Parasomnias

- NREM-Related Parasomnias
  - Disorders of Arousal (From NREM Sleep)
  - Confusional Arousals
  - Sleepwalking
  - Sleep Terrors
  - Sleep Related Eating Disorder
- REM-Related Parasomnias
  - REM Sleep Behavior Disorder
  - Recurrent Isolated Sleep Paralysis
  - Nightmare Disorder
- Other Parasomnias
  - Exploding Head Syndrome
  - Sleep Related Hallucinations
  - Sleep Enuresis
  - Parasomnia Due to a Medical Disorder
  - Parasomnia Due to a Medication or Substance
  - Parasomnia, Unspecified
  - Isolated Symptoms and Normal Variants
  - Sleep Talking

American Academy of Sleep Medicine, International Classification of Sleep Disorders, 3rd ed., 2014

Disorders of Arousal (From NREM Sleep)

Criteria A-E must be met
A. Recurrent episodes of incomplete awakening from sleep.
B. Inappropriate or absent responsiveness to efforts of others to intervene or redirect the person during the episode.
C. Limited (e.g., a single visual scene) or no associated cognition or dream imagery.
D. Partial or complete amnesia for the episode.
E. The disturbance is not better explained by another sleep disorder, mental disorder, medical condition, medication, or substance use.

Notes
1. The events usually occur during the first third of the major sleep episode.
2. The individual may continue to appear confused and disoriented for several minutes or longer following the episode.

American Academy of Sleep Medicine, International Classification of Sleep Disorders, 3rd ed., 2014
Confusional Arousals

Alternate Names
Elpenor syndrome.

Diagnostic Criteria
Criteria A-C must be met
A. The disorder meets general criteria for NREM disorders of arousal.
B. The episodes are characterized by mental confusion or confused behavior that occurs while the patient is in bed.
C. There is an absence of terror or ambulation outside of the bed.

Notes
1. There is typically a lack of autonomic arousal such as mydriasis, tachycardia, tachypnea, and diaphoresis during an episode.

Sleepwalking

Alternate Names
Somnambulism.

Diagnostic Criteria
Criteria A and B must be met
A. The disorder meets general criteria for NREM disorders of arousal.
B. The arousals are associated with ambulation and other complex behaviors out of bed.

Trigger factors for NR parasomnias

- Sleep deprivation (Mayer G, 1998; Joncas, 2002)
- UARS, OSA (Lupi, 2002)
- Substance induced: Alcohol, Thoridazine, Lithium (Espa, 2002; Zolpidem, version, 1994; Gammahydroxybutyrate (Mayer G, 2000)
- Fever
- Psychogenic stress situations (Kra in Fieber, 1995)
Sleep Terrors

Alternate Names
Night terrors, pavor nocturnus.

Diagnostic Criteria
Criteria A-C must be met
A. The disorder meets general criteria for NREM disorders of arousal.
B. The arousals are characterized by episodes of abrupt terror, typically beginning with an alarming vocalization such as a frightening scream.
C. There is intense fear and signs of autonomic arousal, including mydriasis, tachycardia, tachypnea, and diaphoresis during an episode.

American Academy of Sleep Medicine, International Classification of Sleep Disorders, 3rd ed., 2014

Sleep Related Eating Disorder

Alternate Names
Sleep eating

Diagnostic Criteria
Criteria A-D must be met
A. Recurrent episodes of dysfunctional eating that occur after an arousal during the main sleep period.
B. The presence of at least one of the following in association with the recurrent episode of involuntary eating:
1. Consumption of peculiar forms or combinations of food or inedible or toxic substances.
2. Sleep-related injurious or potentially injurious behaviors performed while in pursuit of food or while cooking food.
3. Adverse health consequences from recurrent nocturnal eating.
C. There is partial or complete loss of consciousness during the eating episode, with subsequent impaired recall.
D. The disturbance is not better explained by another sleep disorder, mental disorder, medical disorder, medication, or substance use.

American Academy of Sleep Medicine, International Classification of Sleep Disorders, 3rd ed., 2014

Sleep Related Eating Disorder

Differential Diagnosis
SRED must be distinguished primarily from night eating syndrome (NES), which is characterized by excessive eating between dinner and bedtime and during full awakenings during the sleep period.

In contrast to daytime eating disorders (bulimia nervosa, anorexia nervosa), inappropriate compensatory behavior, such as self-induced vomiting, enemas, misuse of laxatives, diuretics, or other medications, or other purging activity, are not present in SRED, although the two conditions may be comorbid.

A person with a daytime eating disorder may also have a coexisting SRED that is associated with confusional arousals but not associated with purging behaviors during the night or upon arising in the morning.

Patients with longstanding SRED and excessive weight gain may eventually fast during the daytime and/or engage in excessive exercise to prevent obesity from the SRED.

American Academy of Sleep Medicine, International Classification of Sleep Disorders, 3rd ed., 2014
Sleep related Movement Disorders
ICSD 2

- Restless Legs Syndrome
- Periodic limb movement disorder
- Sleep related leg cramps
- Sleep related bruxism
- Sleep related rhythmic movement disorder
- SRMD, other

Isolated Symptoms, apparently normal variants and unresolved issues
ICSD 2

- Long sleeper, short sleeper
- Snoring
- Sleep talking
- Sleep starts (hypnic jerks)
- Benign sleep myoclonus of infancy
- Hypnagogic foot tremor and alternating leg muscle activation during sleep
- Propriospinal myoclonus at sleep onset
- Excessive fragmentary myoclonus

International Classification of Sleep Disorders
3rd Edition

Sleep related movement disorders:
- Restless Legs Syndrome
- Periodic Limb Movement Disorder
- Sleep Related Leg cramps
- Sleep Related Bruxism
- Sleep related Rhythmic Movement Disorder
- Benign Sleep Myoclonus of Infancy
- Propriospinal Myoclonus at Sleep Onset
- Sleep Related Movement Disorder due to a Medical Disorder, due to a Medication or Substance or unspecified

Isolated Symptoms and Normal Variants:
- Excessive Fragmentary Myoclonus
- Hypnagogic Foot Tremor and Alternating Leg Muscle Activation
- Sleep Starts (Hypnic Jerks)
Bruxism

ICSD - 2 criteria

• The patient reports or is aware of tooth-grinding sounds or tooth clenching during sleep
• One or more of the following is present:
  - Abnormal wear of teeth
  - Jaw muscle discomfort, fatigue or pain and jaw lock upon awakening
  - Masseter muscle hypertrophy upon voluntary forceful clenching
• The jaw muscle activity is not better explained by another current sleep disorder, medical or neurological disorder, medication use or substance use disorder.

Wording changes in ICSD-3

- Increased masseter and temporalis muscle activity during sleep, along with grinding sounds
- REMA episodes can occur during all sleep stages, but are most common in N1 and N2 (> 20%). < 10% of REMA episodes occur during REM sleep. However, in some individuals, sleep-related bruxism occurs predominantly in REM sleep
- Temporally associated with sleep arousal
- Precipitated by signs of autonomic/cardiac activation

Three subtypes of EEG pattern
- Sustained tonic activity lasting longer than 2 seconds
- Mixed pattern
- An episode begins after at least a three-second interval with no muscle activity
Bruxism

• Prevalence: Clinically relevant in around 5%, usually recognized by bed partner or dentist
• Predisposing factors: malocclusion, psychogenic, basal ganglia disease
• Complications: temporomandibular joint disorders, dental attrition, periodontic damage, headache, bed-partner disturbance
• PSG: EMG of masseter or temporalis muscles recommended
• Close temporal association between sleep apnea-hypopnea and bruxism events (Saito 2013), dependent on arousal duration (Kato 2013)
• Association of bruxism with rise in arterial blood pressure (Nashed 2012)
• RMMA as marker of bruxism and oromandibular myoclonus more frequent in RBD than controls (Abe 2013)

Drug- or Chemical-Related Bruxism

• Alcohol (Hartman, 1994)
• Cocaine (Cardoso, 1993), amphetamines (Ashcroft, 1965, See 2003), fenfluramine (Lewis, 1971)
• Dopaminergic: levodopa treated PD (Mager 1970), MSA (Wally 2004)
• "Antidopaminergic": haloperidol (Micheli, 1993; Amir, 1997), flunarizine (Micheli, 1993)

Differential Diagnosis and Treatment

Differential diagnosis
• Epilepsy (oral lesions, oral automatisms)
• Salivary gland swelling (Lavigne 2001)
• Orofacial dystonia
• Rhythmic masticatory muscle activity without grinding in normals (Lavigne 2001)

Treatment
• Splint (protective effect. Reduction of grinding questionable) (Lavigne 2001)
• Psychotherapy, biofeedback, relaxation techniques?
• Transcutaneous electric stimulation of lip (rev. in Ferber 1995, Alvarez-Arenal 2001)
• Bromocriptine not effective (Lavigne 2001)
• Propanolol? Diazepam (Lavigne 2001) (rev. in Ferber, 1995)
• Botulinum Toxin (Tan 2000)
• Restoration of worn dentition (e.g. Lobbezoo 2004)
• Botox? Reduces intensity rather than generation (Shim 2014)
• Gabapentin? (Muradov 2013)
Polysomnography in Bruxism

Sleep Related Rhythmic Movement Disorder
Sleep Related
Rhythmic Movement Disorder
ICSD – 2 criteria

- The patient exhibits repetitive, stereotyped, and rhythmic motor behaviors.
- The movements involve large muscle groups.
- The movements are predominantly sleep related, occurring near nap or bedtime, or when the individual appears drowsy or asleep.
- The behaviors result in a significant complaint as manifest by at least one of the following:
  - Interference with normal sleep
  - Significant impairment in daytime function
  - Self-inflicted bodily injury that requires medical treatment (or would result in injury if preventable measures were not used)
- The rhythmic movements are not better explained by another current sleep disorder, medical, neurological, or mental disorder, medication use, or substance use disorder.

Rhythmic Movements in Sleep / RMD

- Prevalence: 2/3 in < 9 months old, ½ in < 19 months old, 8% in 4 years old children (Dyken 2001)
- Male: female ratio 4:1
- Clusters: 0.5 – 2 Hz
- Duration of episodes: minutes or hours
- During drowsiness and sleep onset, NR, more rarely in REM, also in W (mostly in mentally retarded children)
- Complications: Carotid dissection, SDH (Aldrich 1999)
- Stimulation of vestibular system or relaxation induced by vestibular stimulation? (Aldrich 1999)

Wording changes in ICSD-3

Sleep related rhythmic movement disorder
- The patient exhibits >4 repetitive, stereotyped, and rhythmic motor behaviors (0.5-2 Hz)
- The movements involve large muscle groups
- The movements are predominantly sleep related, occurring near nap or bedtime, or when the individual appears drowsy or asleep
- The behavior results in a significant complaint
Polysomnography in RMD

Rhythmic Movement Disorder
Differential Diagnosis and Treatment

• Exclude differential diagnosis

• Atypical presentation possible
(Yeh & Schenck 2013)

• Behavioral therapy, controlled
sleep restriction

• Benzodiazepines, tricyclics

Propriospinal Myoclonus
Propriospinal Myoclonus at Sleep Onset
ICSD – 2 criteria

- The patient complains of sudden jerks, mainly of the abdomen, trunk, and neck
- The jerks arise upon relaxed wakefulness and drowsiness, and disappear upon mental activation and at sleep onset.
- The disorder is not better explained by another sleep disorder, medical or neurological disorder, mental disorder, medication use, or substance use disorder

Wording changes in ICSD-3

Propriospinal myoclonus at sleep onset
- Brief myoclonic EMG bursts recurring non-periodically with alpha activity present on the EEG and, in particular, when alpha activity spread from posterior to anterior regions. Jerks disappear either with EEG desynchronisation, due to mental activation, or with appearance of sleep spindles and K-complexes
- Jerks remain absent throughout sleep but may occasionally reappear upon awakening
- Polysomnography with extended EMG recording demonstrates that the jerks arise first in spinal intersegmental muscles and then propagate to more muscular and cranial structures according to a propriospinal pattern of propagation
- Detailed analysis of the jerks shows that the EMG activity originates in muscles innervated by thoracic or cervical spinal segments (dorsocostal, intercostals, paraspinals, rectus abdominis) and then spreads to more rostrally and caudally innervated muscles
- At a slow velocity (2 to 16 milliseconds; around 5 milliseconds on average)
- Back-averaging of the EEG does not show any jerk-locked cortical activity
- Epileptic EEG discharges are not observed in PSM

ICSD 3, AASM 2014

Propriospinal myoclonus at the sleep-wake transition: A new type of parasomnia

(Vetrugno et al, Sleep 2001)
Polysomnographic recordings in Case 1 illustrating the quasi-periodic recurrence of myoclonus during relaxed wakefulness, causing sudden arousal. Mylohyoid, mylohyoideus; Masset, masseter; SCM, sternocleidomastoideus; Pect, pectoralis; Interc, intercostalis; Bic Br, biceps brachi; Tric Br, triceps brachi; Rect abd, rectus abdominis; Parasp, thoraco-lumbar paraspinalis; Rect fem, rectus femoris. Vetrugno et al. 2001

Histograms illustrating the occurrence of myoclonic jerks (bottom) in relation to the sleep-wake cycle in Case 1. Peaks in the lower trace express the number of jerks per 1-minute intervals. Jerks are limited to the drowsiness period preceding sleep onset. EMG recording of a single myoclonic jerk in Case 1 showing a rostrocaudal propagation of muscular activity starting in the right sternocleidomastoideus. Mass, masseter; Mylo, mylohyoideus, SCM, sternocleidomastoideus; tl Parasp, thoraco-lumbar paraspinalis, Rectus Fem, rectus femoris. Vetrugno et al. 2001
Excessive Fragmentary Myoclonus

ICSD – 2 criteria

- The patient exhibits small movements of the fingers, toes, or corners of the mouth or small muscle twitches, resembling either physiologic hypnic myoclonus or fasciculations. The movements may be present during wakefulness or sleep.
  
  Note: In many cases, no visible movements are present. Gross or jerk-like movements across the joint space are not observed. Patients are typically unaware of the movements, and the phenomenon represents an incidental EMG finding on polysomnography. Daytime symptoms may be present, or patients may be totally asymptomatic.

- Polysomnographic monitoring demonstrates recurrent and persistent very brief (75- to 150-millisecond) EMG potentials in various muscles occurring asynchronously and asymmetrically in a sustained manner without clustering.

- More than five potentials per minute are sustained for at least 20 minutes of NREM stages 2, 3, or 4 sleep.

- The disorder is not better explained by another sleep disorder, medical or neurological disorder, mental disorder, medication use, or substance use disorder.

Fragmentary Myoclonus

- EMG potential below 150 ms duration

- Amplitude between 50 – 200 µV

- With or without visible movement (Broughton and Tolentino 1984)

- May be related to excessive daytime sleepiness (Broughton and Tolentino 1984; Broughton et al. 1985)

- Similar phenomenon: physiologic hypnic myoclonus (Montagna 1988)

- Cutoff values for normal and excessive not well defined
Objectives: To investigate the frequency of FM in a sleep disorders population, to analyze its distribution across sleep stages and to examine potential associations with clinical correlates, and night-to-night variability.

Design: Retrospective review of 102 PSG records (62 patients)

Measurements and Results:
- FM Index (FMI) in REM > FMI in S1 and S2 > FMI in S3/S4 (not significant)
- FMI positively correlated with age, and FMI in men higher than in women
- FMI positively correlated with sleep-related breathing disorders (rho=0.270, p=0.036); respiratory indices (AHI: rho=0.403, p=0.002; ODI: rho=0.378, p=0.004) and body mass index (rho=0.28, p=0.028)
- Linear regression model: age, male sex and oxygen desaturation were significant (p<0.05)
- FMI Night-to-Night variability was 1.6 (range 1-3.9)

Conclusion: Fragmentary myoclonus was present in every patient of this population
- Clinical significance is unknown, but association with ODI points to association with sleep related breathing disorders.
- Not primarily sleep-related phenomenon, FMI during wakefulness and light sleep similar.

Frauscher B., Kunz A., Brandbauer E., Umlar H., Poeser W. Högl B. Sleep Medicine 2011

Frauscher et al. 2011
Frauscher et al. 2011
Hypnagogic Foot Tremor
ALMA and HFT

Hypnagogic Foot Tremor
ICSD – 2 criteria

- The patient reports foot movements (directly experienced or observed by others) that occur at the transition between wake and sleep or during light sleep
- Polysomnographic or activity monitoring demonstrates:
  - Recurrent EMG potentials or foot movement typically at 1 to 2 Hz (range 0.5 to 3 Hz) in one or both feet
  - Burst potentials longer than the myoclonic range (greater than 250 milliseconds) and usually less than one second
  - Trains lasting 10 or more seconds
- The disorder is not better explained by another sleep disorder, medical or neurological disorder, mental disorder, medication use, or substance use disorder
Hypnagogic Foot Tremor


Hypnagogic Foot Tremor

Minor motor activity in sleep
RFM/HFT, ALMA and HFM

(Wichniak et al, 2001)

Total out of 375 consecutive patients (7.1%)

- Single short series: 10-15 sec, in several pts
- Frequent series > 30 sec

- Generally bilateral but asynchronous

- 0.3-3 Hz (mostly: 1-2 Hertz)

- 100-500 ms

- High N/N variability

- Highest frequency in presleep wakefulness, also S1 and 2 of NR and during arousals.

(Wichniak et al, 2001)

Alternating leg muscle activation during sleep and arousals:

ALMA

16 out of appr. 1500 patients (calculated frequency: appr. 1.1 %)

- 1.4-22 sec bilateral
- 0.5-3 Hz (usually between 1-2 Hz)

- 100-500 ms

- Arouse from all stage sleep and REM, in 12 pts, around arousals and in 4 unrelated to arousals

(Yang and Winkelman 2010)

- Unilateral
- Bilateral
- Alternating

- Usually unilateral

- 1.6 +/- 0.0 (range 0.4-3.7)

- 100-700 ms

- Associated with cardiac acceleration

- 2/3 out of W
- 1/3 out of sleep

- OSA 62%, PLMD 13.5% OSA and PLMS 18.9%

- OR of having RLS 3.52

(Yang and Winkelman 2010)

Clinical and Polysomnographic Characteristics of High Frequency Leg Movements

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Scientific Investigators

New Research

Journal of Clinical Sleep Medicine

Clinical and Polysomnographic Characteristics of High Frequency Leg Movements

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Abstract: The aim of this study was to describe the clinical and polysomnographic characteristics of patients with HFLM.

Method: Among 486 patients (232 females, 254 males) referred for overnight diagnostic PSG over a 5-month period, 37 patients demonstrated HFLM (16 males and 21 females). HFLM was defined as four distinct leg movements occurring at a frequency of 1.5-3 Hz between stage 3 or 4 NREM sleep and REM sleep.

Results: HFLM occurred during wake, 35% occurred during sleep. Of those HFLM episodes occurring during sleep, 44% occurred in stages 3 and 4, and 5% during REM. The movements usually stopped independently, but sometimes they showed a bilateral pattern. The mean frequency was 1.5-2.5 Hz (range 1.5-3.5). The mean number of occurrences of HFLM per subject per night was 3.6 (range 0.1-37.8). Of those patients with HFML compared to those without HFML, the parasomnias were significantly more common than the group without HFML (p < 0.05).

Conclusions: Further studies are needed to establish criteria for scoring HFLM. Examination of other patient cohorts with HFML will be needed to determine whether HFML are a valid clinical entity.

Keywords: Leg movements, periodic leg movements of sleep, restless leg syndrome, anterior Skips.

Neck Myoclonus
(Head Jerks)
Characteristic polysomnographic presentation of a neck myoclonus. Figure 1 represents a 30-sec REM sleep epoch containing a short-lasting "stripe-shaped" movement-induced artifact visible vertically over the EEG channels (black arrow). After visual inspection of the digitally synchronized video registration, the movement-induced EEG artifact could be identified as a neck myoclonus.

Frauscher et al. 2010
Motor disturbances during non-REM and REM sleep in narcolepsy-cataplexy: a video-polysomnographic analysis

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<th>Binary with Cataplexy</th>
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<tr>
<td>Mean motor activity index</td>
<td>59.9±23/h</td>
<td>15.4±9.2/h</td>
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<td>32 Body Regions</td>
<td>38.2±15.6</td>
<td>14.8±10</td>
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<td>Total Arousal Index</td>
<td>21.6±9</td>
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<td>Motor Activity-Related Arousal Index</td>
<td>17.6±9.8</td>
<td>5.9±2.3</td>
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<th>Narcolepsy-cataplexy patients</th>
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Figure 1. Distribution of motor activity indices across sleep stages. Bars represent mean values, whiskers represent the standard error of the mean. REM, rapid eye movement.

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<thead>
<tr>
<th>Name</th>
<th>Frequency, n</th>
<th>Sequences</th>
<th>Uni/Bilateral</th>
<th>Frequency</th>
<th>Sin</th>
<th>Single EMG</th>
<th>Burst duration</th>
<th>Observations</th>
<th>Sleep related comorbidity</th>
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<tbody>
<tr>
<td>Wichniak et al, 2001</td>
<td>Rhythmic feet movements while falling asleep RFM / Hypnagogic foot tremor 28 out of 375 consecutive patients (7.1%) Single short series between 10-15 sec, in several pts frequent series &gt; 30 sec Generally bilateral but asynchronous 0.3-3 Hz (mostly: 1-2 Hertz) 510 +/-291 ms High N/N variability Highest frequency in presleep, also S1 and 2 of NR and during arousals. 22 SBD, 6 RLS, 2 PLMS; 1 Narcolepsy, 2 sleep walking 1 head banging, 2 insomnia</td>
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<td>Chervin, Consens et al, 2003</td>
<td>Alternating leg muscle activation during sleep and arousals: ALMA 16 out of appr. 1500 patients (calculated frequency: appr. 1.1 %) 1.4-22 sec bilateral 0.5-3 Hz (usually between 1-2 Hz) 100-500 ms Arouse from all stage sleep and REM, in 12 pts, around arousals and in 4 unrelated to arousals 2 methylphen., 2 PPX, 2 BZD, 1 AED</td>
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<td>Yang and Winkelman, 2010</td>
<td>High frequency leg movements HFLM (for rhythmic leg movements 1-3 hz) 37 out of 486 consecutive patients (7.6%) Mean duration 17.6 sec +- 1.1 sec 26.5 +/-5 sequences per night Unilateral</td>
<td>Bilateral</td>
<td>Alternating</td>
<td>Usually unilateral</td>
<td>1.6 +- 0.0 sec (range 0.4-3.7) 100-700 ms Associated with cardiac acceleration 2/3 out of W 1/3 out of sleep OR of having RLS 3.52</td>
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Chok, et al, Mov Disord of Sleep, 2nd ed. In prep
End

• NonREM parasomnias and sleep related movement disorders constitute important differential diagnosis for movement disorder specialists and neurologists.