

Table 1. Features of adult and childhood obstructive sleep apnea syndrome

	Adult	Child
Snoring	Alternating, with pauses	Continuous
Excessive day time sleepiness	Main symptom	Infrequent
Obesity	Very common	Infrequent
Failure to thrive/underweight	Not reported	Fairly Common
Mouth breathing	Usually not	Common
Male preponderance	Yes(8 - 10 : 1)	No(1 : 1 prepubertal)
Enlarged tonsils and adenoids	Uncommon	Most common
Enlarged tonsils and adenoids	Apnea	Hypopnea
Most common obstructive pattern	Very common	Uncommon
Arousal on apnea termination	Very common	Uncommon
Sleep pattern disruption	Cardiopulmonary, EDS	Cardiopulmonary, FTT
Complications		behavior, perioperative
Surgery as treatment	Selective cases, minority UP3	Most cases, T & A, UP3
CPAP as treatment	Most common treatment	Selected cases, minority
Mortality	Death during sleep, CVS	Usually perioperative

CVS : cardiovascular, EDS : excessive day time sleepiness, FTT : failure to thrive (adopted from Bower CM et al, 2000)

Table 2. Features of OASA as compared with UARS

	OSAS	UARS	
Large negative Pes during sleep (> 10 cm H ₂ O)	+	+	가 . adenoid
Sleep interruption	+	+	facies
Snoring	+	+	10-12)
Nighttime disturbances	+	+	15% adenoid facies 가 . ¹³⁾
Daytime symptoms	+/-	+/-	
Sweating	+/-	+/-	
Poor school performance	+	+	Excessive daytime sleepiness
Behavioral problems	+	+	
Abnormalities by standard PSG criteria	+	-	가 . ³⁾¹⁴⁾
Oxygen desaturation	+	+/-	
Correctable with airway surgery or CPAP	+	+	Obesity 가
Pes=esophageal pressure. + : always, +/- : usually but may be absent, - : not present (adopted from Bower CM et al, 2000)			
Mouth breathing, adenoid facies, and adenotonsillar hypertrophy	12 가		가 . 5~ 가
	가 . ⁵⁾¹⁵⁾		

Increased respiratory effort

23)24)

Hypertension and other cardiovascular consequence

Enuresis

trusor muscle)

가

(de-

5

1/3

16)

Sleep patterns

25)

(micro - arousal)

Gastroesophageal reflux/aspiration

(knee - chest position, neck extension etc.)

GERD

5)

GERD

Behavioral changes/bedtime behavior

진 단

History

가 (Table 3).

primary snoring OSAS

26)

Cognitive function

21) O Brien

Physical examination

가

가

(phonological processing)

22)

Growth impairment

가

Table 3. Symptoms of sleep disordered breathing in children

1. Loud snoring
2. Noisy breathing during sleep
3. Daytime mouth breathing
4. Growth retardation
5. Repetitive upper airway infections
6. Rebellious and aggressive behavior
7. Attention deficit disorder

Adopted from Troell RJ et al. 2005

가

Guilleminault scoring system (orocraniofacial scale score) (Fig. 1),⁵⁾²⁶⁾²⁷⁾ orocraniofacial scale score가 19 point scale 13.8 (high orocraniofacial scale score) 96% Sleep disordered breathing 0~4 grade grade 가 1 가 25% , grade 2.7 Sleep disordered breathing 92% 가 grade 3~4 high orocraniofacial scale score 100% Sleep disordered breathing²⁶⁾

PSG 31~55% PSG 가 PSG 28-32) 1) 2) CNS disease가 3) 2 4) 가 5) 가 6) Boderline case

소아수면무호흡증을 진단하는 보조적인 방법 PSG

PSG 1975 Guilleminault²⁷⁾가 noc-turnal polysomnography PSG gold standard criteria apnea index가 1 apnea/hypopnea index(AHI)가 5 (Table 4).⁵⁾²⁶⁾

Table 4. Abnormal values on pediatric polysomnography

AI >1
AHI >5
CO ₂ 50 mmHg > 10% sleep time
CO ₂ 45 mmHg > 60% sleep time
Minimum O ₂ saturation < 92% (95%)

Adopted from Bower CM et al, 2000

OROCRANIOFACIAL FEATURES CLINICAL SCALE :		
Feature	Scale	Score
Chin size	0=Wide, 3=Small and triangular	_____
Steepness of mandibular plane	0=Horizontal, 3=Steep	_____
Maxilla vs mandible position	0=Prognathic, 4=Retrognathic	_____
Hard palatal height	0=Low-placed, 2=High-placed	_____
Shape of face	0=Square, 2=Long face	_____
Soft palatal length	0=Short, 2=Long	_____
Intermolar width	0=Wide, 2=Narrow	_____
		Total : _____

Scores
top third : >13.8
Middle third : 6.5 - 13.8
Lower third : < 6.5

Fig. 1. Orocraniofacial features clinical scale (adopted from Troell RJ et al 2005).

Goldstein, video, audio, X ray, 48%
 recording, sleep audiotape
 X ray
 MRI, Cephalometry
 Simple overnight oxymetry
 Brouillette
 overnight pulse oximetry 97%
 positive predictive value
 Over-night four channel sleep study heart rate, respiratory effort, air flow, oxyhemoglobin concentration

EEG sleep stage
 (38)(39)

소아 수면 무호흡증의 합병증

(Table 5).⁵⁾

치료 및 예후

가 first line
 75%
 85%
 (26)

Medical treatment

Table 5. Complication of childhood OSAS

Developmental/behavioral	Failure to thrive Short status Impaired growth hormone release Shyness/Social withdrawal Developmental delay School/Learning problems Attention deficit disorder Personality changes Restlessness
Cardiovascular	Cor pulmonale/Pulmonary hypertension Polycythemia Hypertension Arrhythmia
Gastrointestinal	GERD Feeding problem
Pulmonary	Chronic aspiration Repetitive airway infections
Neurologic	Enuresis Dull affect/lethargy
Surgical	Respiratory complication Cardiovascular complication Perioperative death Bruxism/orthodontic problem
Dental	Daytime fatigue
Other	Nocturnal sweating Sleepwalking Death (?incidence)

adopted from Bower CM et al, 2000

corticosteroid

(40)

Mechanical treatment

가 CPAP 가 가

(5)

Table 6. Outcome of tonsillectomy and adenoidectomy

Author	Procedure	N	Patients	%Cure
Nishimura	T & A	55	Child	94
Kudoh	T & A	31	Obese	All
Suen	T & A	26	Child	84
Frank	T & A	32	Child	Most

adopted from Charles M et al, 2000

Surgical management

가
가
Strauss
, 3
가 . 41)

T & A

90% (Table 6).⁵⁾ 80~
3
AHI가 10 20

UPPP

Muller manuver UPPP
가
AHI가 20
5)

Maxillofacial framework surgery

CPAP
중심 단어 :

sleep disturbance and sleep related breathing disorders and their relation to daytime sleepiness in 4-5 year old children. *Am Rev Respir Dis* 1991;143:A381.

- 3) Leach J, Olson J, Hermann J, Manning S. Polysomnographic and clinical findings in children with obstructive sleep apnea. *Arch Otolaryngol Head Neck Surg* 1992; 118(7):741-4.
- 4) Guillemainault C, Eldridge FL, Simmons FB, Dement WC. Sleep apnea in eight children. *Pediatrics* 1976;58(1):23-30.
- 5) Bower CM, Gungor A. Pediatric obstructive sleep apnea syndrome. *Otolaryngol Clin North Am* 2000;33(1):49-75.
- 6) Loughlin GM. Obstructive sleep apnea in children. *Adv Pediatr* 1992;39:307-36.
- 7) Mills PJ, Dimsdale JE. Sleep apnea: a model for studying cytokines, sleep, and sleep disruption. *Brain Behav Immun* 2004;18(4):298-303.
- 8) Ali NJ, Pitson D, Stradling JR. Natural history of snoring and related behaviour problems between the ages of 4 and 7 years. *Arch Dis Child* 1994;71(1):74-6.
- 9) Gislason T, Benediktsdottir B. Snoring, apneic episodes, and nocturnal hypoxemia among children 6 months to 6 years old. An epidemiologic study of lower limit of prevalence. *Chest* 1995;107(4):963-6.
- 10) Hecht JT, Thompson NM, Weir T, Patchell L, Horton WA. Cognitive and motor skills in achondroplastic infants: neurologic and respiratory correlates. *Am J Med Genet* 1991;41(2):208-11.
- 11) Klein JC. Nasal respiratory function and craniofacial growth. *Arch Otolaryngol Head Neck Surg* 1986;112(8): 843-9.
- 12) Leighton Bc. Aetiology of the malocclusion of the teeth. *Arch Dis Child* 1991;66(9):1011-2.
- 13) Butt W, Robertson C, Phelan P. Snoring in children: is it pathological? *Med J Aust* 1985;143(8):335-6.
- 14) Carroll JL, McColley SA, Marcus CL. Reported symptoms of childhood obstructive sleep apnea syndrome (OSA) vs. primary snoring. *Am Rev Respir Dis* 1992;145:177.
- 15) Silvestri JM, Weese-Mayer DE, Bass MT, Kenny AS, Hauptman SA, Pearsall SM. Polysomnography in obese children with a history of sleep-associated breathing disorders. *Pediatr Pulmonol* 1993;16(2):124-9.
- 16) Ng DK, Chan CH, Kwok KL, Leung LC, Chow PY. Childhood obstructive sleep apnoea: hypertension was not mentioned. *BMJ* 2005;331(7513):405; author reply 406.
- 17) Ali NJ, Pitson DJ, Stradling JR. Snoring, sleep disturbance and behaviour in 4-5 years old. *Arch Dis Child* 1993;68(3):360-6.

REFERENCES

- 1) Mandel EM, Reynolds CF 3rd. Sleep disorders associated with upper airway obstruction in children. *Pediatr Clin North Am* 1981;28(4):897-903.
- 2) Ali NJ, Pitson DJ, Stradling JR. The prevalence of snoring,

- 18) Ali NJ, Piston D, Stradling JR. *Sleep disordered breathing: Effects of adenotonsillectomy on behaviour and psychological functioning.* *Eur J Pediatr* 1996;155(1):56-62.
- 19) Goldstein NA, Post JC, Rosenfeld RM, Campbell TF. *Impact of tonsillectomy and adenoidectomy on child behavior.* *Arch Otolaryngol Head Neck Surg* 2000;126(4):494-8.
- 20) Koo SK, Goh EK, Choi CH, Song CY, Kim HK, Lee CH, et al. *Impact of adenotonsillar hypertrophy on child personality and behavior.* *Korean J Otolaryngol* 2003;46:953-64.
- 21) Gozal D. *Sleep-disordered breathing and school performance in children.* *Pediatrics* 1998;102(3 Pt 1):616-20.
- 22) O'Brien LM, Mervis CB, Holbrook CR, Bruner JL, Klaus CJ, Rutherford J, et al. *Neurobehavioral implications of habitual snoring in children.* *Pediatrics* 2004;114(1):44-9.
- 23) Marcus CL, Carrol JL, Koerner CB, Hamer A, Lutz J, Loughlin GM. *Determinant of growth in children with the obstructive sleep apnea syndrome.* *J pediatr* 1994;125(1):556-62.
- 24) Koo HE, Koo GJ, Jung HS, Nam SI, Kim YC, Koo SK, et al. *The effect of adenotonsillectomy on weight change in young children.* *Korean J Otolaryngol* 1998;41(12):1594-7.
- 25) Brouillette RT, Fernbach SK, Hunt CE. *Obstructive sleep apnea in infants and children.* *J Pediatr* 1982;100(1):31-40.
- 26) Troell RJ, Terris DJ. *Sleep apnea and sleep disordered breathing.* In: *Cummings CW, Flint PW, Harker LA, Haughey BH, Richardson MA, Robbins KT et al, editors. Otolaryngology Head & Neck Surgery. 4th ed. Philadelphia: Mosby;2005. p.1701-16.*
- 27) Guilleminault C, Peraita R, Souquet M, Dement WC. *Apneas during sleep in infants: possible relationship with sudden infant death syndrome.* *Science* 1975;190(4215):677-9.
- 28) Guilleminault C, Pelayo R, Leger D, Clerk A, Bocian RC. *Recognition of sleep-disordered breathing in children.* *Pediatrics* 1996;98(5):871-82.
- 29) Aljadeff G, Gozal D, Bailey-Wahl SL, Burrell B, Keens TG, Ward SL. *Effects of overnight supplemental oxygen in obstructive sleep apnea in children.* *Am J Respir Crit Care Med* 1996;153(1):51-5.
- 30) Goldstein NA, Sculerati N, Walsleben JA, Bhatia N, Friedman DM, Rapoport DM. *Clinical diagnosis of pediatric obstructive sleep apnea validated by polysomnography.* *Otolaryngol Head Neck Surg* 1994;111(5):611-7.
- 31) Marcus CL, Omlin KJ, Basinki DJ, Bailey SL, Rachal AB, Von Pechmann WS, et al. *Normal polysomnographic values for children and adolescents.* *Am Rev Respir Dis* 1992;146(5 Pt 1):1235-9.
- 32) Messner A. *Evaluation of obstructive sleep apnea by polysomnography prior to pediatric adenotonsillectomy.* *Arch Otolaryngol Head Neck Surg* 1999;125(3):353-6.
- 33) Goldstein NA, Pugazhendhi V, Rao SM, Weedon J, Campbell TF, Goldman AC, et al. *Clinical assessment of pediatric obstructive sleep apnea.* *Pediatrics* 2004;114(1):33-43.
- 34) Potsic WP. *Comparison of polysomnography and sonography for assessing regularity of respiration during sleep in adenotonsillar hypertrophy.* *Laryngoscope* 1987;97(12):1430-7.
- 35) Mahboubi S, Marsh RR, Potsic WP, Pasquariello PS. *The lateral neck radiograph in adenotonsillar hyperplasia.* *Int J Pediatr Otorhinolaryngol* 1985;10(1):67-73.
- 36) Koo GJ, Nam SI, Lee JH, Ko YH, Kim DK, Koo SK, et al. *Roentgenographic study of upper airway in patients with obstructive sleep apnea syndrome.* *Korean J Otolaryngol* 1998;41(3):328-32.
- 37) Brouillette RT, Morielli A, Leimanis A, Waters KA, Luciano R, Ducharme FM. *Nocturnal pulse oximetry as an abbreviated testing modality for pediatric obstructive sleep apnea.* *Pediatrics* 2000;105(2):405-12.
- 38) Ferber R, Millman R, Coppola M, Fleetham J, Murray CF, Iber C, et al. *Portable recording in the assessment of obstructive sleep apnea. ASDA standards of practice.* *Sleep* 1994;17(4):378-92.
- 39) Jacob SV, Morielli A, Mograss MA, Ducharme F, Schloss MD, Brouillette RT. *Home testing for pediatric obstructive sleep apnea syndrome secondary to adenotonsillar hypertrophy.* *Pediatr Pulmonol* 1995;20(4):241-52.
- 40) Brouillette RT, Manoukian JJ, Ducharme FM, Oudjhane K, Earle LG, Ladan S, et al. *Efficacy of fluticasone nasal spray for pediatric obstructive sleep apnea.* *J Pediatr* 2001;138(6):838-44.
- 41) Rosen CL, Larkin EK, Kirchner HL, Emancipator JL, Bivins SF, Surovec SA, et al. *Prevalence and risk factors for sleep-disordered breathing in 8- to 11-year-old children: association with race and prematurity.* *J Pediatr* 2003;142(4):383-9.