

Diagnostic work up of Sleep Disorders for Children

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UW SCHOOL
OF MEDICINE



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Goals

1. Discuss the evaluation of children with sleep complaints
2. Review the diagnostic tools and when to order sleep studies
3. Recognize the most common sleep disorders

What
patients do
we see in
sleep clinic?

Normal children

Children from parents of all backgrounds

Children with genetic syndromes

Children with psychiatric conditions

Children with craniofacial syndromes

Children with PTSD

Children post injuries

Childre with medical co-morbidities

Most common parental concerns about sleep:

Child is not able to fall asleep independently

Child has frequent nocturnal awakenings

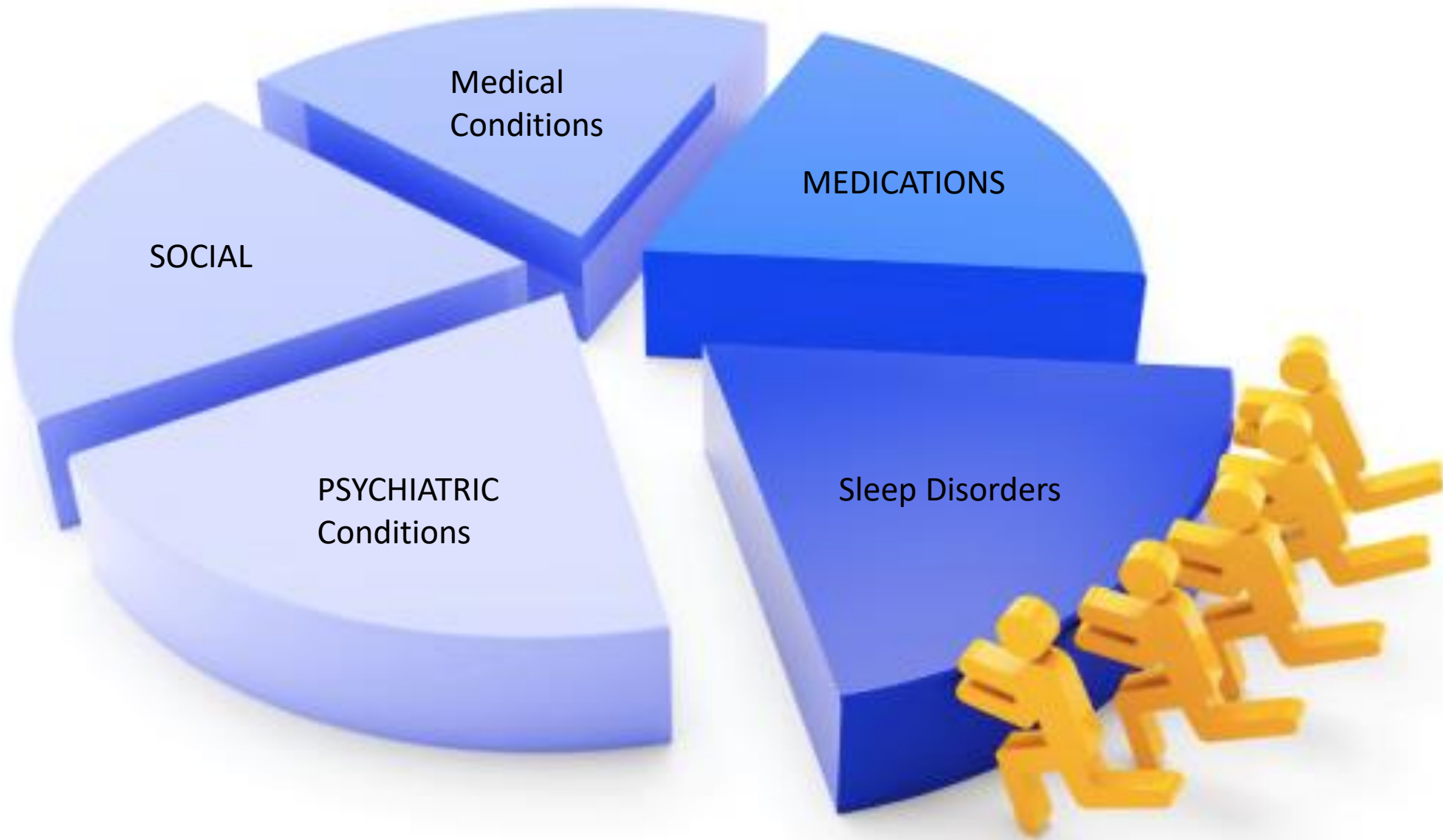
Early awakenings

Abnormal awakenings (movements or parasomnias)

Snoring or breathing problems

Excessive daytime sleepiness or behavioral problems

Not sleeping enough



Medical
Conditions

MEDICATIONS

SOCIAL

PSYCHIATRIC
Conditions

Sleep Disorders

How do we diagnose sleep disorders

Clinical History

Physical Exam

Sleep Diaries

Actigraphy

Polysomnography

MSLT

Imaging/Blood tests

Practice parameters,
anticipatory
guidelines, position
statements

AMERICAN ACADEMY OF PEDIATRICS

CLINICAL REPORT

Guidance for the Clinician in Rendering Pediatric Care

Tracy L. Trotter, MD; Judith G. Hall, OC, MD; and the Committee on Genetics

Health Supervision for Children With Achondroplasia

PRACTICE PARAMETERS

Practice Parameters for the Treatment of Snoring and Obstructive Sleep Apnea with Oral Appliances: An Update for 2005

An American Academy of Sleep Medicine Report

Clete A. Kushida, MD, PhD¹; Timothy I. Morgenthaler, MD²; Michael R. Littner, MD³; Cathy A. Alessi, MD⁴; Dennis Bailey, DDS⁵; Jack Coleman, Jr., MD⁶; Leah Friedman, PhD⁷; Max Hirshkowitz, PhD⁸; Sheldon Kapen, MD⁹; Milton Kramer, MD¹⁰; Teofilo Lee-Chiong, MD¹¹; Judith Owens, MD¹²; Jeffrey P. Pancer, DDS¹³

¹Stanford University Center of Excellence for Sleep Disorders, Stanford, CA; ²Mayo Sleep Disorders Center, Mayo Clinic, Rochester, MN; ³VA Greater Los Angeles Healthcare System and David Geffen School of Medicine at UCLA, Sepulveda, CA; ⁴UCLA/Greater Los Angeles Healthcare System, Sepulveda, CA; ⁵Englewood, Colorado; ⁶Middle Tennessee ENT, Murfreesboro, TN; ⁷Stanford University School of Medicine, Stanford, CA; ⁸Baylor College of Medicine and VA Medical Center, Houston, TX; ⁹VA Medical Center and Wayne State University, Detroit, MI; ¹⁰Maimonides Medical Center, Psychiatry Department, Brooklyn, NY and New York University School of Medicine, New York, NY; ¹¹National Jewish Medical and Research Center, Sleep Clinic, Denver, CO; ¹²Department of Pediatrics, Rhode Island Hospital, Providence, RI; ¹³Toronto, Ontario, CN

JCEM THE JOURNAL
OF CLINICAL
ENDOCRINOLOGY
& METABOLISM

Recommendations for the Diagnosis and Management of Prader-Willi Syndrome

A. P. Goldstone, A. J. Holland, B. P. Hauffa, A. C. Hokken-Koelega, M. Tauber and on behalf of speakers contributors at the Second Expert Meeting of the Comprehensive Care of Patients with PWS

J. Clin. Endocrinol. Metab. 2008 93:4183-4197 originally published online Aug 12, 2008; doi: 10.1210/jc.2008-0649

www.jcem.com
The Journal of Clinical Endocrinology & Metabolism
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Vol. 98, No. 12
Printed in U.S.A.

CONSENSUS

Consensus Guidelines for the Diagnosis and Treatment of Growth Hormone (GH) Deficiency in Childhood and Adolescence: Summary Statement of the GH Research Society*

GH RESEARCH SOCIETY†

Medical Department M, Aarhus Kommunehospital, DK-8000, Aarhus C, Denmark

The pediatric sleep history

6 y/o boy with past history of Down syndrome referred for suspected sleep disordered breathing

The child sleeps in his own room in his own bed. Bedtime routine...

Falls asleep at 9 PM once asleep there are 1 two awakenings

There is: snoring, enuresis, sleepwalking, sleeptalking, restless legs....

The child wakes up at 8 AM, refreshed. No naps. No behavioral problems, hyperactivity. Attends 1st grade special ed. No problems in school. B grades.



Pediatric sleep history

- How does child fall asleep?
- Are there awakenings through the night
- How many hours does the child sleep?
- Snoring or breathing problems?
- Other behaviors during sleep?
- Are there daytime concerns?
 - Sleepiness
 - Hyperactivity
 - Cognitve

Physical exam



Observation: behavior, habitus



Vital signs



HEENT: bone structure, face, macroglossia, palate



Neck: thyroid



Torso: chest, back (scoliosis)



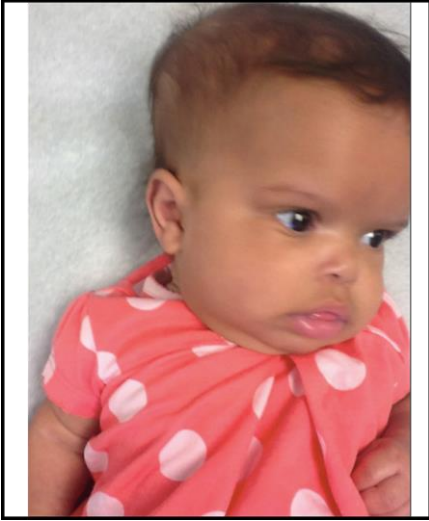
Neurologic exam: hypotonia



Psychiatry: depression, anxiety



Skin

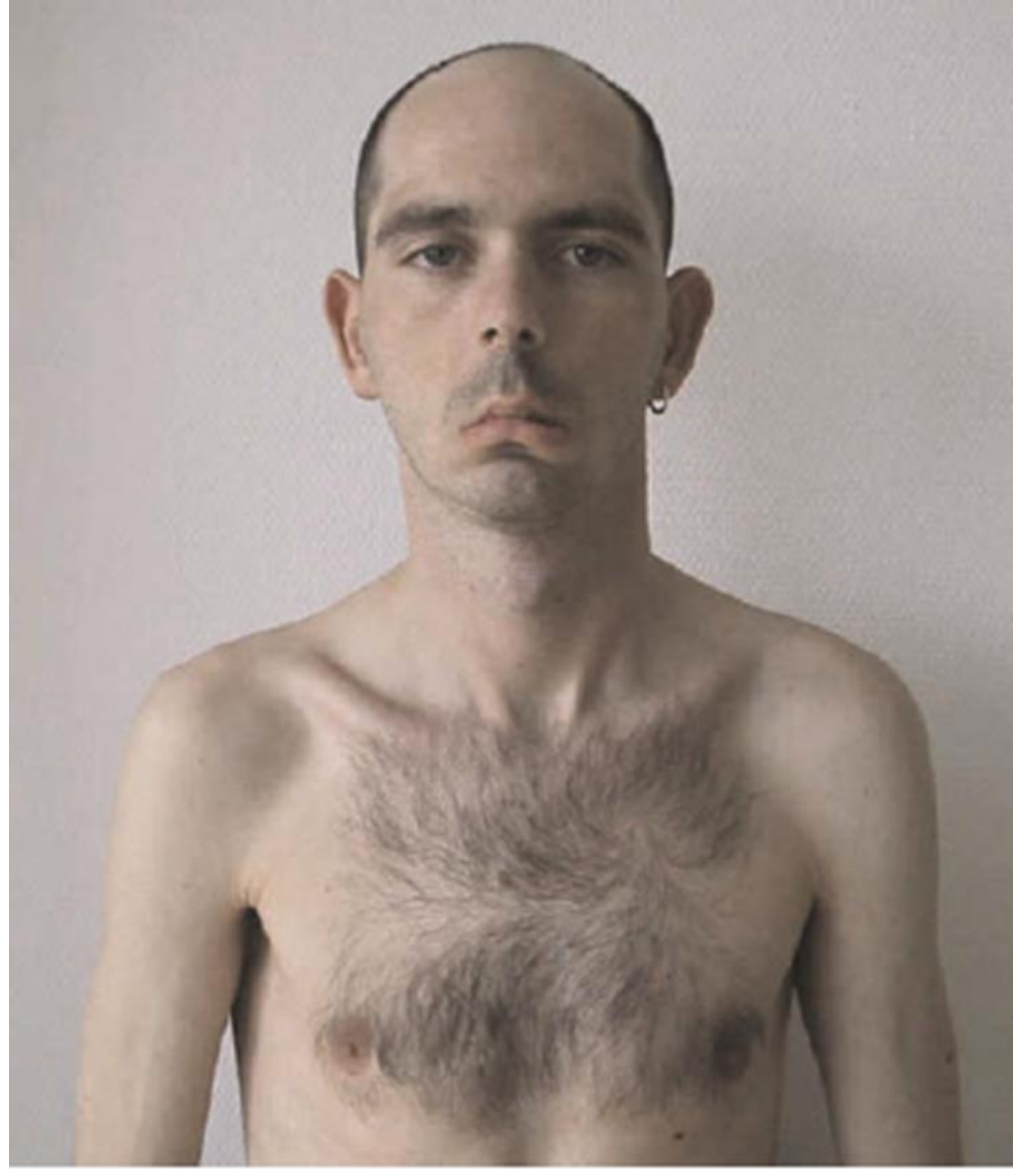




Pierre Robin Sequence
Evaluation, Management, Indications for Surgery, and Pitfalls
Otolaryngol Clin N Am 45 (2012) 695–710



Treacher Collins syndrome: clinical implications for the paediatrician—a new mutation in a severely affected newborn and comparison with three further patients with the same mutation, and review of the literature.
Schlump et. *Eur J Pediatr* (2012) 171:1611–1618



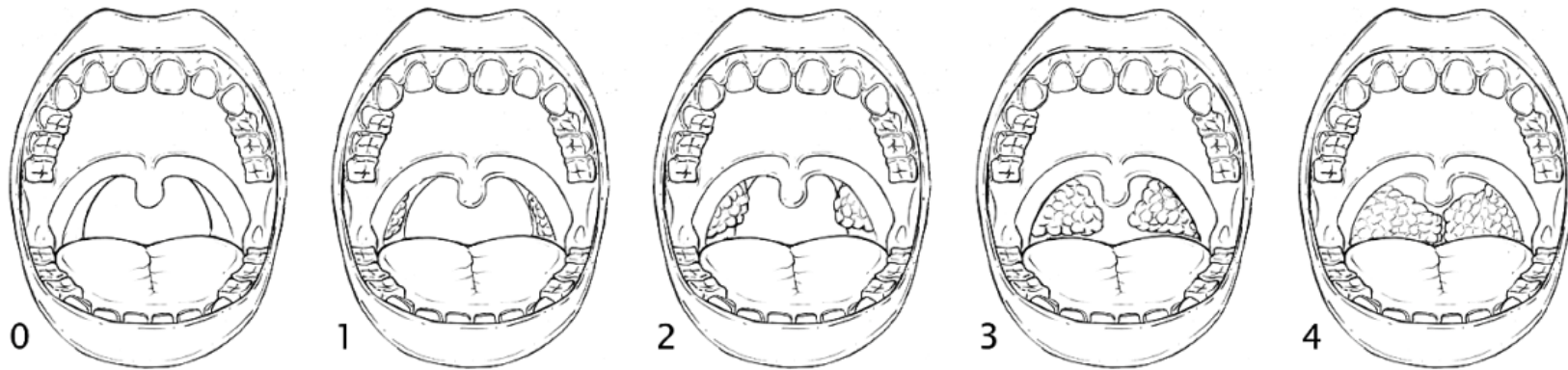






Tonsil Size

Figure 2—Tonsillar size.

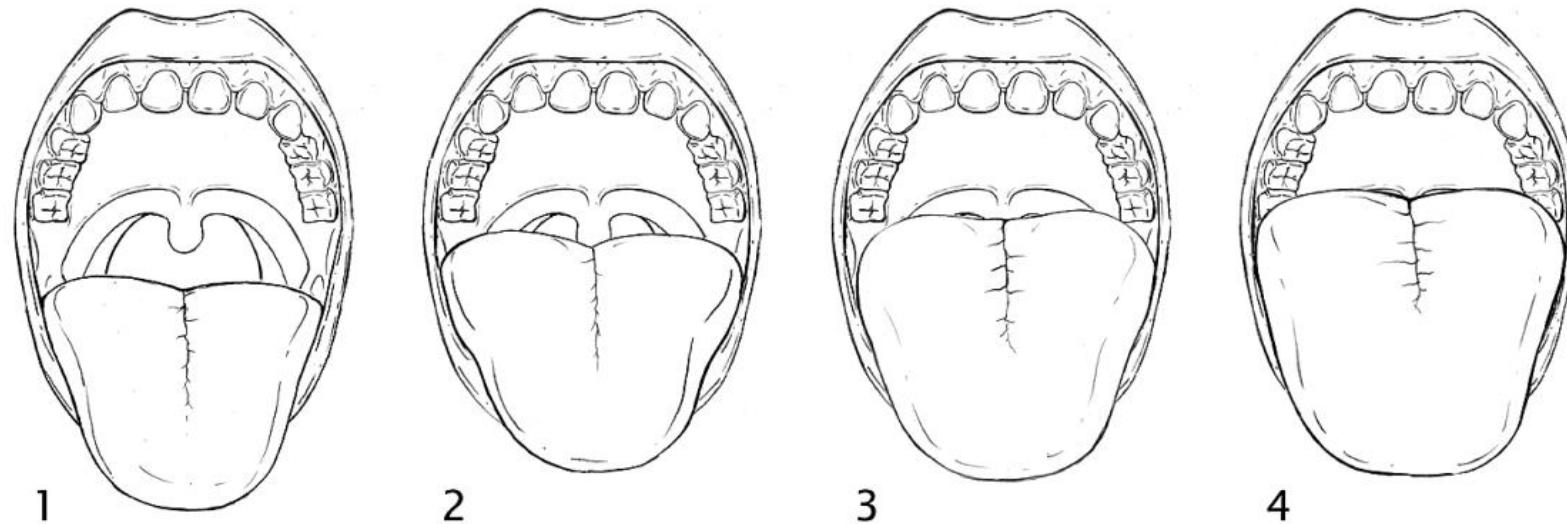


Grade 0: No tonsil tissue present. Grade 1: Tonsils hidden within the faucial/tonsillar pillars. Grade 2: Tonsils extending to the pillars but not beyond them. Grade 3: Tonsils extending beyond the faucial/tonsillar pillars but not to the midline. Grade 4: Tonsils extending to the midline and may be touching each other.

Kumar HVM, Schroeder JW Jr, Gang Z, Sheldon SH.
Mallampati score and pediatric obstructive sleep apnea.
J Clin Sleep Med 2014;10(9):985-990

Mallampati Score

Figure 1—Mallampati score.



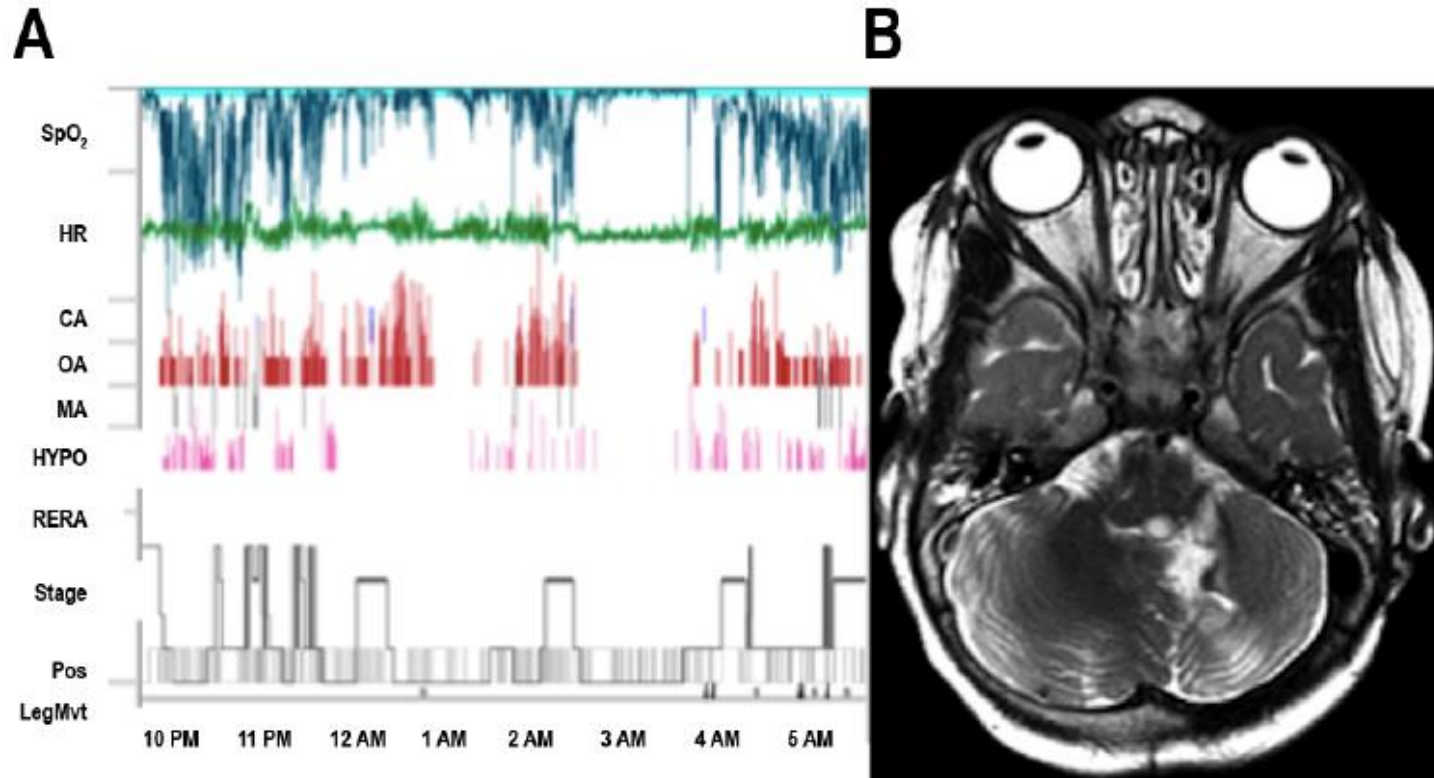
Class 1: Faucial/tonsillar pillars, uvula and soft palate are all visible. Class 2: Partial visibility of the faucial/tonsillar pillars, uvula and soft palate. Class 3: Base of the uvula, soft and hard palate visible. Class 4: Only hard palate is visible.

Kumar HVM, Schroeder JW Jr, Gang Z, Sheldon SH.
Mallampati score and pediatric obstructive sleep apnea.
J Clin Sleep Med 2014;10(9):985-990

Imaging



Figure 1



N NEW RESEARCH

JCSM
Journal of Clinical
Sleep Medicine

<http://dx.doi.org/xxxxxxxxxxxxxx>

Two-Year-Old with Post-Surgical Hypoglossal Nerve Injury and Obstructive Sleep Apnea

Lourdes M. DelRosso, M.D.^{1*}; Romy Hoque, M.D.¹; Eduardo Gonzalez-Toledo, M.D., Ph.D.²

¹Division of Sleep Medicine, Department of Neurology, Louisiana State University School of Medicine, Shreveport, LA; ²Department of Radiology, Louisiana State University School of Medicine, Shreveport, LA

Malformaciones craneofaciales

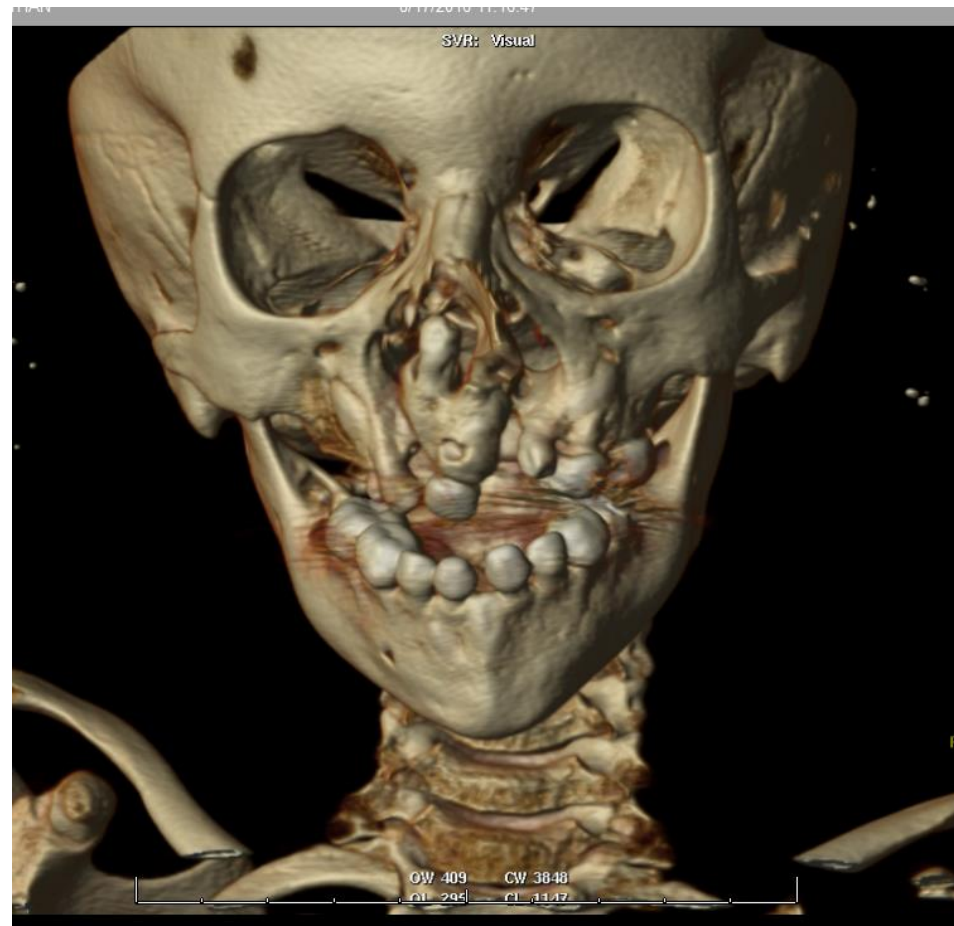
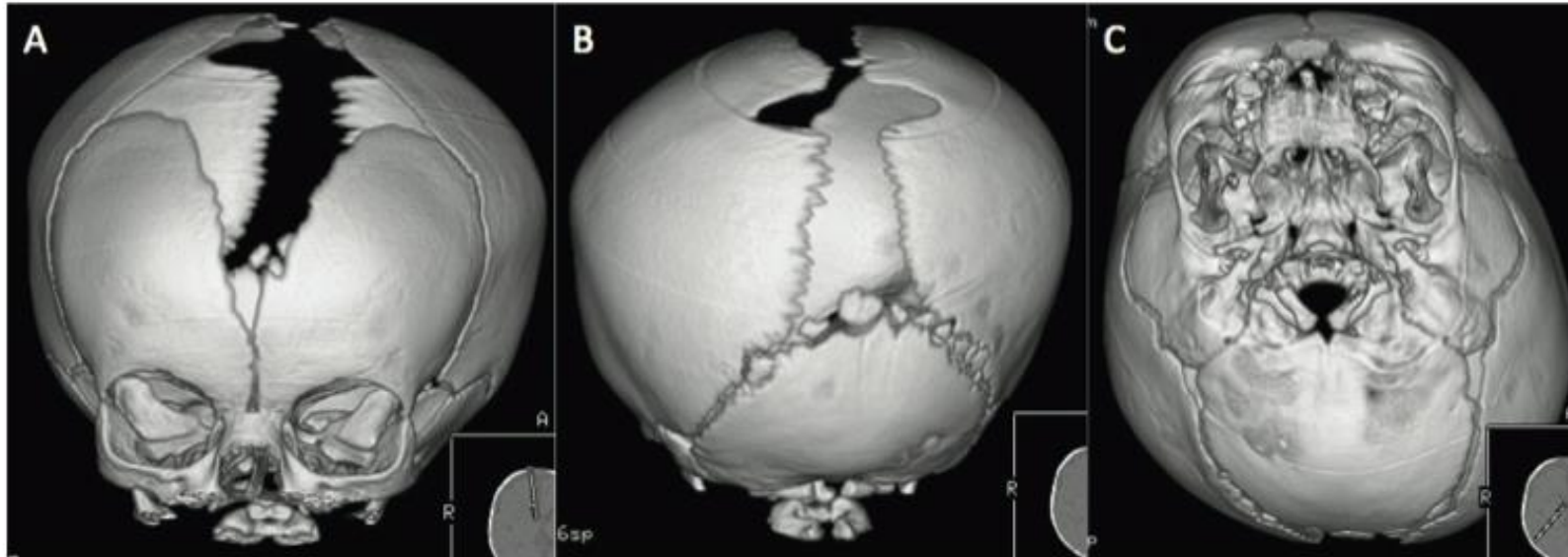


Figure 1—Three-dimensional reconstructed computerized tomography of the head in a patient with achondroplasia



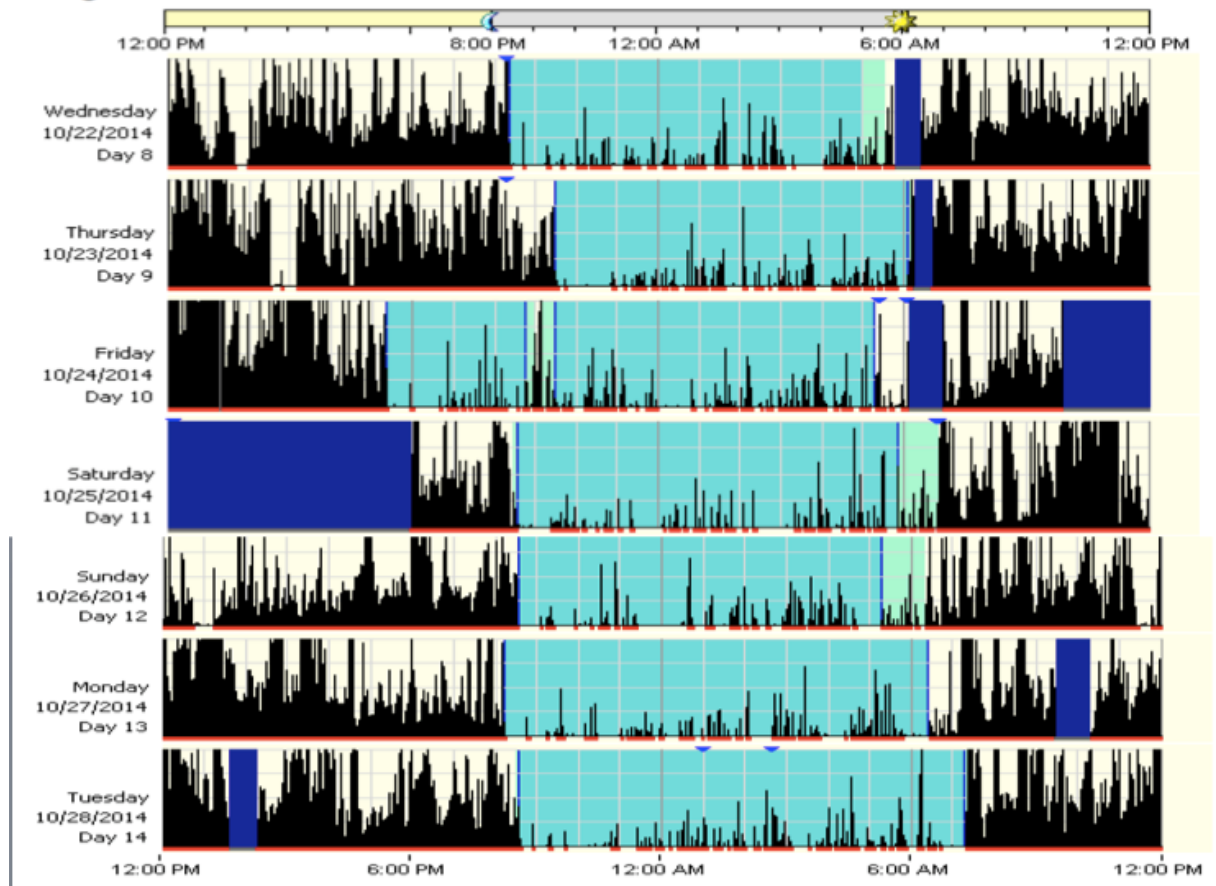
(A) Open anterior fontanelle with a transverse diameter of 80 mm and an anterior-posterior diameter of 127 mm. **(B)** Open posterior fontanelle with a transverse diameter of 46 mm and an anterior-posterior diameter of 19 mm. **(C)** Small short cranial base with mild narrowing of the foramen magnum: 16.8 mm by 18.8 mm.



Actigraphy



Actogram:



RECOMMENDATIONS FOR THE USE OF ACTIGRAPHY





QUALITY OF EVIDENCE









- ⊕⊕⊕⊕ High
- ⊕⊕⊕⊖ Moderate
- ⊕⊕⊖⊖ Low
- ⊕⊖⊖⊖ Very Low

BENEFITS VERSUS HARMS

- B>h** Benefits outweigh harms
- B=H** Benefits approximately equal harms
- H>b** Harms outweigh benefits

PATIENT VALUES AND PREFERENCES

-  Vast majority of patients would use
-  Majority of patients would use
-  Majority of patients would not use
-  Vast majority of patients would not use

- | | | |
|----|---|--|
| 1. | We suggest that clinicians use actigraphy to estimate sleep parameters in adult patients with insomnia disorder. (Conditional) | ⊕⊕⊕⊖
B>h
 |
| 2. | We suggest that clinicians use actigraphy in the assessment of pediatric patients with insomnia disorder. (Conditional) | ⊕⊕⊕⊖
B>h
 |
| 3. | We suggest that clinicians use actigraphy in the assessment of adult patients with circadian-rhythm sleep-wake disorder. (Conditional) | ⊕⊖⊖⊖
B>h
 |
| 4. | We suggest that clinicians use actigraphy in the assessment of pediatric patients with circadian-rhythm sleep-wake disorder. (Conditional) | ⊕⊕⊖⊖
B>h
 |
| 5. | We suggest that clinicians use actigraphy integrated with home sleep apnea test devices to estimate total sleep time during recording (in the absence of alternative objective measurements of total sleep time) in adult patients suspected of sleep-disordered breathing. (Conditional) | ⊕⊕⊖⊖
B>h
 |
| 6. | We suggest that clinicians use actigraphy to monitor total sleep time prior to testing with the Multiple Sleep Latency Test in adult and pediatric patients with suspected central disorders of hypersomnolence. (Conditional) | ⊕⊕⊕⊖
B>h
 |
| 7. | We suggest that clinicians use actigraphy to estimate total sleep time in adult patients with suspected insufficient sleep syndrome. (Conditional) | ⊕⊕⊕⊖
B>h
 |
| 8. | We recommend that clinicians not use actigraphy in place of electromyography for the diagnosis of periodic limb movement disorder in adult and pediatric patients. (Strong) | ⊕⊕⊕⊖
H>b
 |

Polysomnography

- “Pediatric Polysomnography” Sleep Med Clin. 2009 September ; 4(3): 393–406.



RECOMMENDATIONS FOR DIAGNOSTIC INDICATIONS FOR POLYSOMNOGRAPHY IN SLEEP RELATED BREATHING

- | | | |
|--------------|--|-----------|
| 3.2.1 | Polysomnography is indicated when the clinical assessment suggests the diagnosis of obstructive sleep apnea syndrome in children. | STANDARD |
| 3.2.2 | Polysomnography is indicated when the clinical assessment suggests the diagnosis of congenital central alveolar hypoventilation syndrome or sleep related hypoventilation due to neuromuscular disorders or chest wall deformities. It is indicated in selected cases of primary sleep apnea of infancy. | GUIDELINE |
| 3.2.3 | Nap (abbreviated) polysomnography is not recommended for the evaluation of obstructive sleep apnea syndrome in children. | GUIDELINE |
| 3.2.4 | Polysomnography is indicated when there is clinical evidence of a sleep related breathing disorder in infants who have experienced an apparent life-threatening event (ALTE). | GUIDELINE |

HYPERSONNIA

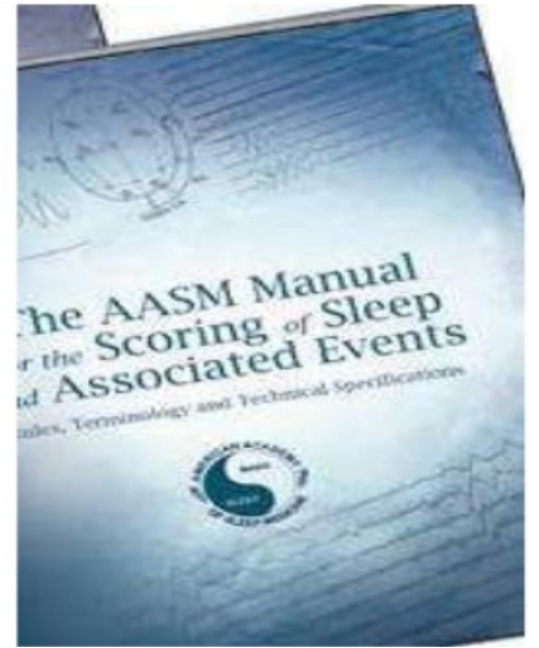
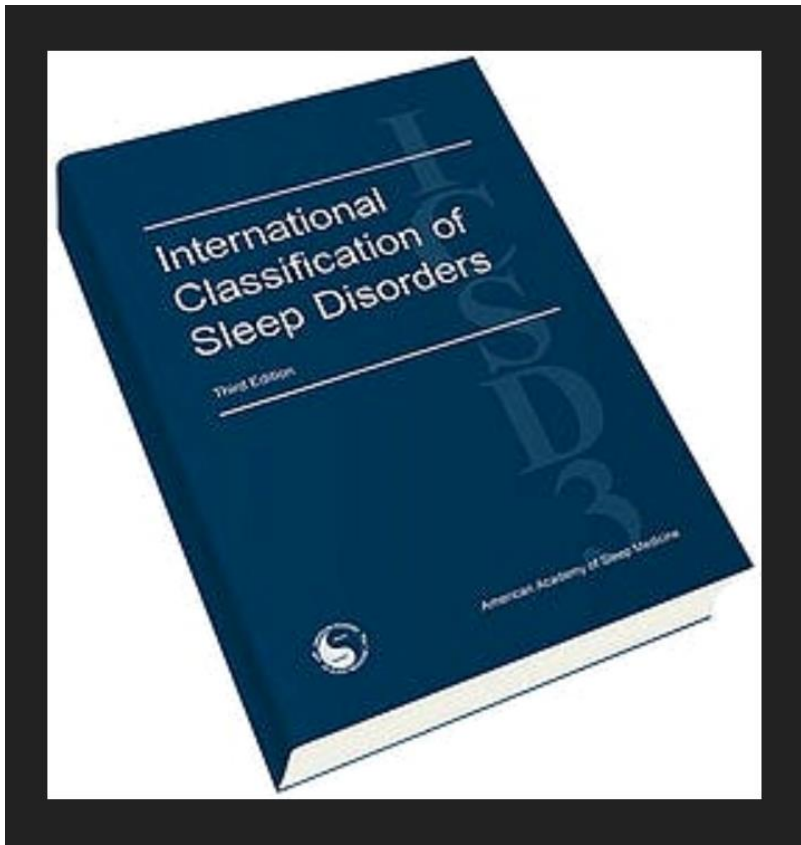
- | | | |
|-------|--|----------|
| 3.1.1 | The MSLT, preceded by nocturnal PSG, is indicated in children as part of the evaluation for suspected narcolepsy. | STANDARD |
| 3.1.2 | The MSLT, preceded by nocturnal PSG, is indicated in children suspected of having hypersomnia from causes other than narcolepsy to assess excessive sleepiness and to aid in differentiation from narcolepsy | OPTION |

PARASOMNIA

- | | | |
|-------|---|-----------|
| 3.2.1 | The polysomnogram using an expanded EEG montage is indicated in children to confirm the diagnosis of an atypical or potentially injurious parasomnia or differentiate a parasomnia from sleep-related epilepsy when the initial clinical evaluation and standard EEG are inconclusive. | OPTION |
| 3.2.2 | Children with frequent NREM parasomnias, epilepsy, or nocturnal enuresis should be clinically screened for the presence of comorbid sleep disorders, and polysomnography should be performed if there is a suspicion for sleep-disordered breathing or periodic limb movement disorder. | GUIDELINE |

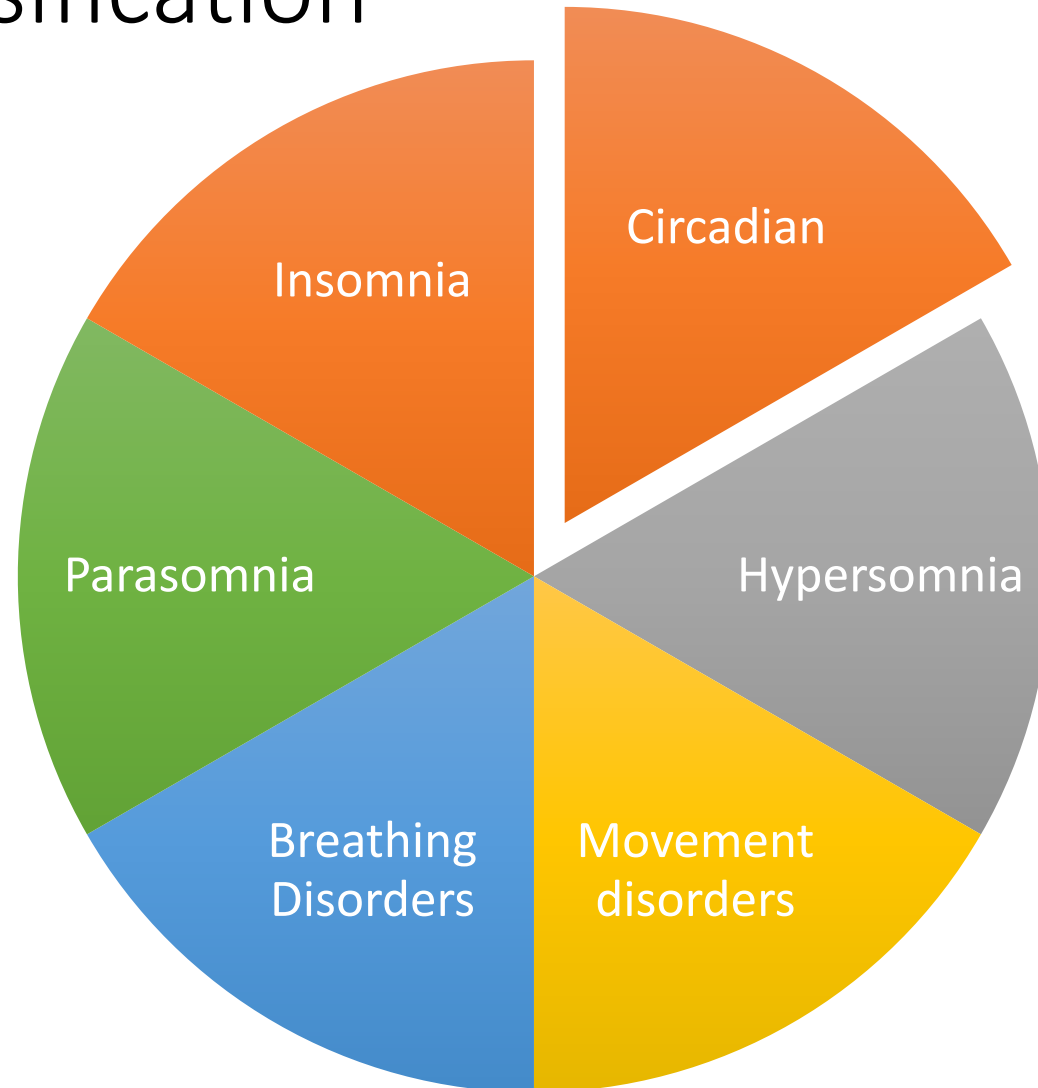
SLEEP RELATED MOVEMENT DISORDERS

- | | | |
|-------|--|----------|
| 3.3.1 | Polysomnography is indicated in children suspected of having RLS who require supportive data for diagnosing RLS. | OPTION |
| 3.3.2 | PSG is indicated for children suspected of having PLMD for diagnosing PLMD. | STANDARD |
| 3.3.3 | Polysomnography is not routinely indicated for evaluation of children with sleep-related bruxism. | STANDARD |

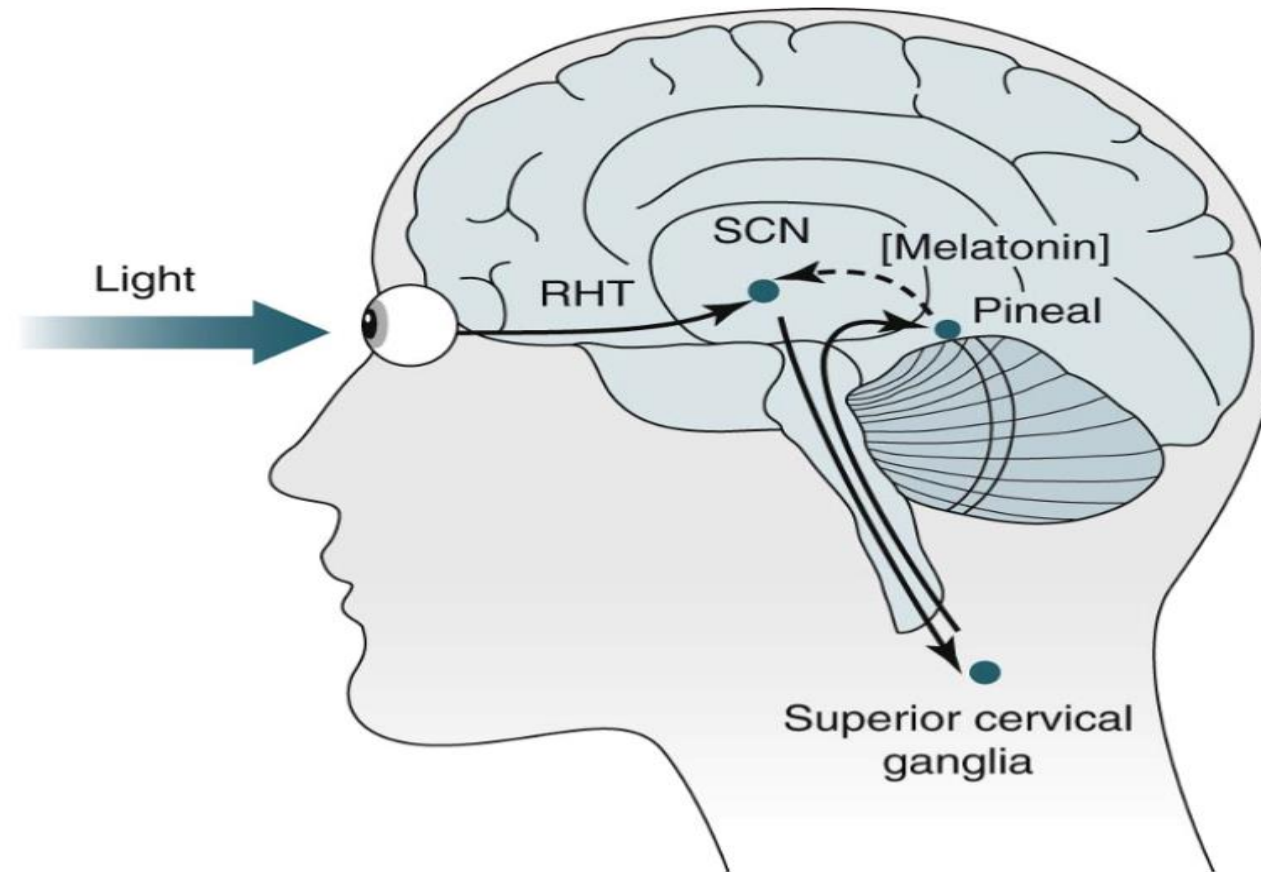


ICSD-3 and Scoring Manual

Sleep Disorders ICSD-3 Classification



Circadian Disorders



Circadian Disorders

- Adolescents (8%)
- Most common: delayed sleep phase
- History, sleep diaries and actigraphy are useful

- Also common in blind children, children with autism spectrum, and after hospitalizations.
- Melatonin, bright light and sleep hygiene
- Refer if other disorders suspected to contribute

Parasomnia



NREM

Common in children (50%)
Sleepwalking, sleeptalking, night terrors and confusional arousals
Can be induced or precipitated by fever, sleep deprivation, and certain medications
Safety measures and reassurance

REM

Nightmares (common in 3-6 years old)
REM behavior disorder (RBD) extremely rare in children
RBD = Dream enactment (running when chased, hiding, biting) and remembers dream when awoken
Refer if suspected RBD

When to refer

- Secondary enuresis and suspected OSA
- Injurious parasomnia
- Suspected REM behavior disorder
- Suspected nocturnal seizures



When to suspect nocturnal seizures?

Repetitive events through the night

Stereotypic

Abnormal postures (dystonia)

Timing (parasomnia occurs within 2 hours of falling asleep)

Duration s- eizures are usually brief (<2 minutes)

Obstructive sleep apnea



Figure from: Alkhalil Et AL. Molecular diagnosis in Iranian patients with spinal muscular Atrophy. *Arch Iranian Med.* **7(1):** 47 – 52; 2004

Table 2
Clinical measures in detecting pediatric OSA.

	OSA (N = 116)	Non-OSA (N = 106)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	<i>p</i>	OR (95% CI)
Anatomical measure								
Male gender	63.8%	70.8%	70.8	36.2	50.3	57.5	0.271	0.7 (0.4–1.3)
Age < 6 years	44.0%	39.6%	39.6	56.0	45.2	50.4	0.513	1.2 (0.7–2.0)
Tonsil hypertrophy	76.7%	34.9%	76.7	65.1	70.6	71.9	<0.001*	6.1 (3.4–11.1)
Adenoid hypertrophy	75.0%	44.3%	75.0	55.7	64.9	67.0	<0.001*	3.8 (2.1–6.7)
Obesity	28.4%	14.2%	28.4	85.8	68.8	52.3	0.01*	2.4 (1.2–4.8)
Historical measure								
Snoring > 5 nights/week	76.7%	51.9%	76.7	48.1	61.8	65.4	<0.001*	3.1 (1.7–5.4)
Snoring > 3 months	83.6%	65.1%	83.6	34.9	58.4	66.1	0.002*	2.7 (1.5–5.2)
Diaphoresis	24.1%	23.6%	24.1	76.4	52.8	47.9	0.92	1.0 (0.6–1.9)
Bedwetting	14.7%	9.4%	14.7	90.6	63.0	49.2	0.24	1.6 (0.7–3.8)
Awaken	35.7%	25.0%	35.7	75.0	63.5	48.8	0.04*	1.7 (1.0–2.7)
Nightmare	26.7%	27.4%	26.7	72.6	51.7	47.5	0.92	1.0 (0.5–1.8)
Breathing pause	42.2%	12.3%	42.2	87.7	79.0	58.1	<0.001*	5.2 (2.6–10.4)
Mouth breathing	83.6%	77.4%	83.6	22.6	54.2	55.8	0.24	1.5 (0.8–2.9)
Sleepiness	19.0%	12.3%	19.0	87.7	62.9	49.7	0.17	1.7 (0.8–3.5)
Attention	41.4%	42.5%	41.4	57.5	51.6	47.3	0.87	1.0 (0.6–1.6)
Depression	0.9%	1.9%	0.9	98.1	33.3	47.5	0.52	0.5 (0.0–5.1)
Low self-esteem	6.9%	9.4%	6.9	90.6	44.4	47.1	0.49	0.7 (0.3–1.9)
Shy	14.7%	13.2%	14.7	86.8	54.8	48.2	0.76	1.1 (0.5–2.4)
Hyperactive	20.7%	24.5%	20.7	75.5	48.0	46.5	0.50	0.8 (0.4–1.5)
Low academic performance	19.0%	16.0%	19.0	84.0	56.4	48.6	0.57	1.2 (0.6–2.5)

CI, confidence interval; NPV, negative predictive value; OR, odds ratio; OSA, obstructive sleep apnea; PPV, positive predictive value.

Data were analyzed using Chi-square test.

* Significant level was below 0.05.

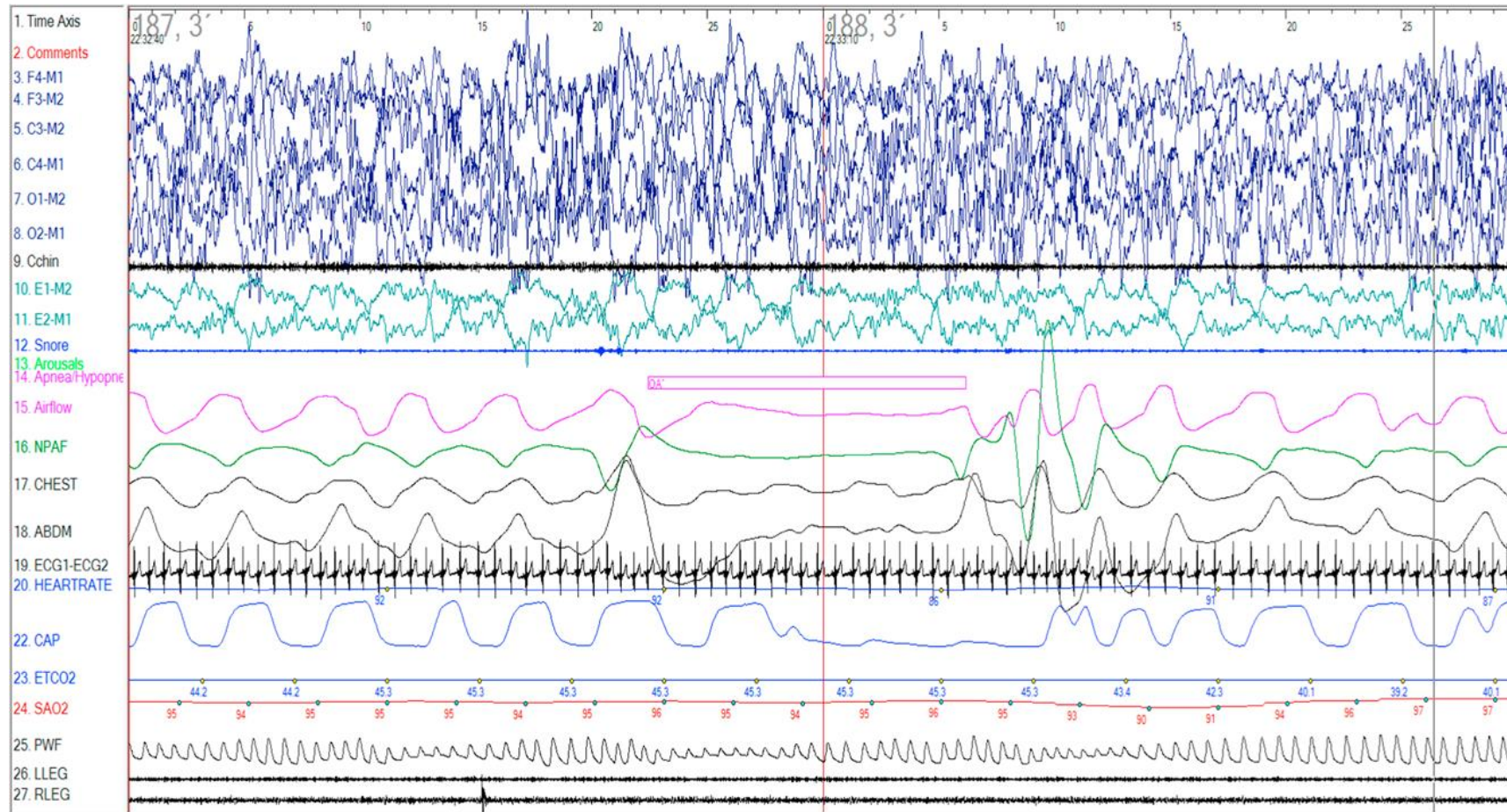
Detection of pediatric obstructive sleep apnea syndrome: history y or anatomical findings

Kun-Tai Kang et. al Sleep Medicine

1 of the following	And	1 of the following
1. Snoring		Polysomnography AHI > 1
2. Paradoxical chest/abdomen		
3. Daytime symptoms <ul style="list-style-type: none">• Excessive sleepiness• Behavioral problems• Academic problems		Obstructive hypoventilation (ETCO ₂ > 50 Torr por 25% de TST) with: snoring, nasal signal flattening or chest abdomen paradoxing.

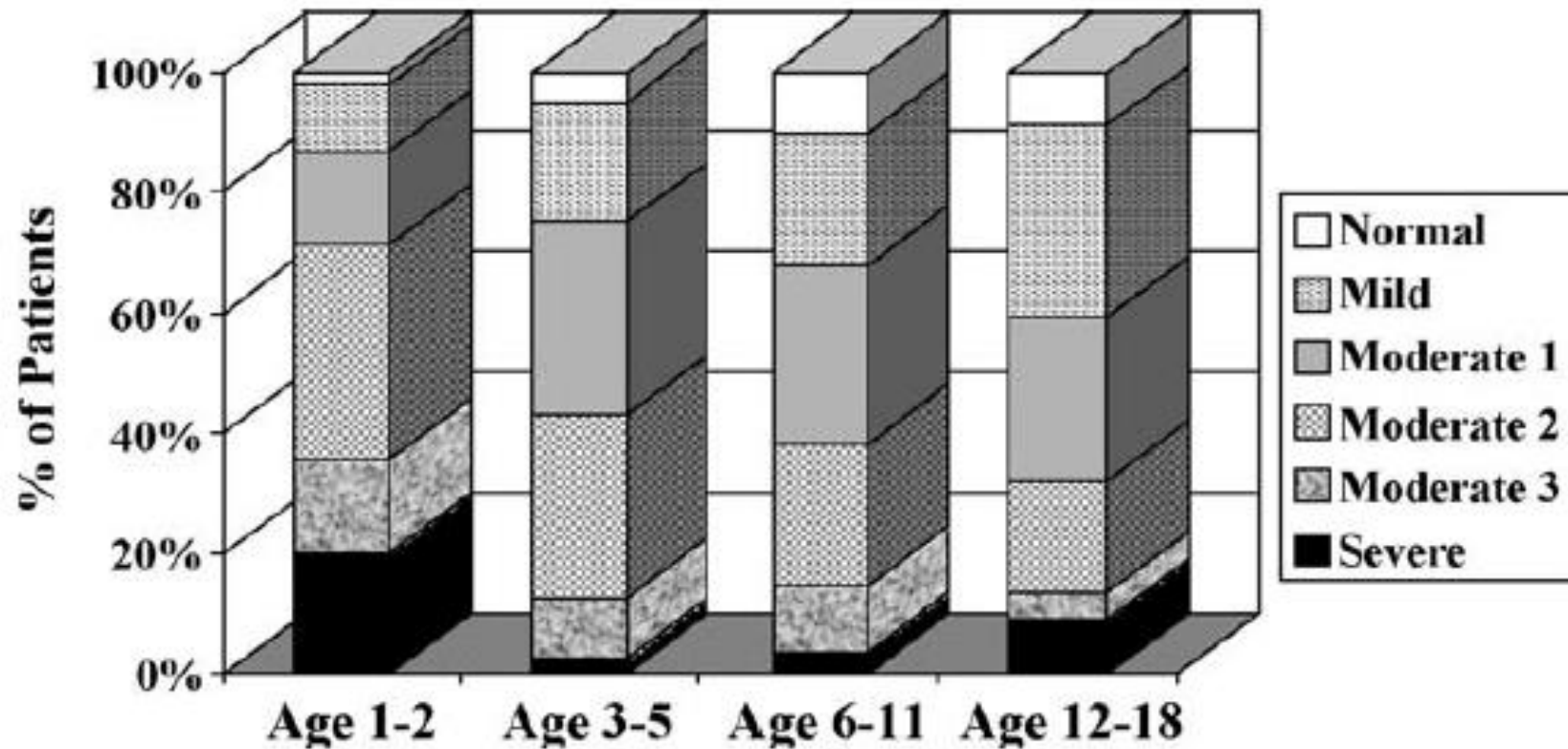
ICSD-3 AASM
Diagnostic Criteria

Scoring Rules Pediatric



OSA Severity (obstructive AHI)





Age specific differences in pediatric obstructive sleep apnea§

Debra M. Don *, Kenneth A. Geller, Jeffrey A. Koempel, Sally Davidson Ward

International Journal of Pediatric Otorhinolaryngology 73 (2009) 1025–1028

The very first paper

REPRINT

Vol. CXVIII.

Fasc. I—III (1944).

ACTA MEDICA SCANDINAVICA



ASTHENIA CRURUM PARAESTHETICA («IRRITABLE LEGS»)

A NEW SYNDROME CONSISTING OF WEAKNESS, SENSATION OF COLD AND NOCTURNAL PARESTHESIA IN THE LEGS, RESPONDING TO A CERTAIN EXTENT TO TREATMENT WITH PRISCOL AND DORYL. — A NOTE ON PARESTHESIA IN GENERAL

By

K. A. *EKBOM*

(Stockholm)

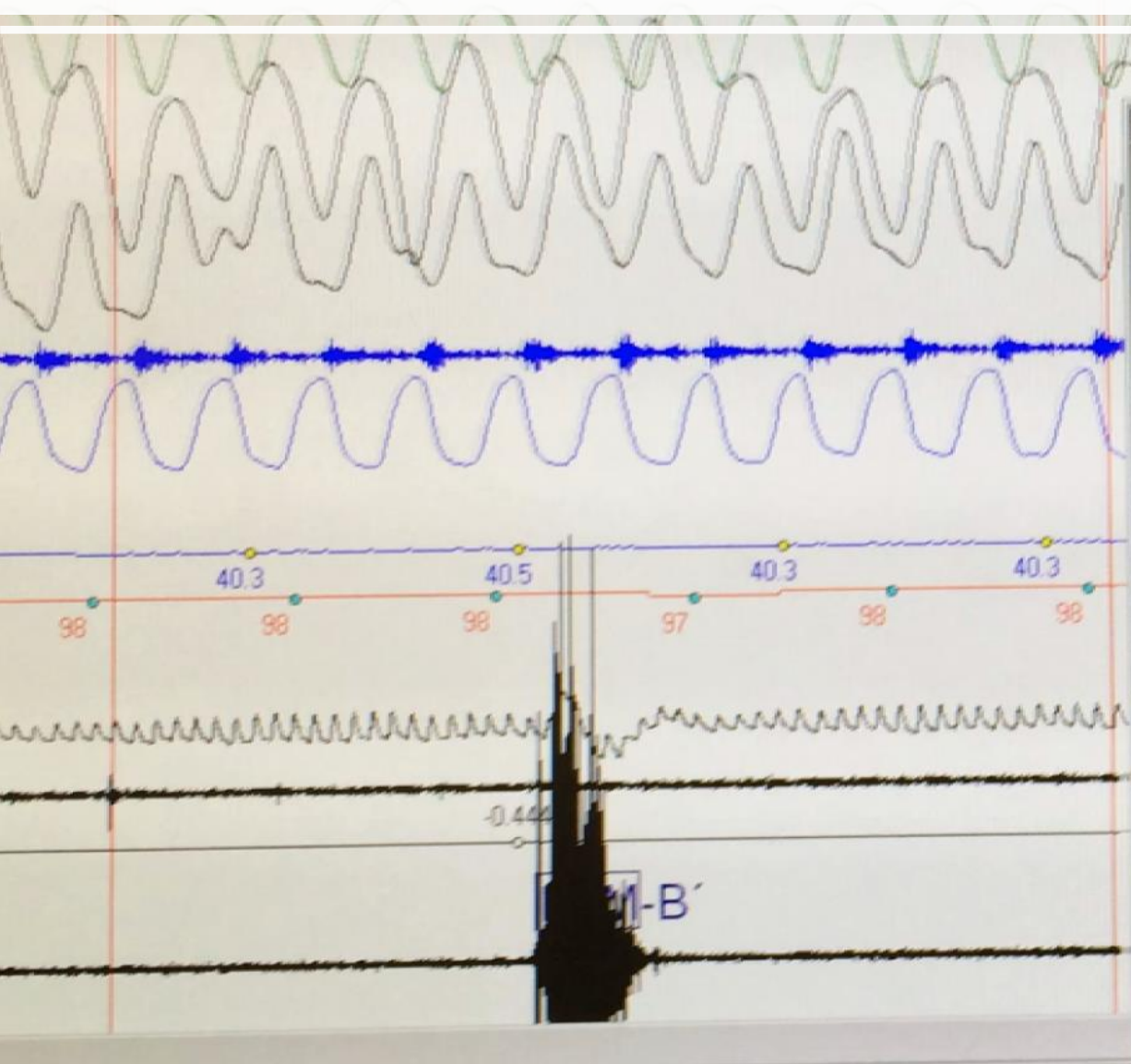


RLS vs. PLMS

- Restless Leg Syndrome (RLS): urge to move the legs during wakefulness
- Periodic leg movements of sleep (PLMS): leg kicks during sleep
- Both link to iron deficiency
- IF suspected but not clear by history or does not know if disrupts sleep ---- PSG

Higher prevalence in patients with ADHD

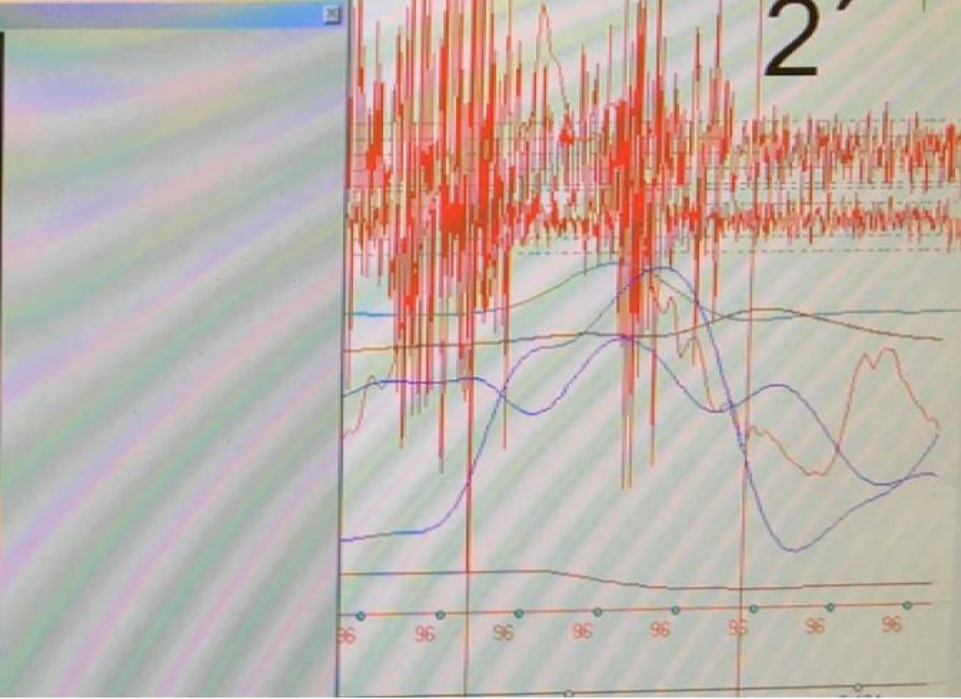
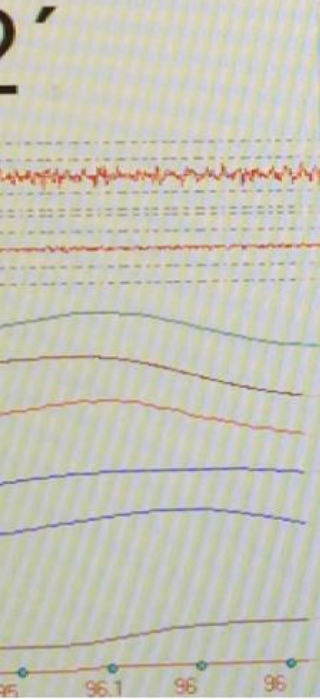
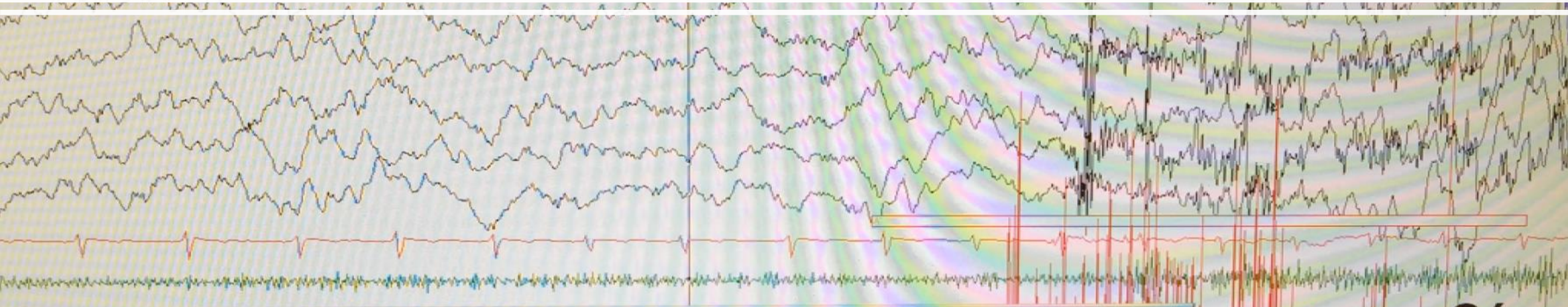
Periodic leg movements



Sleep Related Rhythmic Movement Disorder

- Typically in infants and young children
- Body rocking, Head rolling
- Prevalence: At nine months body rocking 43%; head banging 22%; head rolling 24%. At 18 months 33%. Five years 5%
- Familial
- Onset prior to one year of age.
- Reassurance and prevention of injuries

Body Rocking





Insomnia

- Inadequate sleep hygiene
 - Behavioral-
 - Limit setting
 - Sleep onset association disorder
 - Chronic Insomnia
 - Mood disorders/Depression/Anxiety
 - Medications
- *Higher prevalence in patients with Autism Spectrum Disorder*
- *Refer when behavioral interventions are not successful after 3 months*

Behavioral Insomnia of Childhood

- No gender prevalence
- 6 months of age is a reasonable age to consider
- Child often goes to bed and falls asleep quickly for others (babysitter, grandparent) or in other situations (allowed to watch TV and sleep on couch in living room)



Hypersomnia

- Most common cause: Insufficient sleep!
- Adequate sleep hygiene and total sleep for age should be recommended
- Other causes should be explored
- DO NOT MISS:
 - NARCOLEPSY
 - RECURRENT HYPERSOMNIA (Kleine Levin Syndrome)

Narcolepsy

- Excessive sleepiness present almost daily for at least three months
- Cataplexy
- MSLT, sleep latency <8 min, < 2 SOREMP
- The hypersomnia is not better explained by another sleep disorder, mental disorder, medication use or substance use disorder

Interventions

What has the parent done in the past?

How long has it been tried?

Did it work?

What factors contributed to failure?

Medications?

Weight?

Smoking?

What is the goal for the visit in the parents mind?

Conclusions



Sleep disorders are common in children and vary from insomnia, parasomnia, sleep disordered breathing, movement disorders and circadian disorders.



Parental concerns vary from normal to various sleep, medical, psychiatric, disorders



There are populations at higher risks of sleep disorders



Personalized history and physical



Appropriate diagnostic test



Questions?