillary first molar width (mm)	r _s	0.72	0.179	-0.216	-0.353	0.035	0.042	-0.216	-0.158	-0.002	0.100	-0.005	-0.368
	P	.762	.450	.360	.095	.885	.859	.358	.506	.995	.674	.993	.110

DOME, distraction osteogenesis maxillary expansion; RA, retropalatal airway; OA, oropharyngeal airway; HA, hypopharyngeal airway; AHI, apnea-hypopnea index; ODI, oxygen desaturation index; AI, apnea index; LOS, lowest oxygen saturation; **, Statistically significant at P < 0.05.

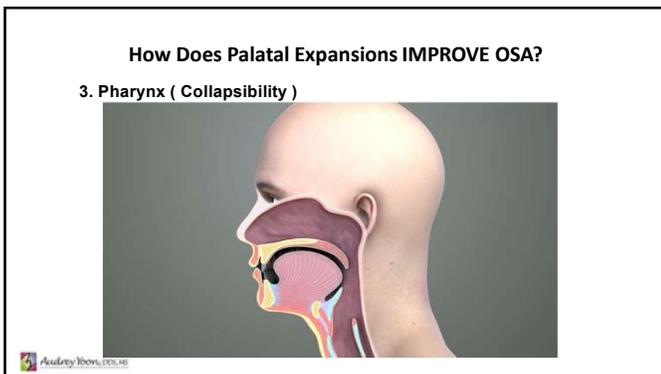
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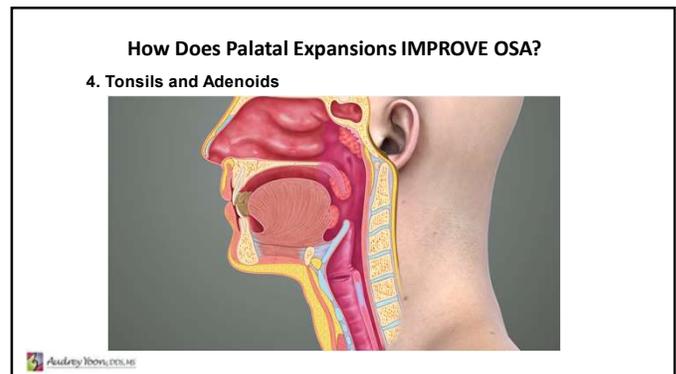
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CHAT study

THE NEW ENGLAND JOURNAL OF MEDICINE
ORIGINAL ARTICLE
A Randomized Trial of Adenotonsillectomy for Childhood Sleep Apnea
N Eng J Med 2013

5 yrs old
Snoring
Restless Sleep
Tonsil : Grade 3
Adenoid : 60 % occluded

- If Watchful waiting ->
 - 46%: normalization of the PSG
 - No improvement of symptoms (PSQ changes : 0)
 - 35 % : worsening of OSA
- If Early adenotonsillectomy->
 - 79% : normalization of the PSG
 - Symptoms, 2ndary Behavior, quality of life and PSG findings : **improvement**

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Management of the Developing Dentition and Occlusion in Pediatric Dentistry

5 yrs old
Pacifier until 3 yr ->
lower lip sucking habit

Snoring
Restless Sleep
Narrow high arch palate
Overjet : 9 mm
Class II div 1
Adenoid :
Tonsil : Grade 3
Adenoid : 60 % occluded
ENT referral

- Primary dentition stage:
Habits and crossbites should be diagnosed and **if predicted not likely to be self correcting, they should be addressed as early as feasible** to facilitate normal occlusal relationships.

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Management of the Developing Dentition and Occlusion in Pediatric Dentistry

5 yrs old
Pacifier until 3 yr ->
lower lip sucking habit

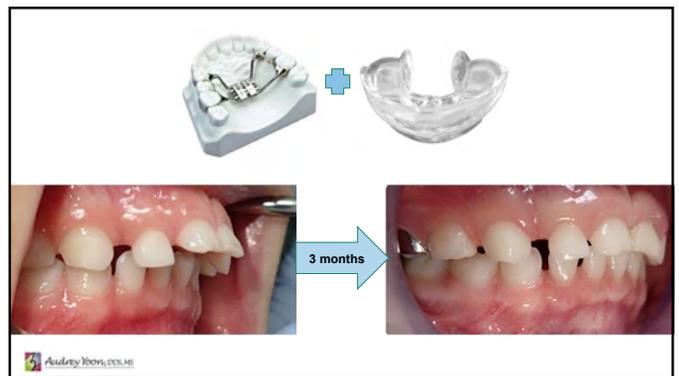
Snoring
Restless Sleep
Narrow high arch palate
Overjet : 9 mm
Class II div 1
Adenoid :
Tonsil : Grade 3
Adenoid : 60 % occluded
ENT referral

- Treatment Consideration : * Primary dentition stage
 - a. all anomalies of tooth number and size
 - b. anterior and posterior crossbites
 - c. presence of habits along with their dental and skeletal sequelae
 - d. openbite
 - e. airway problems.

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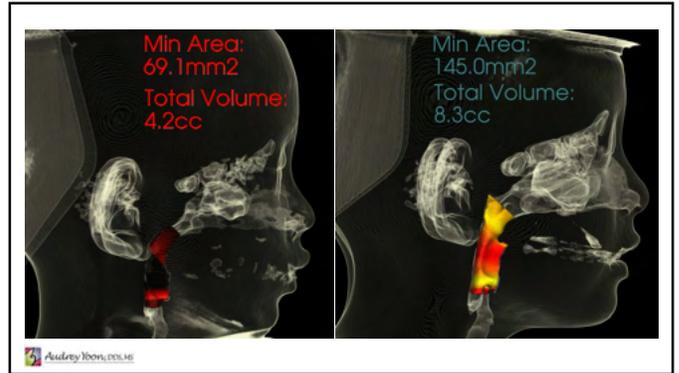
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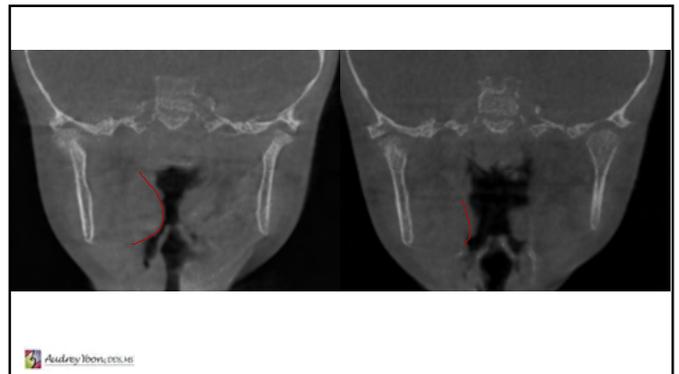
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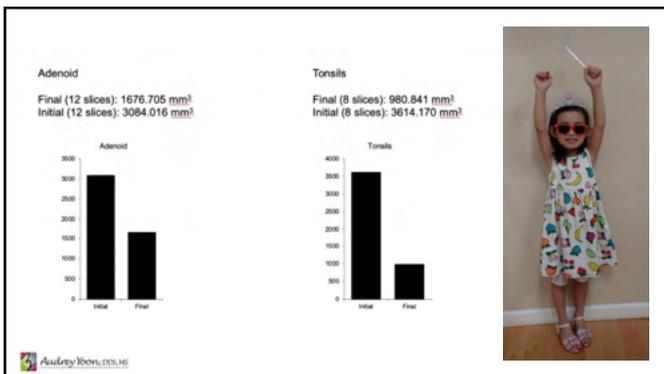
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Sleep Medicine
Volume 92, April 2022, Pages 96-102

Original Article

Impact of rapid palatal expansion on the size of adenoids and tonsils in children

Audrey Yoon ^a, Mohamed Abdelwahab ^b, Rebecca Bockow ^c, Ava Vakili ^d, Katherine Lovell ^d, Inwon Chang ^e, Rumpa Ganguly ^f, Stanley Liu ^b, Clete Kushida ^a, Christine Hong ^{g, h}

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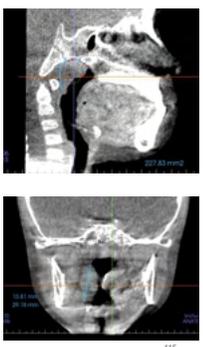
Sleep Medicine
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Objectives

- To compare and evaluate change in pts' adenoid and palatine tonsils with RPE using 3D volumetric analysis



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Materials and Methods

60 children

Narrow and high-arch palates

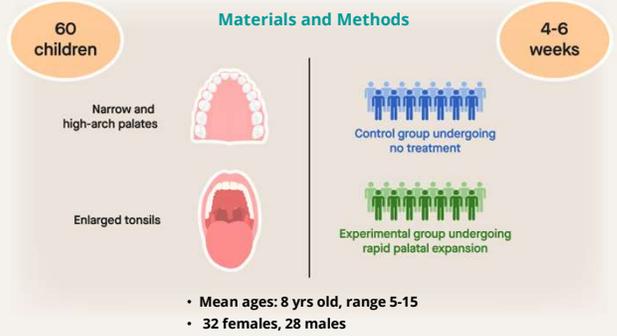
Enlarged tonsils

4-6 weeks

Control group undergoing no treatment

Experimental group undergoing rapid palatal expansion

- Mean ages: 8 yrs old, range 5-15
- 32 females, 28 males



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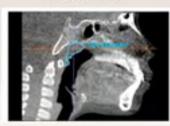
Materials and Methods

Cone-beam computational tomography

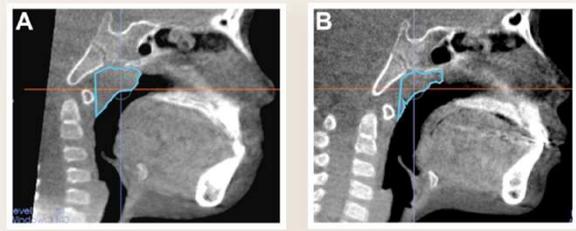
Scans were performed before rapid palatal expansion



and an average of 13 months afterwards



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The expansion group experienced a statistically significant decrease in both adenoid and tonsil volume

Results

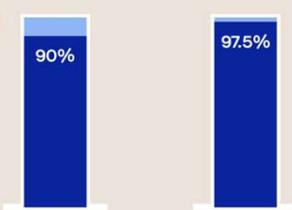
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Results

Patients with decreased adenoid volume: 90%

Patients with decreased tonsil volume: 97.5%

The expansion group experienced a statistically significant decrease in both adenoid and tonsil volume



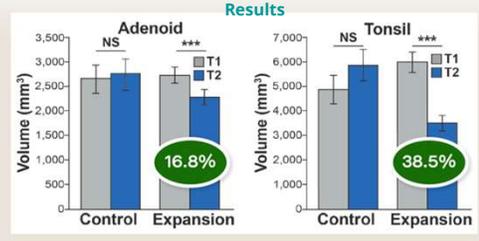
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Results

Adenoid: NS (Control vs Expansion), T1 vs T2: *** (Expansion), 16.8% decrease

Tonsil: NS (Control vs Expansion), T1 vs T2: *** (Expansion), 38.5% decrease

The expansion group experienced a statistically significant decrease in both adenoid and tonsil volume



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Conclusion

- RPE significantly reduced the size of both adenoid and palatine tonsils : **another long-term benefit of RPE treatment**

Tonsil Type	Group	Time 1 Volume (mm ³)	Time 2 Volume (mm ³)
Adenoid	Control	~2,500	~2,500
	Expansion	~2,500	~1,800
Palatine	Control	~4,500	~4,500
	Expansion	~4,500	~3,200

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Videos (Auto-play)

Before RPE

After RPE

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How does palatal expansion shrink the size of tonsils and adenoids?

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How Does Palatal Expansions shrink tonsils?

Less Irritation of lymphoid Tissue
Increase Nasal Volume
(esp. internal nasal valve area)

- Decrease resistance to airflow through the nose
- Decrease Air Velocity & Decrease Air resistance &
- Lower Inspiratory Pressure & Improve collapsibility
- **Improving the irritation of lymphoid tissue**

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How Does Palatal Expansions shrink tonsils?

Nitric oxide (NO)

- One of the most important signal molecules in the body : selectively mediating cell signaling
- Involved in virtually every organ
- Keep blood vessels flexible
- Encourage vasodilation
- Lower blood pressure
- Improve mood & cognition
- **Support immune system *****
- **Defends against pathogens *****

The Nobel Prize in Physiology or Medicine 1998 was awarded jointly to Robert F. Foye, Louis Ignarro, and Paul M. Wink for their discoveries concerning nitric oxide as a signalling molecule in the cardiovascular system.

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How Does Palatal Expansions shrink tonsils?

Nitric oxide (NO)

- A strong neurotransmitter that increases ventilation-perfusion ratio
- **Produced in the nose and the paranasal sinuses**
- Plays a role in maintaining upper airway dilator muscles tone, regulation of spontaneous respiration, and neuromuscular control during sleep.
- **Helps in boosting immunity & rids of bacteria in airborne particles**

Haight JS, Djupesland PG. Nitric oxide (NO) and obstructive sleep apnea (OSA). *Sleep Breath*. Jun 2003

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How Does Palatal Expansions shrink tonsils?

Nasal Breathing Restoration

- Nasal Breathing Restoration reverse the hypertrophic response of tonsils to antigen
- Reduce inflammation and irritation of lymphoid tissues



Audrey Yoon, DDS, MS

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Dentist Role for Pediatric Sleep Disordered Breathing

Bridging the Gap: Integrating Pediatric Dentistry and Sleep Medicine

1. Early Detection
2. Growth Modification
3. Patient Education
4. Interdisciplinary Collaboration
5. Long Term Monitoring of Growth

Audrey Yoon, DDS, MS

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Building the anatomical structure which lasts the lifetime



Patient Specific Airway Design from Children to Adult
The optimal esthetics and function

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Thank You



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