

MOVEMENT RULES

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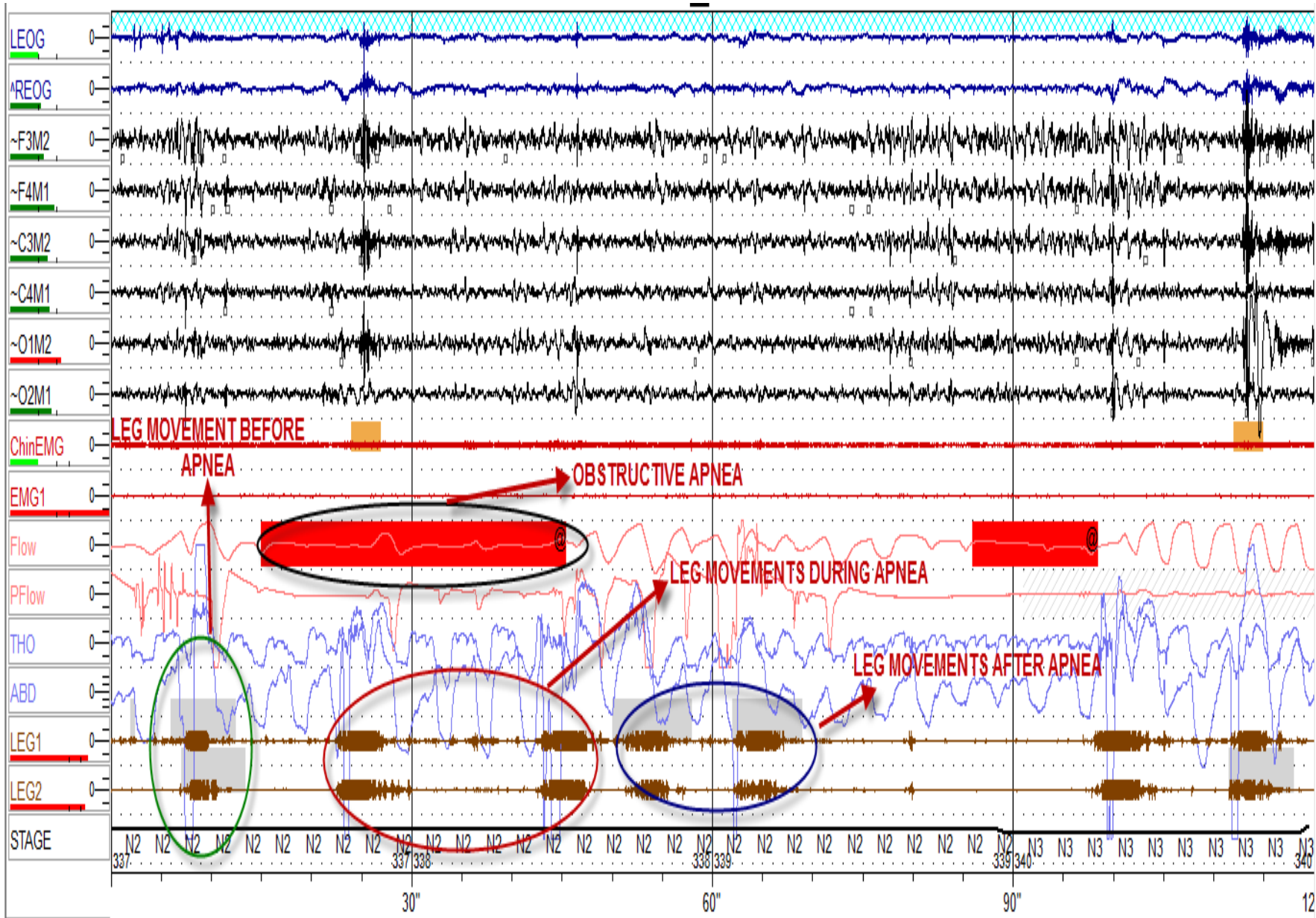
1. Scoring Periodic Limb Movement in Sleep (PLMS)

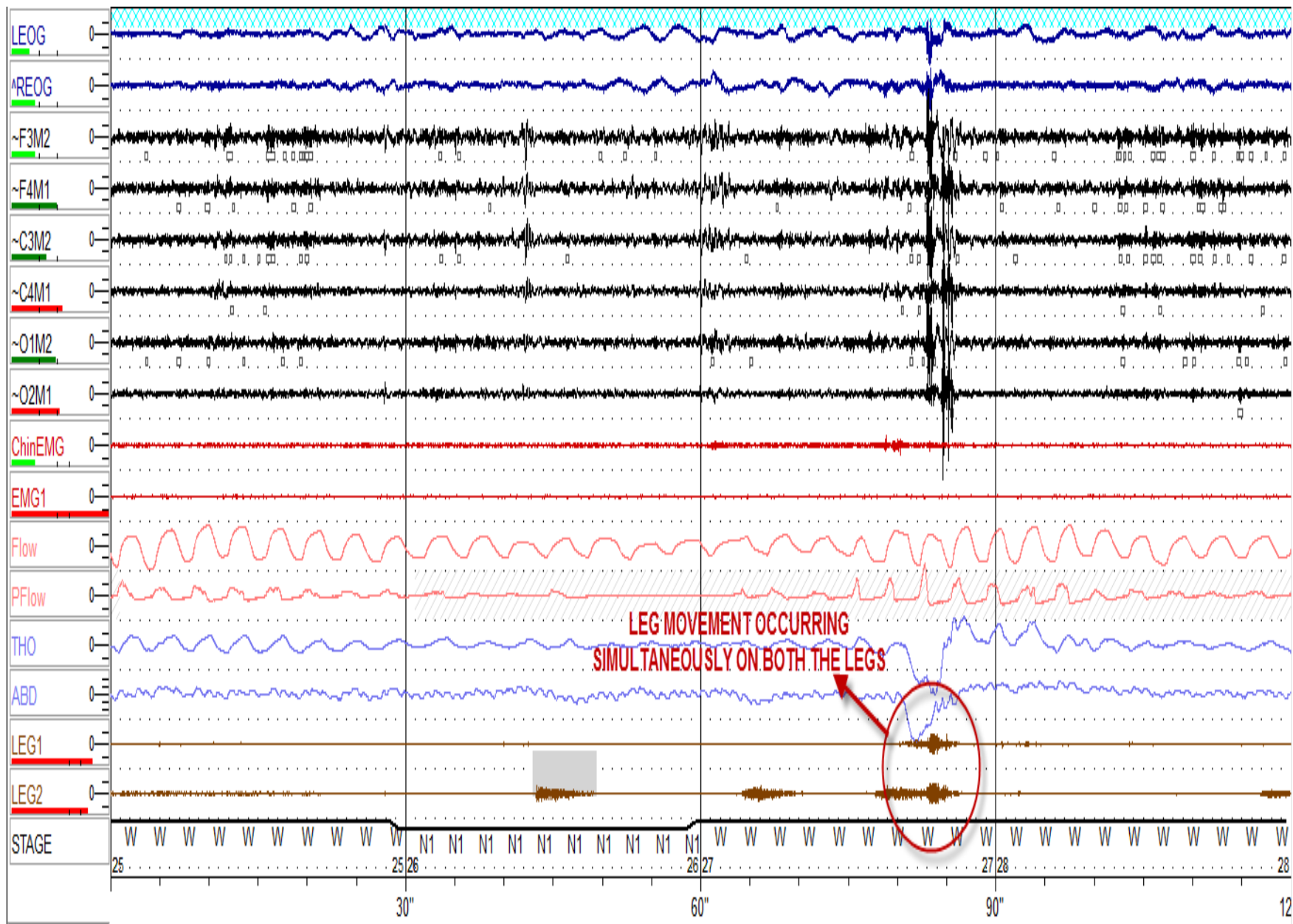
A. The following rules define a significant Leg Movement (LM) event –

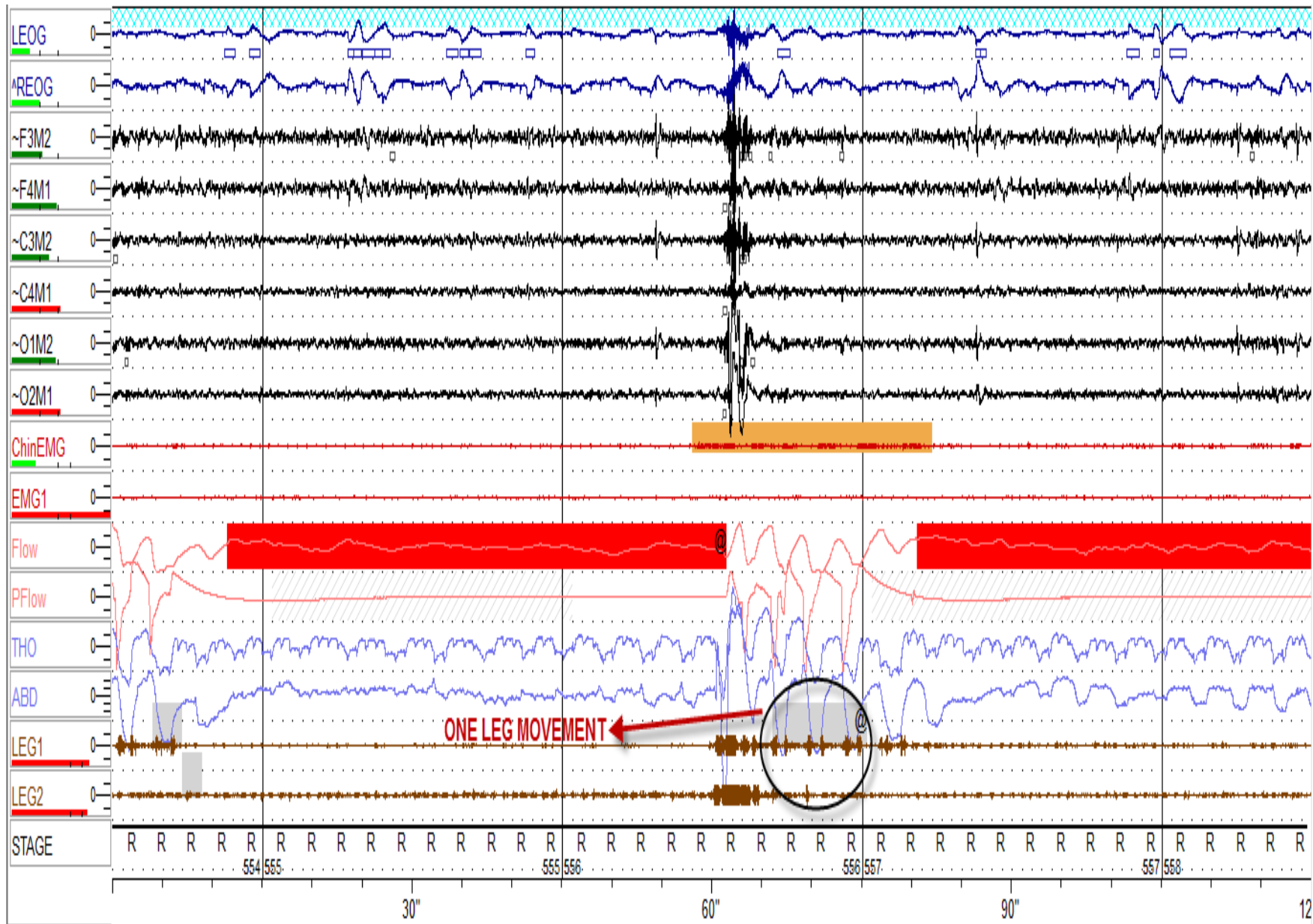
- The minimum duration of a LM event is 0.5 seconds
- The maximum duration of a LM event is 10 seconds
- The minimum amplitude of a LM event is an 8 μV - increase in EMG voltage above resting EMG
- The timing of the ending of a LM event is defined as the point at which there is an 8 μV - increase in EMG voltage above resting EMG.
- The timing of the ending of a LM event is defined as the start of a period lasting at least 0.5 seconds during which the EMG does not exceed 2 μV above resting EMG.

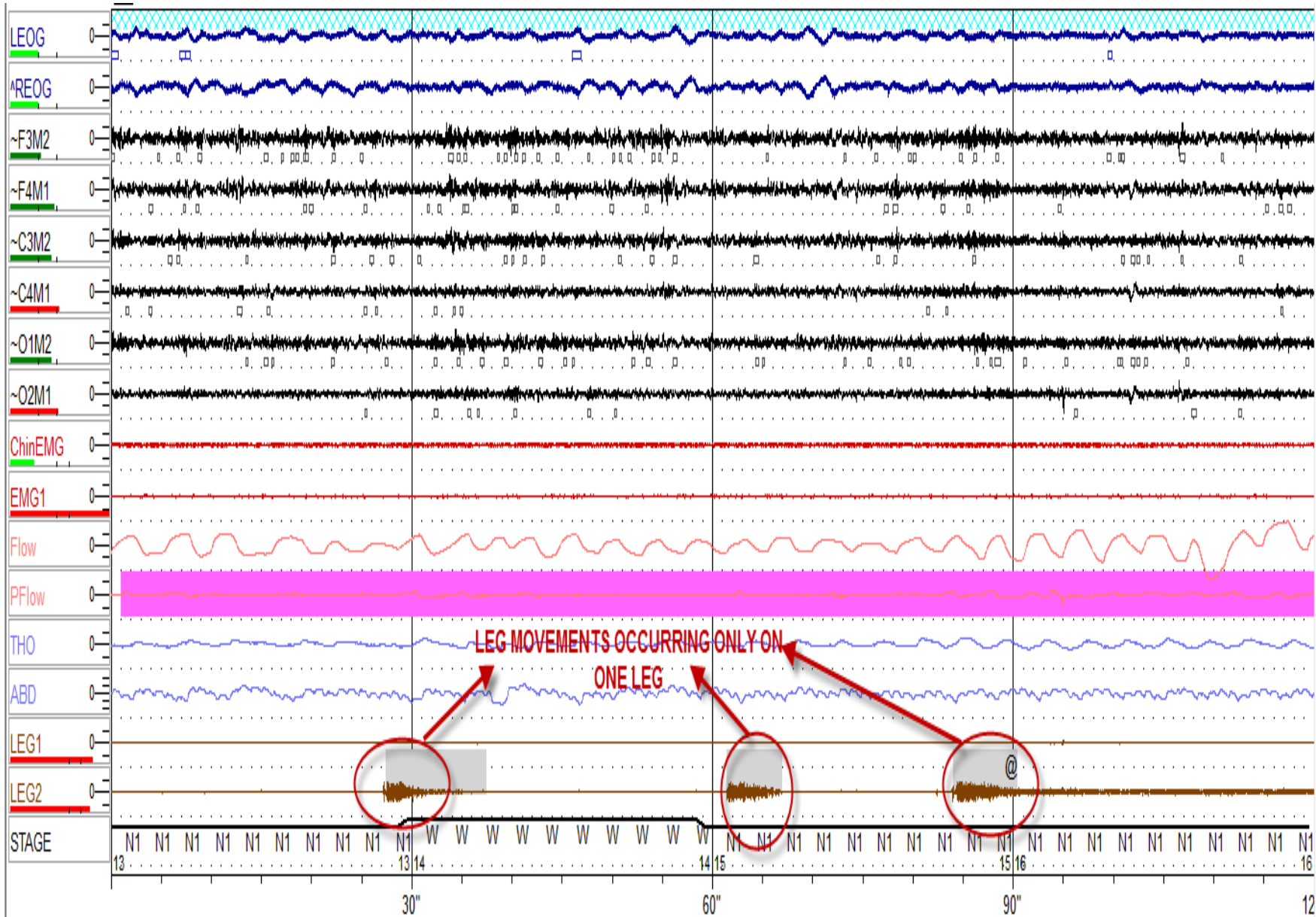
B. The following rules define a PLM series –

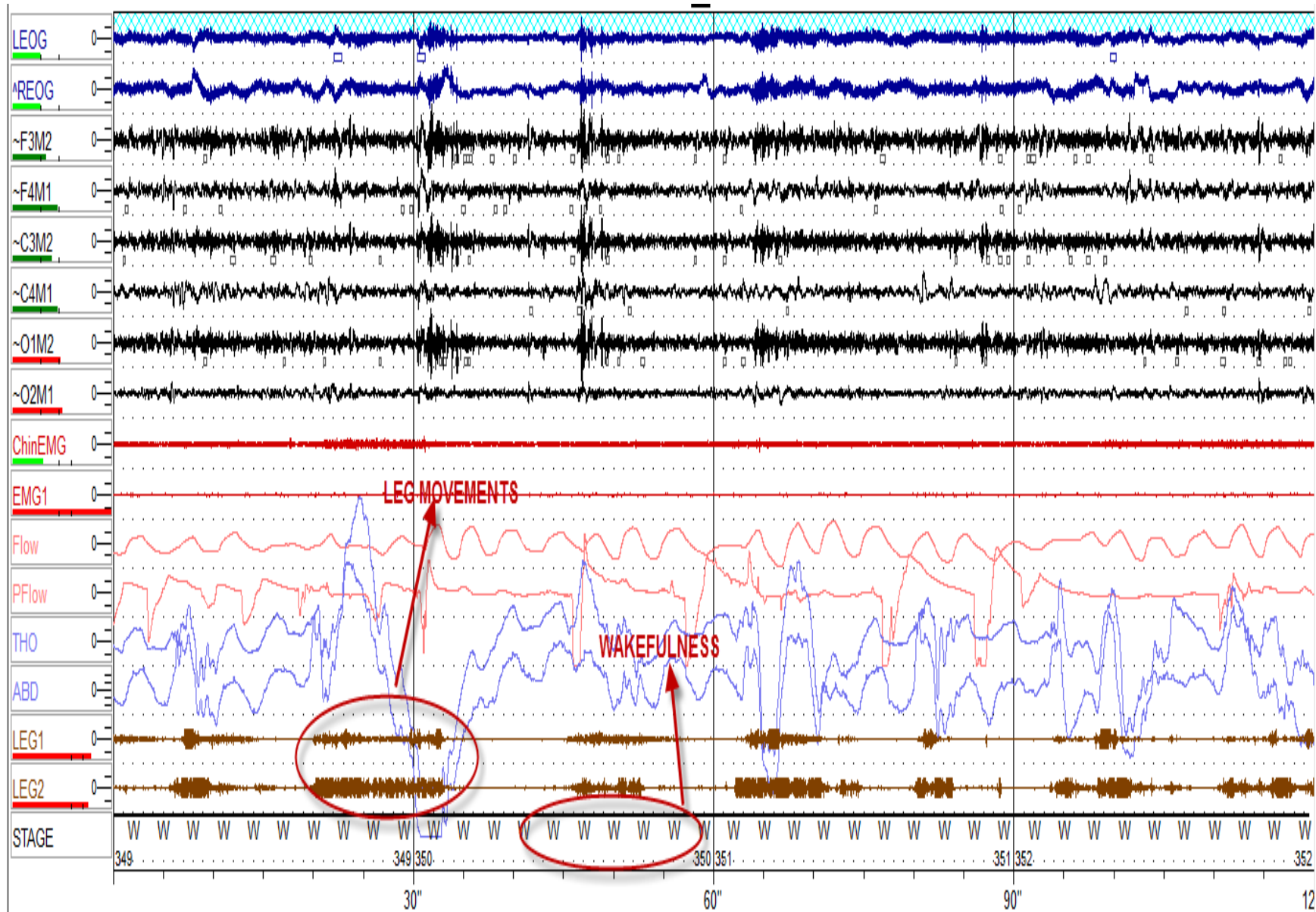
- The minimum number of consecutive LM events needed to define a PLM series is 4 LMs.
- The minimum period length between LMs (defined as the time between onset of consecutive LMs) to include them as part of a PLM series is 5 seconds.
- The maximum period length between LMs (defined as the time between onsets of consecutive LMs) to include them as part of a PLM series is 90 sec.
- Leg movements on 2 different legs separated by less than 5 seconds between movements onsets are counted as a single leg movement.

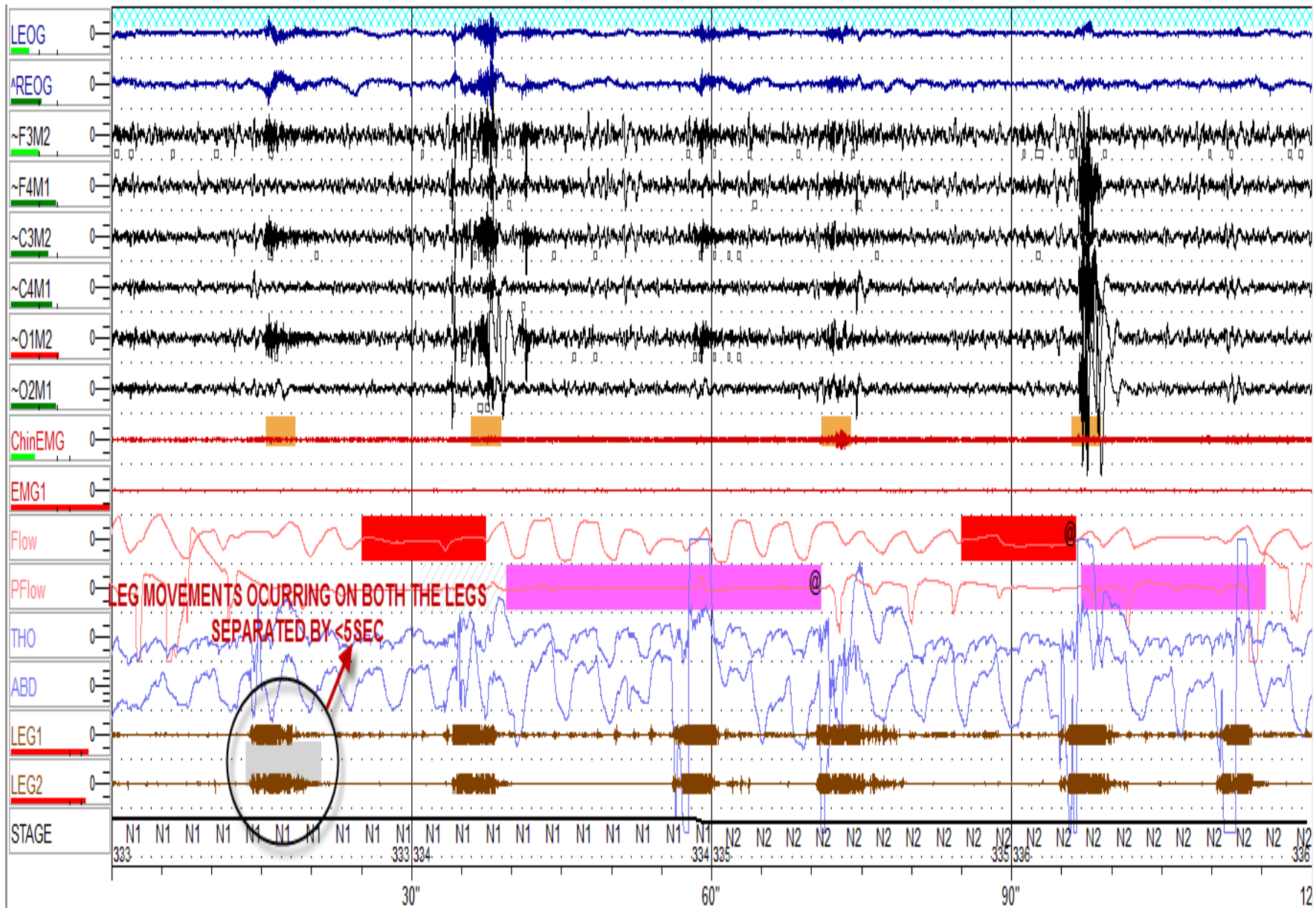












Notes –

- An LM should not be scored if it occurs during a period from 0.5 seconds preceding an apnea or hypopnea to 0.5 seconds following an apnea or hypopnea.
- An arousal and a PLM should be considered associated with each other when there is <0.5 seconds between the end of one event and the onset of the other event regardless of which is first.
- Surface electrodes should be placed longitudinally and symmetrically around the middle of the muscle so that they are 2 to 3 Cm apart or 1/3 of the length of the anterior tibialis muscle, whichever is shorter.

- Both legs should be monitored for the presence of the leg movements. Separate channels for each leg are strongly preferred.
- Combining electrodes from the 2 legs to give 1 recorded channel may suffice for some clinical settings, though it should be recognized that this strategy may reduce the number of detected LMs.
- Movements of the upper limbs may be sampled if clinically indicated.
- The rules in “A” above define a significant leg movement event by absolute increase in μV above resting baseline for the anterior tibialis EMG.
- This requires a stable resting EMG for the relaxed anterior tibialis whose absolute signal should be no greater than $+10 \mu\text{V}$ between negative and positive deflection ($\pm 5 \mu\text{V}$) or $+5\mu\text{V}$ for rectified signals.

- Use of 60 Hz (notch) filters should be avoided.
- Impedance need to be less than 10,000 Ω less than 5,000 Ω is preferred but may be difficult to obtain.
- Sensitivity limits of -100 and 100 μV (upper/lower) are preferred.
- When two periodic limb movements occur with an interval of less than 10 seconds and each is associated with a 3 second arousal, only the first arousal should be scored although both limb movements may be scored.
- In this scenario, the arousal index and PLMS arousal index, but not the PLMS index, would be influenced by not scoring the second "arousal."

Scoring Alternating Leg Muscle Activation (ALMA)

A. The following rules define ALMA –

- The minimum number of discrete and alternating bursts of leg muscle activity needed to score an ALMA series is 4 ALMAs.
- The minimum frequency of the alternating EMG bursts in ALMA is 0.5 Hz.
- The maximum frequency of the alternating EMG bursts in ALMA is 3.0 Hz.

Notes –

- ALMAs alternate between legs.
- The usual range for duration of ALMA is 100-500 msec.
- ALMA may simply be a benign movement phenomenon associated with characteristic EMG patterns as there have been no reported clinical consequences.

2. Scoring Hypnagogic Foot Tremor (HFT)

A. The following rules define HFT:

- The minimum number of bursts needed to make a train of bursts in Hypnagogic foot tremor is 4 bursts.
- The minimum frequency of the EMG bursts in Hypnagogic foot tremor is 0.3 Hz
- The maximum frequency of the EMG bursts in Hypnagogic foot tremor is 4.0 HZ

NOTES –

- The usual range for duration of Hypnagogic foot tremor is 250-1000 msec.
- HFT may simply be benign movement phenomenon associated with characteristic EMG patterns as there have been no reported clinical consequences.

3. Scoring Excessive Fragmentary Myoclonus (EFM)

A. The following rules define EFM –

- The usual maximum EMG burst duration seen in fragmentary myoclonus is 150 msec.
- At least 20 minutes of NREM sleep with EFM must be recorded
- At least 5 EMG potentials per minute must be recorded.

Notes –

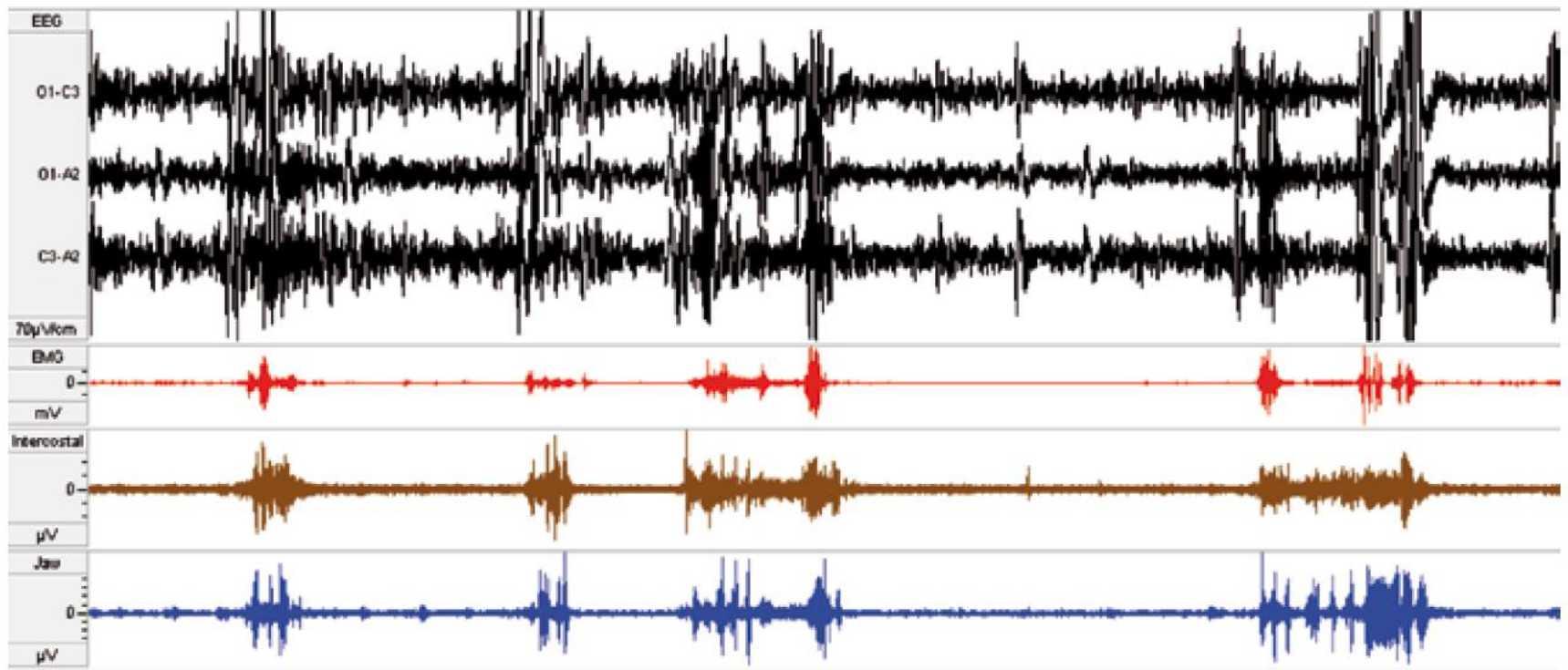
- EFM may be a benign movement phenomenon associated with characteristic EMG pattern as there have been no reported clinical consequences.
- In many cases no visible movements are present.
- Gross jerk-like movements across the joint spaces are not observed.
- When minor movements across a joint space is present, the movement resembles the small twitch-like movements of the fingers, toes and the corner of the mouth intermittently seen in REM sleep in normal individuals.
- In some cases when visible movement is present, the EMG burst duration may be >150 msec.

4. Scoring Bruxism

A. The following rules define bruxism –

- Bruxism may consists of brief (phasic) or sustained (tonic) elevations of chin EMG activity that are at least twice the amplitude of background EMG.
- Brief elevations of chin EMG activity are scored as bruxism if they are 0.25-2 seconds in duration and if at least 3 such elevations occur in a regular sequence.

- Sustained elevations of chin EMG activity are scored as bruxism if the duration is more than 2 seconds.
- A period of at least 3 seconds of stable background chin EMG must occur before a new episode of bruxism can be scored.
- Bruxism can be scored reliably by audio in combination with polysomnography by minimum of 2 audible tooth grinding episodes/night of polysomnography in the absence of epilepsy.



Notes –

- In sleep, jaw contraction frequently occurs.
- This contraction can take 2 forms: a) sustained (tonic) jaw clenching tonic contractions or b) a series of repetitive brief (phasic) muscle contractions termed rhythmic masticatory muscle activity (RMMA).
- In addition to the recommended placement of chin EMG electrodes, additional masseter electrode may be placed at the discretion of the investigator or clinician.

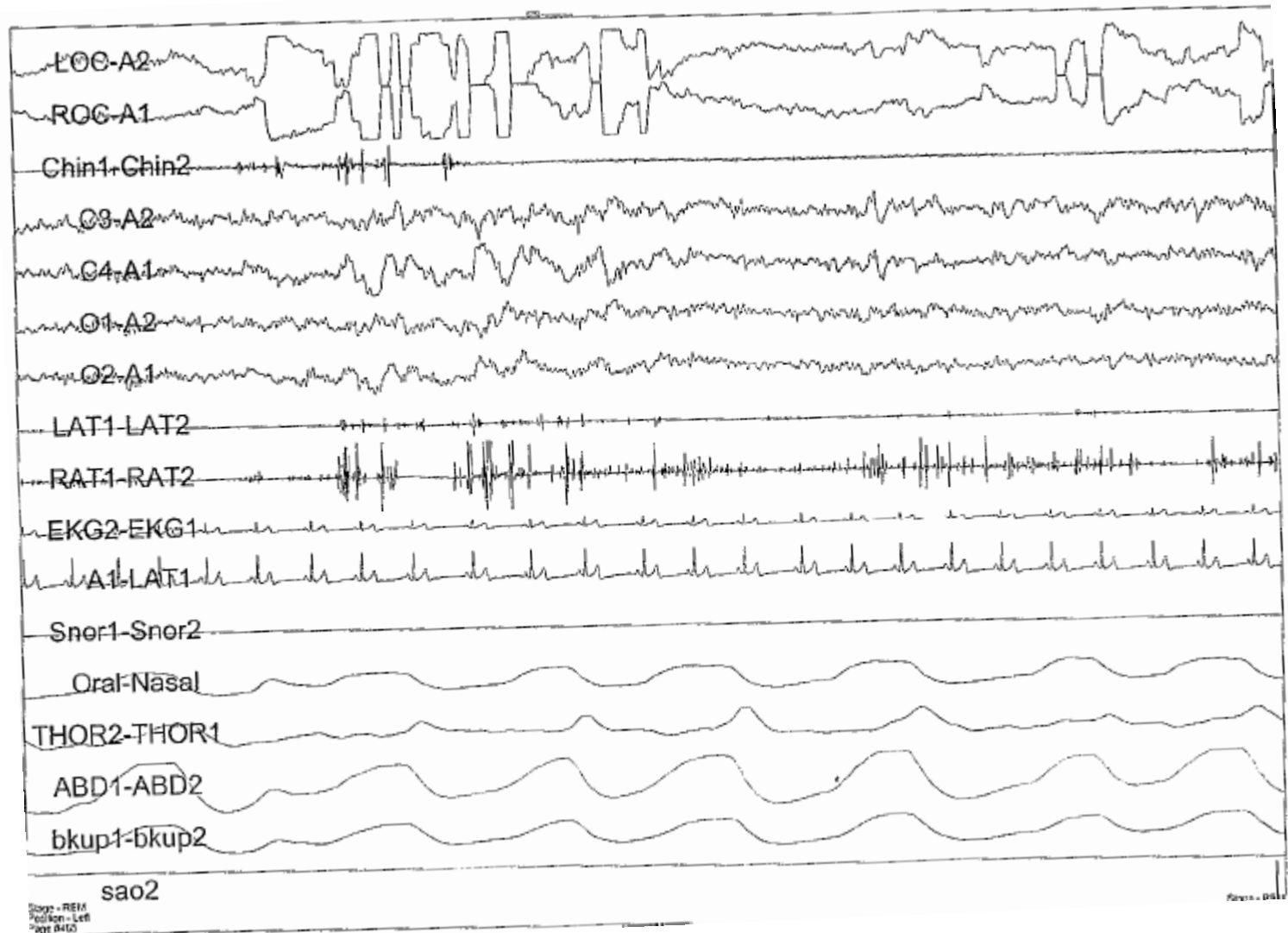
5. Scoring PSG Features of REM Sleep Behaviour Disorder (RBD)

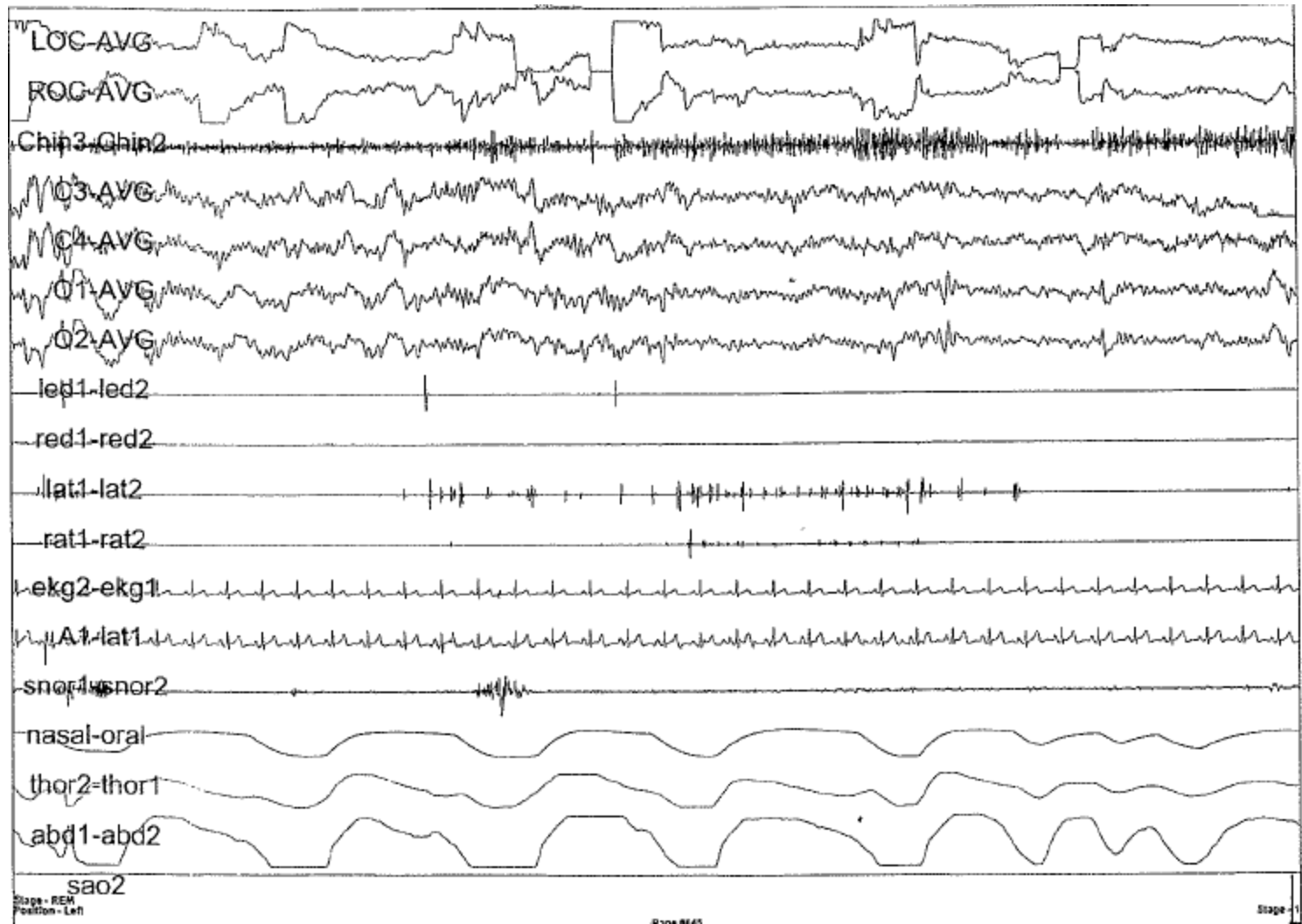
Definition –

- Sustained muscle activity (tonic activity) in REM sleep: An epoch of REM sleep with at least 50% of the duration of the epoch having a chin EMG amplitude greater than the minimum amplitude than in NREM.
- Excessive transient muscle activity (phasic activity) in REM sleep: In a 30 second epoch of REM sleep divided into 10 sequential 3 second mini-epochs, at least 5 (50%) of the mini-epochs contains bursts of transient muscle activity.
- In RBD, excessive transient muscle activity bursts are 0.1-5.0 seconds in duration and at least 4 times as high in amplitude as the background EMG activity.

Rule –

- The polysomnographic characteristics of RBD are characterized by either or both of the following features:
- Sustained muscle activity in REM sleep in the chin EMG.
- Excessive transient muscle activity during REM in the chin or limb EMG.





Notes –

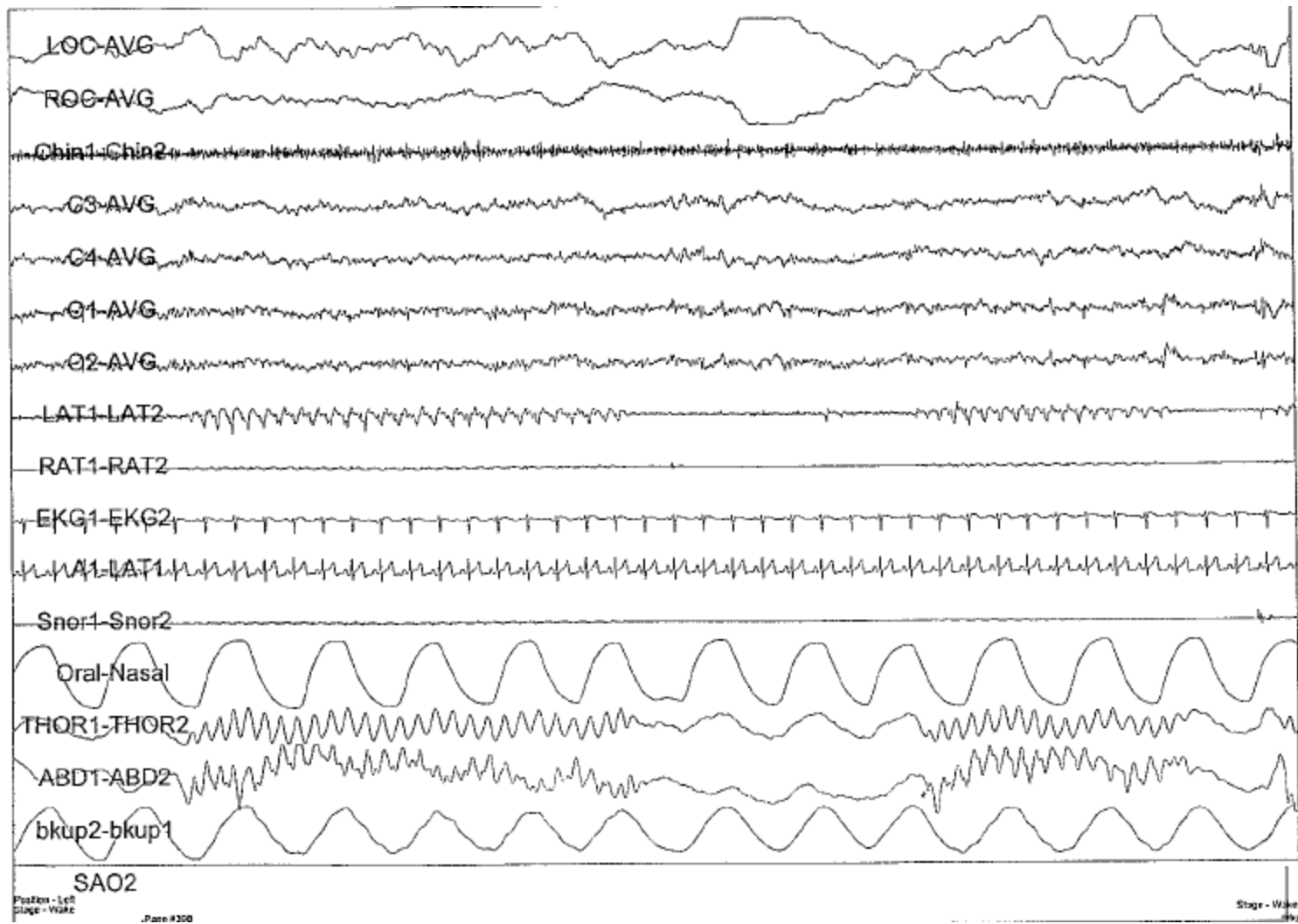
- Time synchronized video PSG audio or characteristic clinical history is necessary to make the diagnosis of RBD in addition to polysomnographic evidence of REM without atonia or excessive transient muscle activity in REM.
- Transient muscle activity and occasional accompanying visible twitching of small muscle groups are a normal phenomenon seen in REM sleep.
- When larger muscle groups are involved, this activity is not associated with large, overt muscular activity acting across large joints.
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- When smaller muscle groups are involved, the movement often involves the distal muscles of the hands and face or the corners of the mouth. Transient muscle activity may be excessive in RBD.

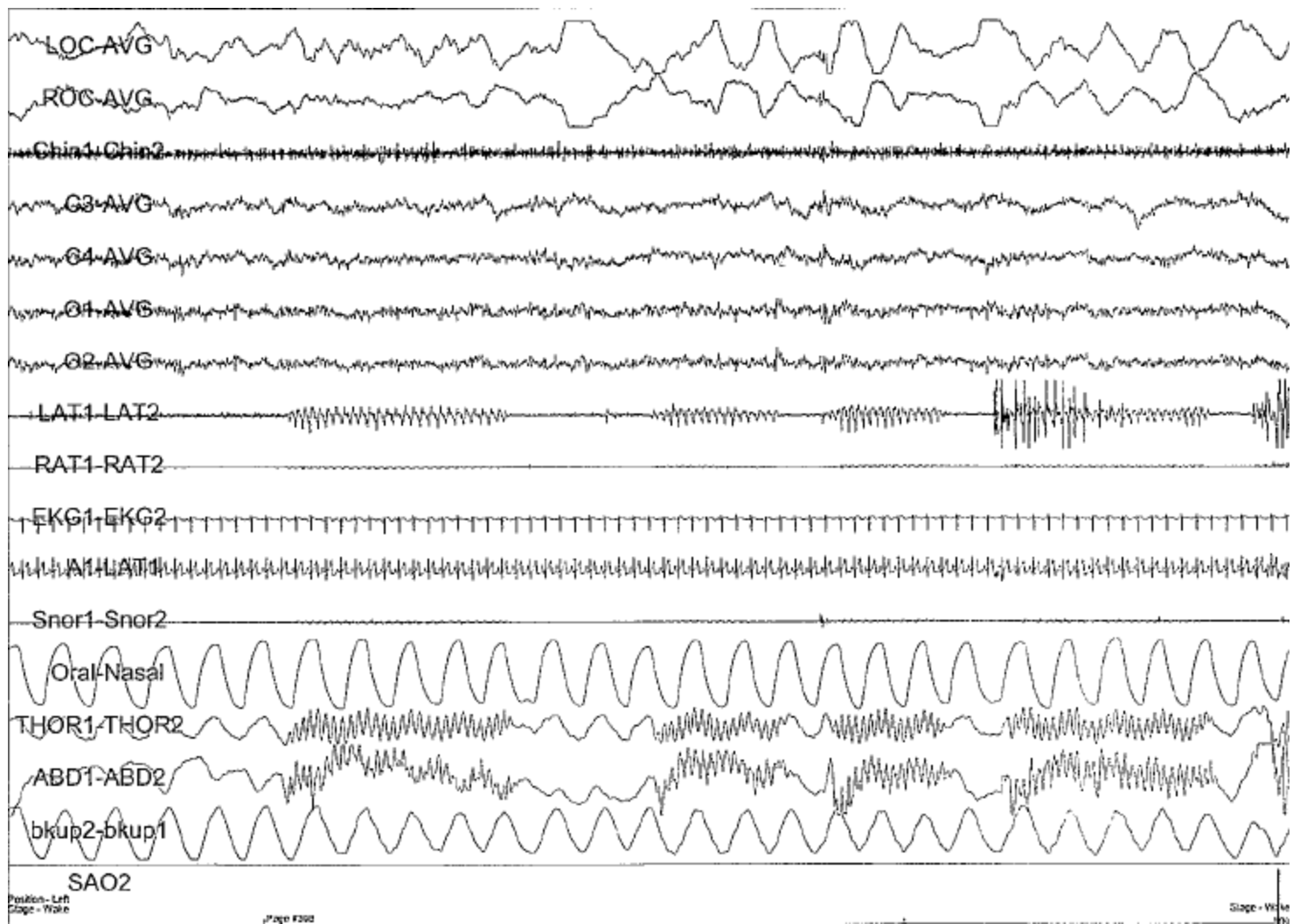
- The sustained muscle activity or the excessive transient muscle activity observed in REM sleep may be interrupted by superimposed (usually dream-enacting) behaviours of RBD.
- In normal individuals there is an atonia seen in REM sleep in the chin and anterior tibialis EMG.
- In this state the baseline amplitude of the EMG signal decreases markedly.
- This atonia of REM sleep is lost to a considerable extent in RBD with variable frequency, and as a result, the EMG baseline amplitude is often higher. In this situation, the EMG can be said to be in a tonic rather than atonic state.

6. Scoring the PSG Features of Rhythmic Movement Disorder

A. The following rule defines the polysomnographic characteristic of rhythmic movement disorder:

- The minimum frequency for scoring rhythmic movements is 0.5 Hz
- The maximum frequency for scoring rhythmic movements is 2.0 Hz
- The minimum number of individual movements required to make a cluster of rhythmic movement is 4 movements.
- The minimum amplitude of an individual rhythmic burst is 2 times the background EMG activity.





Notes –

- Bipolar surface electrode should be placed to record electrical activity of the large muscle group involved.
- Time synchronized video PSG, in addition to polysomnographic criteria, is necessary to make the diagnosis of rhythmic movements disorder.

