Role and Value of Video-PSG and Questionnaires in Diagnosing RBD

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COI Disclosures

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- All unrelated to the topic of this presentation

Learning Objectives

- To recognize diagnostic criteria for RBD and their clinical implications
- To understand and discuss the role and value of questionnaire based instruments to detect RBD
- To appreciate approaches towards video analysis in RBD
- How to perform polysomnography in RBD
- How to analyze PSG EMG activity in RBD
- Quantitative vs qualitative diagnosis of RBD

RBD: Diagnostic Criteria
International Classification of Sleep Disorders
ICSD 2

A) Presence of REM sleep without atonia: excessive sustained or intermittent elevation of submental EMG tone or excessive phasic submental or limb EMG twitching

B) At least one of the following:

Sleep related (potentially) injurious or disruptive behaviors by history

Abnormal REM sleep behavior documented during PSG

C) Absence of EEG epileptiform activity unless clearly distinguishable

D) Symptoms not better explained by another sleep disorder, medical, neurological or mental disorder, medication use or substance use disorder

ICSD 2, 2005

RBD: Clinical characteristics

Association of behavior or vocalizations with dreaming

Apparent dream enactment: behavior seems to resemble dream content

Elaborated dream content

Patient can be awakened easily and is oriented

Episodes usually occur after midnight or more than two hours after sleep onset.

Large variability of behaviors and vocalizations even in the individual patient

Parasomnia our of REM or NonREM? Differentiating features

RBD

- Mostly elderly patients
- Mostly after midnight
- Behaviors take place while patien remains in bed
- Eyes closed
- Can be awakened easily
- Dream recall
- Movements occur in bursts, jerky, not smooth

NR Parasomnia/DOA

- Young patients, onset in childhood
- Before midnight, or first part of the night
- Often leaves the bed
- Difficult to arouse
- Amnesia or fragmentary dream recall
- Normal appearance of movments

RBD

RBD Prevalence

- 0.5 % in the general population

  Ohayon 1997
  Chiu 2001

- 4.8 % in a sleep laboratory series

  Frauscher 2010

- 33 - 46 % in Parkinson disease

  Wetter 2001
  Gagnon 2002
  ...
  Sixel-Döring 2011

Erkrankung	AUTOR	N	Diagnose basiert auf Anamnese	Diagnose basiert auf PSG	RBD
Assoziation mit anderen neurodegenerativen Erkrankungen					
SYNUKLEINOPATHIEN Multisystematrophie	Tison 1995 Plazzi 1997	2 39	+ +	+ +	2 (100 %) 35 (90 %)
Pure Autonomic Failure	Weyer 2006	3	+	+	3(100%)
Lewy Körperchen Demenz	Boeve 1998	37	+	+	34(92%)
TAUOPATHIEN Corticobasale Degeneration	Kimura 1997 Gatto 2007	Fallbericht Fallbericht	+ +	+ +	1 (subklinisch) 2 (subklinisch)
PSP	Wright 1990	Fallbericht	+	+	1
Guadeloupean Parkinson	De Cock 2007	9	+	+	7 (78%)
Alzheimer Demenz	Gagnon 2006	15	+	+	1 (11%)
ANDERE PROTEINOPATHIEN Chorea Huntington	Arnulf 2008	25	+	+	3 (12%)
Parkin mutation	Kumru 2004 Limousin 2009	10 9	+ +	+ +	6 (60%) 1 (9%)
Parkinson-Demenz-ALS Komplex (DJ-1)	Lo Coco 2009	2	+	+	2
Spinocerebelläre Ataxie 2	Bösch 2006	5	+	+	4 (subklinisch)
Spinocerebelläre Ataxie 3	Syed 2003 Iranzo 2003	Fallbericht 9	- +	+ +	1 5 (55%)

Erkrankung	AUTOR	N	Diagnose basiert auf Anamnese	PSG	RBD
Epilepsien					
Epilepsie bei Patienten > 60 Jahre	Manni 2007	80	+	+	10 (12,5%)
Kongenitale Missbildungssyndrom					
Chiari Malformation	Henriques-Filho 2008	103	+	+	23 (22.3%)
Neuroimunologische Erkrankungen					
Gullian-Barrè-Syndrom	Schenck 1986 Cochen 2005	Fallbericht 13	+ +	+ +	1 8 (61.5 %)
Limbische Enzephalitis	Iranzo 2006 Compta 2007 Lin 2009	6 1 Fallbericht	3/6 + +	+ + +	5 (38%) 1 1
Narkolepsie	Schenk 1992 Nightingale 2005	142 55	+ 5/55	+ +	10 (7%) 20 (36%)
Multiple Sklerose	Gomez-Choco 2007	135	4/135	+	3 (1,5%)
Zerebrovaskuläre Erkrankungen					
Ponsinfarkt	Kimura 2000 Xi 2009	Fallbericht Fallbericht	+ +	+ +	1 1

Delayed emergence of a parkinsonian disorder in 38% of 29 older men initially diagnosed with idiopathic rapid eye movement sleep behavior disorder

Carlos H. Schenck, MD; Scott R. Bundlie, MD; and Mark W. Mahowald, MD

Neurology 1996
46:388-93.

29 iRBD aged > 50 after 12.7±7.3 years → PS 38% (1996)

Rapid-eye-movement sleep behaviour disorder as an early marker for a neurodegenerative disorder: a descriptive study

Alex Iranzo, José Luis Molinuevo, Joan Santamaría, Mónica Serradell, María José Martí, Francesc Valldeoriola, Eduard Tolosa

Lancet Neurol 2006;
5: 572–77

44 RBD after 11.5 years: 45% PD/DLB/MSA/MCI

ARTICLES

Quantifying the risk of neurodegenerative disease in idiopathic REM sleep behavior disorder

R.B. Postuma, MD: J.F. Gagnon, PhD;M. Vendette, BSc; M.L. Fantini, MD; J. Massicotte-Marquez, PhD; J. Montplaisir, MD,PhD

Neurology 2009;
72:1296–1300

93 Patienten

- 5-Year Risk 17.7%
- 10-Year Risk 40.6%
- 12-Year Risk 52.4%

for Parkinson Syndrome or MCI

Contents lists available at SciVerse ScienceDirect

Sleep Medicine

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

Original Article

Delayed emergence of a parkinsonian disorder or dementia in 81% of older males initially diagnosed with idiopathic REM sleep behavior disorder (RBD): 16 year update on a previously reported series

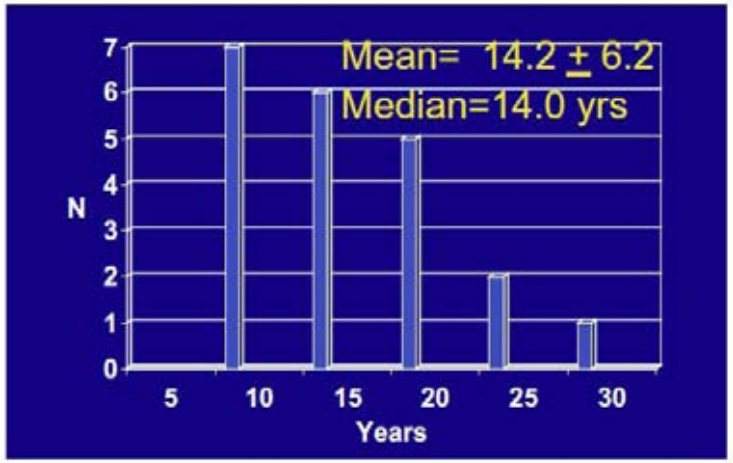
Carlos H. Schenck [a,*], Bradley F. Boeve [b], Mark W. Mahowald [c]

•16 year Update on previous series: 81% after median 14 years

- 80.8% (21/26) of patients initially diagnosed with iRBD developed parkinsonism/dementia after a median interval 14 years

Eventual parkinsonian disorders/dementia in a series of middle-aged and older males initially diagnosed with idiopathic RBD (iRBD).

N = 13 Parkinson's disease	
N = 3 Dementia with Lewy bodies	
N = 1 Dementia (unspecified; profound)	
N = 2 Multiple system atrophy	
N = 2 Clinically diagnosed Alzheimer's disease with autopsy-confirmed combined Alzheimer's disease plus Lewy body disease pathology	
N = 21 iRBD "converters"	
Mean age (±SD), years, iRBD onset	57.7 ± 7.7
Mean age (±SD), years, parkinsonism/dementia onset	71.9 ± 6.6
Mean interval (±SD), years, iRBD onset to parkinsonism/dementia onset (range: 5–29 years)	14.2 ± 6.2



Interval from onset of RBD to onset of parkinsonism/dementia (n = 21)

Questionnaires for RBD

Sleep Medicine 11 (2010) 167–171

Contents lists available at ScienceDirect

Sleep Medicine

Original Article

REM sleep behavior disorder in 703 sleep-disorder patients: The importance of eliciting a comprehensive sleep history

Birgit Frauscher [a], Viola Gschliesser [a], Elisabeth Brandauer [a], Isabelle Marti [a], Martin T. Furtner [a], Hanno Ulmer [b], Werner Poewe [a], Birgit Högl [a,*]

[a] Innsbruck Medical University, Department of Neurology, Anichstrasse 35, A-6020 Innsbruck, Austria
[b] Innsbruck Medical University, Department of Medical Statistics, Informatics and Health Economics, Innsbruck, Austria

Objectives: To evaluate the frequency of RBD in a mixed sleep lab population and assess potential associations.

Methods: Review of charts and PSG reports of 703 consecutive patients.
Patients categorized into those with and without RBD.
Evaluation of associations with concomitant sleep and neurological diagnoses and medications.

Results: 34 patients **(4.8%)** were diagnosed with RBD (27 m; 7 f, 57.7 ± 12.3 years).
RBD idiopathic in 11 (1.6%), symptomatic in 23 (3.3%) secondary to: Parkinson syndromes (n = 11), antidepressants (n = 7), narcolepsy/cataplexy (n = 4), pontine infarction (n = 1).

The majority of RBD patients reported RBD symptoms on specific questioning only, underlining the importance of eliciting a comprehensive sleep history for the diagnosis of RBD.

Questionnaires and interview-based instruments to detect RBD

REM Behavior disorder screening questionnaire (RBDSQ) *(Stiasny-Kolster 2007)*

10 items with 13 yes/no questions (maximum score possible = 13)
address frequency, dream content, nocturnal movements, injuries to self or bed partner, types of motor behaviors during the night, nocturnal awakenings, sleep disruption, and the presence of a neurological disease.

REM Sleep Behavior Disorder questionnaire Hong Kong (RBDQ-HK) *(Li 2010)*

13 questions, each question is answered on two scales:
lifetime occurrence (don't know, no, yes) and recent 1- year frequency.
Questions cover: currency and frequency of dreams and nightmares, dream content, vocalizations during sleep, motor behaviors during sleep, injuries during sleep, sleep disruption.

Mayo Sleep Questionnaire (MSQ) *(Boeve 2011)*

The MSQ, a 16 item measure, to screen for the presence of RBD and other sleep disorders (PLMs, RLS, SW, OSA, and SRLC). The MSQ needs responses of patients' bed partners.

RBD1Q *(Postuma 2012)*

Single question that queries dream enactment behavior in RBD.
"**Have you ever been told, or suspected yourself, that you seem to 'act out your dreams' while asleep (for example, punching, flailing your arms in the air, making running movements, etc.)?**":

Innsbruck REM Sleep Behavior Disorder Inventory (RBDI) *(Frauscher 2012)*

5 item questionnaire : Yes/No/Don't know; Score from 0=minimum to 1=maximum, easy to apply,
RBD summary question : "Do you kick or hit during your sleep because you dream that you have to defend yourself?":

The REM Sleep Behavior Disorder Screening Questionnaire—A New Diagnostic Instrument

Karin Stiasny-Kolster, MD,[1] Geert Mayer, MD,[2] Sylvia Schäfer, MD,[1] Jens Carsten Möller, MD,[1] Monika Heinzel-Gutenbrunner, PhD,[3] and Wolfgang H. Oertel, MD[1]

Mov Disord. 2007; 22(16):2386-93

	Question	Answer
English		
1.	I sometimes have very vivid dreams.	yes/no
2.	My dreams frequently have an aggressive or action-packed content.	yes/no
3.	The dream contents mostly match my nocturnal behaviour.	yes/no
4.	I know that my arms or legs move when I sleep.	yes/no
5.	It thereby happened that I (almost) hurt my bed partner or myself.	yes/no
6.	I have or had the following phenomena during my dreams:	
6.1.	speaking, shouting, swearing, laughing loudly	yes/no
6.2.	sudden limb movements, "fights"	yes/no
6.3.	gestures, complex movements, that are useless during sleep, e.g., to wave, to salute, to frighten mosquitoes, falls off the bed	yes/no
6.4.	things that fell down around the bed, e.g., bedside lamp, book, glasses	yes/no
7.	It happens that my movements awake me.	yes/no
8.	After awakening I mostly remember the content of my dreams well.	yes/no
9.	My sleep is frequently disturbed.	yes/no
10.	I have/had a disease of the nervous system (e.g., stroke, head trauma, parkinsonism, RLS, narcolepsy, depression, epilepsy, inflammatory disease of the brain), which?	yes/no

- 54 RBD patients (19 iRBD, 33 narcolepsy, 2 early PD)
- 160 patients without RBD
- 133 healthy subjects (RBD excluded by medical history)

Using a cut-off value of ?Ø points on the RBDSQ, the questionnaire revealed a sensitivity of 96% and a speci?£ity of 56%, correctly diagnosing 66% of subjects with sleep disorders.

In an unselected control group from the general population, the speci?£ity was considerably higher with 92%, leading to the correct diagnosis in 93%.

Sleep Medicine 11 (2010) 43–48

Contents lists available at ScienceDirect

Sleep Medicine

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

Original Article

Validation of a new REM sleep behavior disorder questionnaire (RBDQ-HK) ☆

S.X. Li [a], Y.K. Wing [a,*], S.P. Lam [a], J. Zhang [a], M.W.M. Yu [a], C.K.W. Ho [a], J. Tsoh [a], V. Mok [b]

- N=107 RBD cases
- N=107 control subjects
- N=6 psychiatric controls

The RBD group had significantly higher scores for both factor 1 (dream-related items) and factor 2 (behavioral items) than the control group ($p < 0.001$).

Sensitivity 82.2%
Specificity 86.9%

Symptoms	Lifetime occurrence			Recent 1-year frequency				
	I don't remember/ I don't know	No	Yes	Did it happen in the recent 1-year?	Once or few times per year	Once or few times per month	1–2 times per week	3 times or above per weeks
1. Did you often have dreams?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
2. Did you often have nightmares?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
3. Did you have dreams with an emotional and sorrowful content?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
4. Did you have dreams with a violent or aggressive content (e.g., fighting with someone)?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
5. Did you have dreams with a frightening and horrifying content (e.g., being chased by ghost)?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
6. Did you have sleep talking?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
7. Did you shout, yell or swear during your sleep?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
8. Did you move your arms or legs in response to your dream contents during sleep?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
9. Have you ever fallen from your bed?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
10. Have you ever hurt yourself or your bed-partner while you were sleeping?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
11. Have you ever *attempted to* assault your bed-partner or almost hurt yourself while you were sleeping?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
12. Did the scenario described in 10 or 11 relate to your dream contents?	□	□	□	□ Yes □ No (Please go to the next question)	□	□	□	□
13. Did the situations described above disturb your sleep?	□	□	□	□ Yes □ No	□	□	□	□

Li SX Sleep Med 2010;11:43-48

RESEARCH ARTICLE

Validation of the Innsbruck REM Sleep Behavior Disorder Inventory

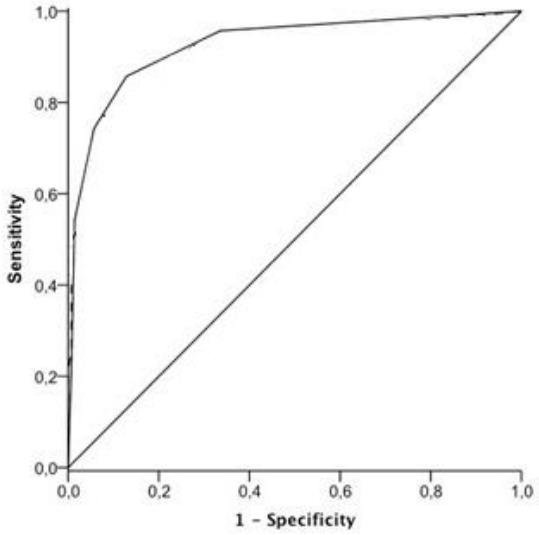
Birgit Frauscher, MD,* Laura Ehrmann, MD, Laura Zamarian, PhD, Florentine Auer, MD, Thomas Mitterling, MD, David Gabelia, MD, Elisabeth Brandauer, MD, Margarete Delazer, PhD, Werner Poewe, MD, and Birgit Högl, MD

Department of Neurology, Innsbruck Medical University, Innsbruck, Austria

Mov Disord. 2012; 27(13):1673-78

	Items	Overall presence		
		I can't remember / Don't know	No	Yes
1.	Do you dream of violent or aggressive situations (e.g. to have to defend yourself)?			
2.	Do you shout, rant or swear during your sleep? (Note: this does not include normal sleeptalking)			
3.	Do you move out of your sleep and occasionally perform „flailing" or more extensive movements?			
4.	Have you ever injured or nearly injured yourself or your bed partner while you were sleeping?			
5.	Are the above described movements out of your sleep occasionally or always in line with the content of your dreams?			

70 patients / 140 controls
5 items had AUC > 0.700
Cut-Off 0.25:
Sensitivity 0.914,
Specificity 0.857,
AUC 0.886



Behavior Disorder: A Multicenter Validation Study

Ronald B. Postuma, MD, MSc,[1,2*] Isabelle Arnulf, MD, PhD,[3]
Birgit Hogl, MD,[4] Alex Iranzo, MD,[5]
Tomoyuki Miyamoto, MD, PhD,[6] Yves Dauvilliers, MD, PhD,[7]
Wolfgang Oertel, MD,[8] Yo-El Ju, MD,[9]
Monica Puligheddu, MD,[10] Poul Jennum, MD,[11]
Amelie Pelletier, PhD,[1,13] Christina Wolfson, PhD,[12,13]
Smaranda Leu-Semenescu, MD,[3] Birgit Frauscher, MD,[4]
Masayuki Miyamoto, MD, PhD,[14]
Valerie Cochen De Cock, MD, PhD,[7]
Marcus M. Unger, MD,[8] Karin Stiasny-Kolster, MD,[8]
Maria Livia Fantini, MD, MSc,[10,15]
and Jacques Y. Montplaisir, MD, PhD[2,16]

Mov disord. 2012 Jun; 27(7):913-16

242 patients with RBD and 242 controls.

- 226 screened positive:
  sensitivity 93.8%
- 211 controls screened negative:
  specificity 87.2%
- Area under the curve 0.905

Sensitivity and specificity of the RBD1Q screen

	RBD	Control	Total
RBD screen +	226	31	257 PPV = 87.9%
RBD screen −	15	211	226 NPV = 93.4%
	241	242	
	Sensitivity = 93.8%	Specificity = 87.2%	

Mayo Sleep Questionnaire

1. Have you ever seen the patient appear to "act out his/her dreams" while sleeping? (punched or flailed arms in the air, shouted or screamed).

If yes,

(a) How many months or years has this been going on? (data on this subquestion were not analyzed in this analysis)
(b) Has the patient ever been injured from these behaviors (bruises, cuts, broken bones)?
(c) Has a bed partner ever been injured from these behaviors (bruises, blows, pulled hair)?
(d) Has the patient told you about dreams of being chased, attacked or that involve defending himself/herself?
(e) If the patient woke up and told you about a dream, did the details of the dream match the movements made while sleeping?

http://www.mayoclinic.org/pdfs/MSQ-copyrightfinal.pdf

NEW RESEARCH

JCSM
Journal of Clinical Sleep Medicine

http://dx.doi.org/10.5664/jcsm.2670

Validation of the Mayo Sleep Questionnaire to Screen for REM Sleep Behavior Disorder in a Community-Based Sample

Bradley F. Boeve, M.D., F.A.A.S.M.[1,3]; Jennifer R. Molano, M.D.[1*]; Tanis J. Ferman, Ph.D.[2]; Siong-Chi Lin, M.D., F.A.A.S.M.[3]; Kevin Bieniek, B.S.[1]; Maja Tippmann-Peikert, M.D., F.A.A.S.M.[1,3]; Brendon Boot, M.B.B.S.[1**]; Erik K. St. Louis, M.D., F.A.A.S.M.[1,3]; David S. Knopman, M.D.[1]; Ronald C. Petersen, Ph.D., M.D.[1]; Michael H. Silber, M.B.Ch.B., F.A.A.S.M.[1,3]

128 subjects

74% normal controls
23% MCI
3% mild AD

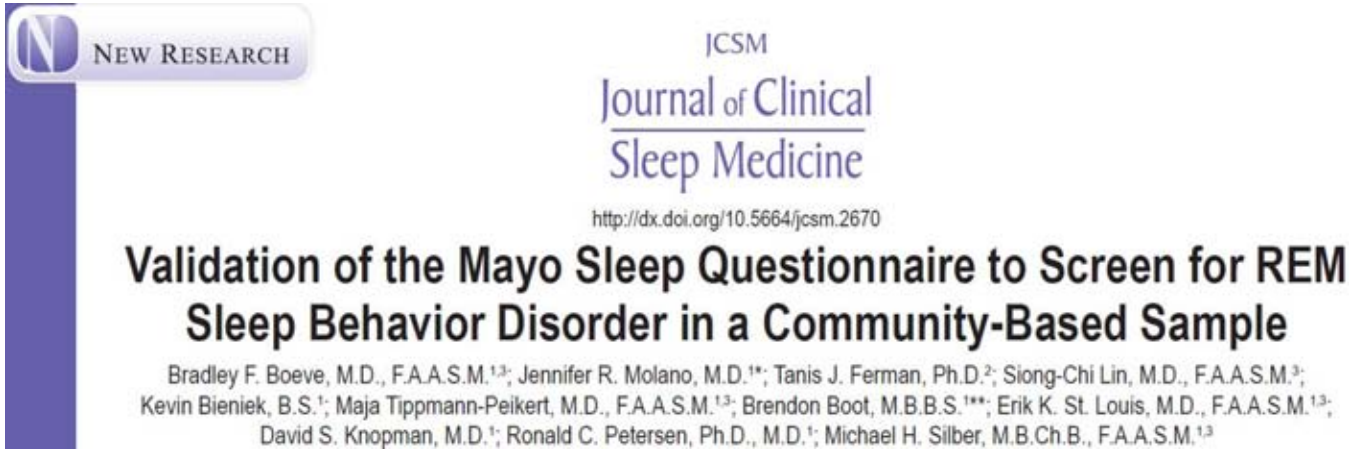
→ 9% diagnosis of RBD

Table 2—Sensitivity and specificity of Question 1 on the Mayo Sleep Questionnaire for PSG-proven RBD*

	DEB and RSWA	No DEB	
MSQ Q1 - Yes	9	4	SN 100% (95%CI: 0.63-1.0)
MSQ Q1 - No	0	84	SP 95% (95%CI: 0.88-0.98)
Total	9	88	

False positives occurred in those with OSA, which is consistent with the known phenomenon of apparent dream enactment behavior in those with untreated OSA.

Boeve BF J Clin Sleep Med 2013;9(5):475-80



We suggest that those subjects in whom question 1 of the MSQ is answered affirmatively by someone knowledgeable about the subject's sleep behavior be classified as having "probable RBD" (pRBD).

Based on these data, a history of one or more of the core features of RBD as reflected on subquestions 1b-1e, adequately differentiates those with true RBD from those without.

These findings suggest that among older individuals residing in a community setting with normal cognition or mild cognitive impairment, the MSQ is an excellent screening tool for the presence or absence of RBD.

Boeve BF J Clin Sleep Med 2013; 9(5):475-80

Sleep Medicine 12 (2011) 445–453

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Sleep Medicine

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

Original Article

Validation of the Mayo Sleep Questionnaire to screen for REM sleep behavior disorder in an aging and dementia cohort

Bradley F. Boeve[a,c,*], Jennifer R. Molano[a], Tanis J. Ferman[e], Glenn E. Smith[b], Siong-Chi Lin[e,f], Kevin Bieniek[a], Wael Haidar[a], Maja Tippmann-Peikert[a,c], David S. Knopman[a], Neill R. Graff-Radford[d], John A. Lucas[e], Ronald C. Petersen[a], Michael H. Silber[a,c]

176 subjects

4% normal controls
96% cognitive impairment or dementia (80% MCI, AD or DLB)
48% parkinsonism

Sensitivity and specificity of question 1 on the Mayo Sleep Questionnaire for PSG-proven RBD*.

	+DEB plus +RSWA	NOT +DEB plus +RSWA		
MSQ Q1 – Yes	79	17	SN	98% [95% CI:0.91–0.99]
MSQ Q1 – No	2	49	SP	74% [95% CI: 0.63–0.84]
Total	81	66		

+DEB = dream enactment behavior by history and/or PSG is present
+RSWA = rapid eye movement sleep without atonia is present

False positives tended to occur in those with historic and PSG features of OSA, which is consistent with the known phenomenon of apparent dream enactment behavior in those with untreated OSA

Boeve BF Sleep Med 2013; 12(5):445-53

Sleep Medicine 12 (2011) 445–453

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Original Article

Validation of the Mayo Sleep Questionnaire to screen for REM sleep behavior disorder in an aging and dementia cohort

Bradley F. Boeve[a,c,*], Jennifer R. Molano[a], Tanis J. Ferman[e], Glenn E. Smith[b], Siong-Chi Lin[e,f], Kevin Bieniek[a], Wael Haidar[a], Maja Tippmann-Peikert[a,c], David S. Knopman[a], Neill R. Graff-Radford[d], John A. Lucas[e], Ronald C. Petersen[a], Michael H. Silber[a,c]

Based on these data,

- the history of injuries to the patient as reflected on subquestion 1b,
- a history of most core features of RBD as reflected on subquestions 1b–e,
-or an absence of OSA features as reflected on question 5,

adequately differentiates those with true RBD from those without.

While it could be debated whether a PSG should be performed in all patients who screen positive on the MSQ for RBD to substantiate the diagnosis of DLB, those who are deemed appropriate could undergo PSG, and in those in whom a PSG cannot be performed or justified, at least the suspicion of RBD (i.e., be labeled ‘‘probable RBD’’) would make the clinician consider LBD as a diagnostic consideration in a patient’s cognitive decline.

Boeve BF Sleep Med 2013; 12(5):445-53

Questionnaire-Based Diagnosis of REM Sleep Behavior Disorder in Parkinson's Disease

Lama M. Chahine, MD,[1,2*] Joseph Daley, MD, PhD,[2] Stacy Horn, DO,[1] Amy Colcher, MD,[1] Howard Hurtig, MD,[1] Charles Cantor, MD[1,2] and Nabila Dahodwala, MD, MSCE[1]

Movement Disorders 2013 28(8):1146-9

Background:

Definitive diagnosis of RBD requires PSG, but that is costly, time intensive, and often not practical for large-scale studies.
Therefore, a questionnaire-based diagnostic approach was assessed.

Methods:

The patient-administered RBD questionnaire and bed-partner-administered question 1 of the Mayo questionnaire were prospectively validated.

Results:

75 PD (51 male, 68 HY stages I and II) participated. 48 had a clinical history of RBD.
Sensitivity was 100% (95% CI, 86.3%–100%) when a combination of both questionnaires was compared with the gold standard of polysomnogram-confirmed RBD.
Sensitivity of the patient questionnaire was highest at a cut off of ?6 or 7 with 74.2 %(95% CI, 55.1-87.5).
Sensitivity of the MQ1 reached 90.3% (95% CI; 74.0-97.5) for the entire cohort.
Among those who achieved REM sleep (n=65), specificity was highest for the patient questionnaire used alone, at 82.4% (95% CI, 64.8%–92.6%) for the MQ1 it reached 67.6% (95% CI; 49.4-82.0).

Conclusions:

A combination of patient and bed-partner questionnaires is a useful tool to detect RBD.

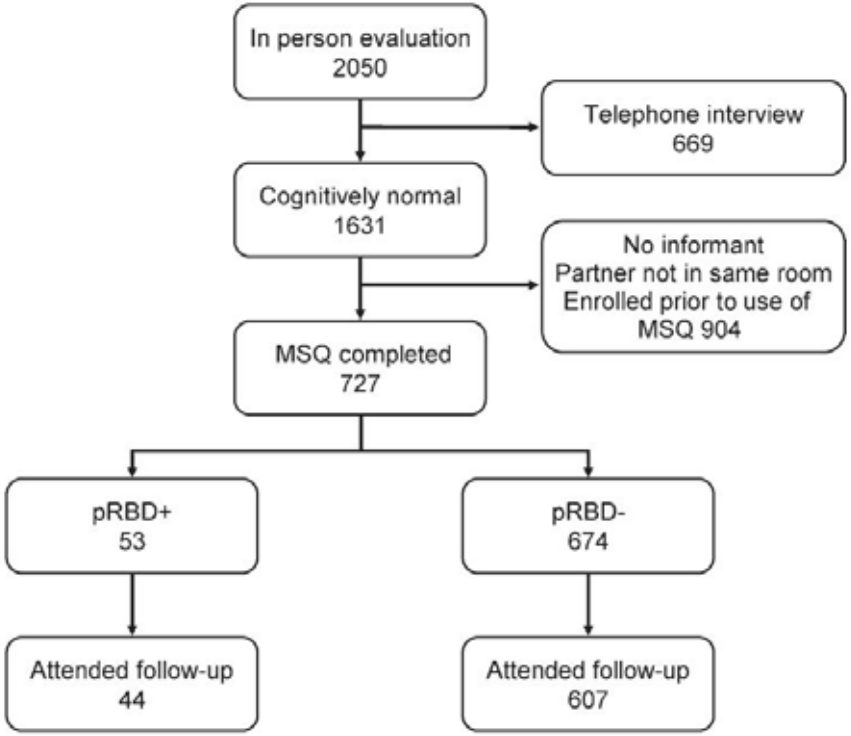
Sensitivity and specificity of currently available RBD questionnaires

Author	Name	Sens/Spec
Stiasny-Kolster et al., Mov Disord (2007)	RBD Screening Questionnaire	96%/56%
Li et al., Sleep Med (2010)	RBDQ-HK	82,2%/86,9%
Boeve et al., Sleep Med (2011)	Mayo Sleep Questionnaire	98%/74%
Postuma et al., Mov Disord (2012)	Single-Question Screen for RBD	93,8%/87,2%
Frauscher et al., Mov Disord (2012)	Innsbruck RBD Inventory	91,4%/85,7%
	RBD summary question	74,3%/92,9%

Probable Rapid Eye Movement Sleep Behavior Disorder Increases Risk for Mild Cognitive Impairment and Parkinson Disease: A Population-Based Study

Brendon P. Boot, MBBS,[1] Bradley F. Boeve, MD,[1,2] Rosebud O. Roberts, MBChB,[3] Tanis J. Ferman, PhD,[4] Yonas E. Geda, MD, MSc,[3,4] V. Shane Pankratz, PhD,[3] Robert J. Ivnik, PhD,[4] Glenn E. Smith, PhD,[4] Eric McDade, DO,[1] Teresa J. H. Christianson, BSc,[3] David S. Knopman, MD,[1] Eric G. Tangalos, MD,[5] Michael H. Silber, MBChB,[1,2] and Ronald C. Petersen, PhD, MD[1,3]

ANN NEUROL 2012;71:49–56



Population-based cohort of cognitively normal 70- to 89-year-olds, screened with MSQ, follow up every 15 months.

34% of the pRBD^{+} group developed MCI/PD compared to 15% in the pRBD^{-} group.

pRBD^{+} subjects were significantly more likely to be taking an antidepressant (23% vs 7%; p=0.001).

pRBD confers a 2.2-fold increased risk of developing MCI/PD within 4 years.

Boot BP Ann Neurol 2012;71(1):49-56

Most important cut-off values for RBD detection

Authors	Investigated EMG measures	Proposed Cut-off scores	Investigated muscles	Epoch duration	Scoring system
Ferri 2008, 2010	REM atonia index	0.8	chin	N/A	semiautomatic
Montplaisir 2010	Phasic EMG activity Tonic EMG activity Leg movements	15% 30 % 24	chin chin tibialis anterior	2 20 N/A	manual scoring
SINBAR (Frauscher 2012)*	Any EMG activity Phasic EMG activity SINBAR EMG activity Tonic EMG activity Any EMG activity Phasic EMG activity SINBAR EMG activity	18 % 16 % 32 % 10 % 15 % 11 % 27 %	chin chin chin + FDS chin chin chin chin + FDS	3 3 3 30 30 30 30	manual scoring

Legend: FDS, flexor digitorum superficialis. *Note that the SINBAR group provided EMG cut-off values for 6 different muscles. For this book chapter only the most important cut-off values are provided.

Modified from Birgit Frauscher & Birgit Högl
Quality control of RBD diagnosis
in ***Sleep in Parkinson´s Disease***
Videnovic A, Högl B (eds.), in preparation

Role of the video

AUTHOR	N (P/C)	AIM OF THE STUDY	VIDEOGRAPHIC METHODS	VIDEOGRAPHIC OUTCOME
Cygan 2010	7	To investigate night-to-night variability of phasic, tonic EMG activity and motor events	Real-time video-analysis (minor, major, complex, scenic events, vocalizations)	In contrast to tonic EMG activity, phasic EMG activity / motor events show significant night-to-night variability
De Cock 2007	51	To investigate the abnormal RBD movements in PD	Video-analysis of behavioral episodes were rated by several scorers	RBD movements may be generated in the cortex bypassing the EPMS
De Cock 2011	22	To investigate motor improvement during RBD in MSA	Video movement analysis, rating by several scorers	Surprising transient disappearance of Parkinsonism during RBD in MSA
Fantini 2003	5	To evaluate the effect of PPX on RBD	Video-PSG analysis (simple vs. complex)	Significant reduction of simple, but not complex motor events under PPX therapy
Frauscher 2007	5/5	To systematically describe motor events in RBD	Real-time video-analysis	High number of motor events (majority: small movements, rare: scenic, violent behaviors)
Frauscher 2009	8/8	To systematically analyze the association between REM sleep with REMs, phasic EMG activity and motor events in RBD	Combined analysis of EMG activity and time synchroneous videographic analysis	Association of major motor activity in RBD and phasic REM sleep
Iranzo 2005	110	To compare clinical and video-PSG features of iRBD vs. RBD due to PD/MSA	RBD severity classification (mild, moderate, severe)	iRBD patients had more severe RBD than PD and MSA patients
Iranzo & Frauscher 2011	11	To evaluate the SINBAR EMG montage for detection of RBD episodes	Combined analysis of phasic EMG activity and time synchroneous video analysis	Detection of majority of motor activity in RBD by the SINBAR EMG montage
Leclair-Visonneau 2010	56/17	To use the model of RBD to investigate if the eyes scan dream images during REM sleep	Combined analysis of REMs and behavior during PSG according to Frauscher et al. 2007	Tough link between the dream action during RBD and the direction of the gaze
Manni 2009	12	To investigate if sudden-onset motor behavioral episodes in RBD are associated with phasic events of REM sleep	Combined analysis of EMG activity and time synchroneous videographic analysis	Association of RBD behavioral episodes and phasic REM sleep
Oudiette 2009	24	To report non-violent RBD behaviors and to evaluate their frequency by interview	Description of video-behavioral episodes	Non-violent elaborative behaviors may also occur in RBD
Sforza 1988	6	To report PSG findings in RBD	PSG under videotape monitoring (simple vs. complex events)	Presence of behavioral episodes during REM sleep
Sixel-Döring 2011	20	To develop a PSG video-based scale for RBD severity	Rating of movements (1-3) and presence of vocalizations (0,1)	RBD severity scale is reliable and easy-to-use
Zhang 2008	55	To assess whether one night is enough for RBD diagnosis	Video analysis (simple, significant, unclassified, vocalization)	- 1 night of PSG is adequate for RBD diagnosis - Diagnostic accuracy is increased by video

Table 2. *Studies involving videographic analysis in RBD*
Legend: i, idiopathic; MSA, multiple system atrophy; PD, Parkinson's disease, PPX, pramipexole; PSG, polysomnography

Frauscher and Högl, in: Chokroverty, Allen, Walters, Montagna (eds). Sleep and Movement Disorders, 2nd ed. 2013

Movement Disorders
Vol. 22, No. 10, 2007, pp. 1464–1470

The *Movement* Disorder Society

Video Analysis of Motor Events in REM Sleep Behavior Disorder

Birgit Frauscher, MD,[1] Viola Gschliesser, MD,[1] Elisabeth Brandauer, MD,[1] Hanno Ulmer, PhD,[2] Cecilia M. Peralta, MD,[1,3] Jörg Müller, MD,[1] Werner Poewe, MD,[1] and Birgit Högl, MD[1]*

[1]*Department of Neurology, Innsbruck Medical University, Innsbruck, Austria*
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ELSEVIER

Sleep Medicine 10 (2009) 174–181

SLEEP MEDICINE

www.elsevier.com/locate/sleep

Original Article

The relation between abnormal behaviors and REM sleep microstructure in patients with REM sleep behavior disorder

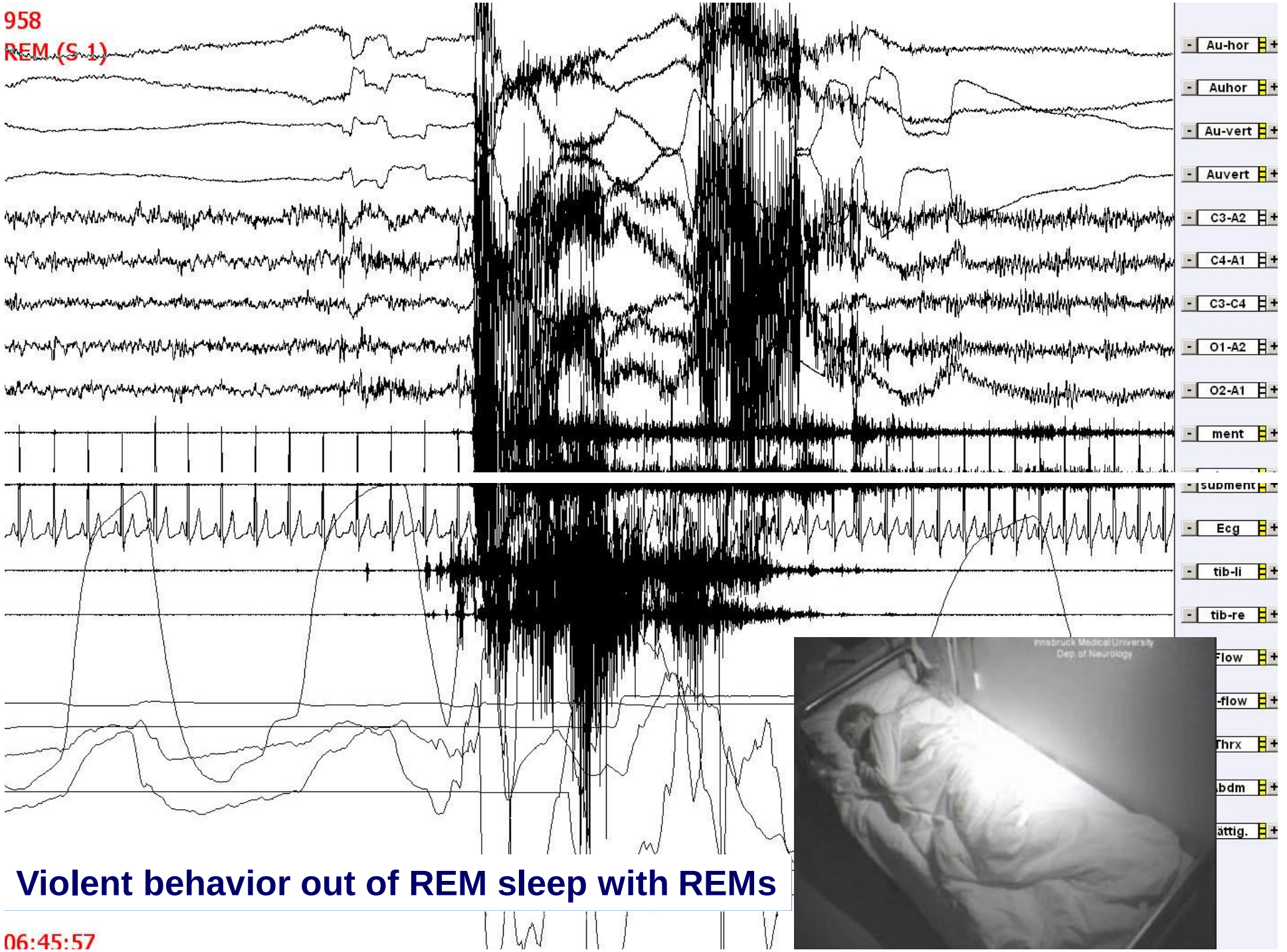
Birgit Frauscher[a], Viola Gschliesser[a], Elisabeth Brandauer[a], Hanno Ulmer[b], Werner Poewe[a], Birgit Högl[a,*]

[a] *Innsbruck Medical University, Department of Neurology, Anichstrasse 35, A-6020 Innsbruck, Austria*
[b] *Innsbruck Medical University, Department of Statistics, Informatics and Health Economics, Innsbruck, Austria*

Methods
- Video classification -

Types of motor events	Examples
Violent motor events Forceful and vehement movements which could potentially injure a bed partner	kicking, punching, jumping out of bed, fighting
Scenic complex behaviors Apparent “acting out” of dream contents or movements different from elementary simple events in term of complexity of action	laughing, crying, singing, gesturing, searching for something, chewing, smacking, grimacing, sitting up in bed, body rolling
Major jerks / movements Simple movements of great excursion of the body being mostly of myoclonic nature	whole body jerk, gross body movement, raising the arm, isolated elevation of one leg
Minor motor activity Small jerky or non-jerky excursions including one body part that usually would not be noticed by a sleeping bed partner.	isolated finger twitches, little toe or foot movements, mouth openings

Frauscher et al. Sleep Medicine (2009) 174–181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Innsbruck Medical University
Dep of Neurology
Violent behavior out of REM sleep with REMs
06:45:57

Conclusions from Video Analysis

Even in severe RBD, most motor events are small and elementary movements

Violent behavioral events represent the „tip of the iceberg“

The majority of elaborate and violent motor events of RBD initiated in REM sleep with REM („phasic REM“), compared to REM sleep without REM („tonic REM“): suggesting a gating function of RwR for major movements, whereas backgound jerking occurs throughout REM

NEW RESEARCH

JCSM
Journal of Clinical Sleep Medicine

Intraindividual Variability of REM Sleep Behavior Disorder in Parkinson's Disease: A Comparative Assessment Using a New REM Sleep Behavior Disorder Severity Scale (RBDSS) for Clinical Routine

Friederike Sixel-Döring, M.D.; Marcus Schweitzer, M.Sc.; Brit Mollenhauer, M.D.; Claudia Trenkwalder, M.D.
Paracelsus-Elena-Klinik, Center of Parkinsonism and Movement Disorders, Kassel, Germany

JCSM, Vol 7, 2011

MOTOR EVENTS

- 0 REM without antonia only
- 1 small distal movements („elementary simple“)
- 2 proximal muscles involved
- 3 axial movement involved

VOCALIZATIONS

- 0 None
- 1Yes

Sixel-Döring and Trenkwalder, JCSM 2011

Nonmotor and diagnostic findings in subjects with de novo Parkinson disease of the DeNoPa cohort

159 early de novo PD patients
110 healthy controls

Table 2 Subjective nonmotor features of de novo PD patients and healthy controls assessed by validated self-rating scales

	PD (n = 159)	HC (n = 110)	Mean difference (95% CI)	*p* Value	Unadjusted *p* value
PDSS total score	n = 152	n = 107		<0.001	<0.001
	15.3 (8.55, 0–41.00)	10.2 (6.34, 0–44.50)	−5.31 (−7.23, −3.40)		
RBD-SQ	n = 125	n = 92		<0.001	0.001
	3.8 (2.8, 0–13.00)	2.2 (2.1, 0–8.00)	−1.61 (−2.305, −0.909)		
RBD-SQ cutoff (>5), yes/no (%)	n = 125	n = 92		0.000	0.001
	38/87 (30/70)	12/79 (15/85)	2.67 (2.01, 3.56)		

We identified a significantly higher prevalence of movement events in REM sleep (51%) in patients with early PD compared to controls (15%), not yet fulfilling the entire spectrum of violent RBD or classification of RBD according to International Classification of Sleep Disorders.

Mollenhauer B Neurology 2013

Parkinson's disease?

Friederike Sixel-Döring MD[1,2#], Ellen Trautmann PhD[1,3],

Brit Mollenhauer MD[1,4*], Claudia Trenkwalder MD[1,4*]

Objective To analyze potential markers in sleep for early recognition of neurodegenerative disease in newly diagnosed, unmedicated patients with PD compared to controls.

Methods vPSG in 158 newly diagnosed, unmedicated PD patients and 110 healthy age-, gender- and education-matched controls (HC).
REM sleep was analyzed for RWA and studied by review of time-synchronized video.
Motor behaviors and/or vocalizations in REM sleep with a purposeful component other than comfort moves were identified as REM sleep behavioral events (RBE). Two or more events had to be present to be classified as "RBE positive". RBE subjects included RBD and non-RBD subjects based upon the presence or absence of RWA > 18.2%.

Results RBE were detected in 81/158 de novo PD patients (51%) and 17/110 HC (15%) ($p<0.001$). RBD was identified in 40/81 RBE positive PD patients (25% of all PD patients) and 2/17 RBE positive HC (2% of all controls). RBE positive patients showed no specific motor or neuropsychological features compared to RBE negative patients. PD patients and HC with RBE had more REM sleep ($p=0.002$) and a higher periodic leg movements in sleep index ($p=0.022$) compared to subjects without RBE.

Conclusion **This first description of RBE shows it occurs more frequently in de novo PD patients than in HC and may be an early sign of neurodegeneration and precede RBD.** There is no specific phenotype of PD associated with newly defined RBE or RBD at this early stage.

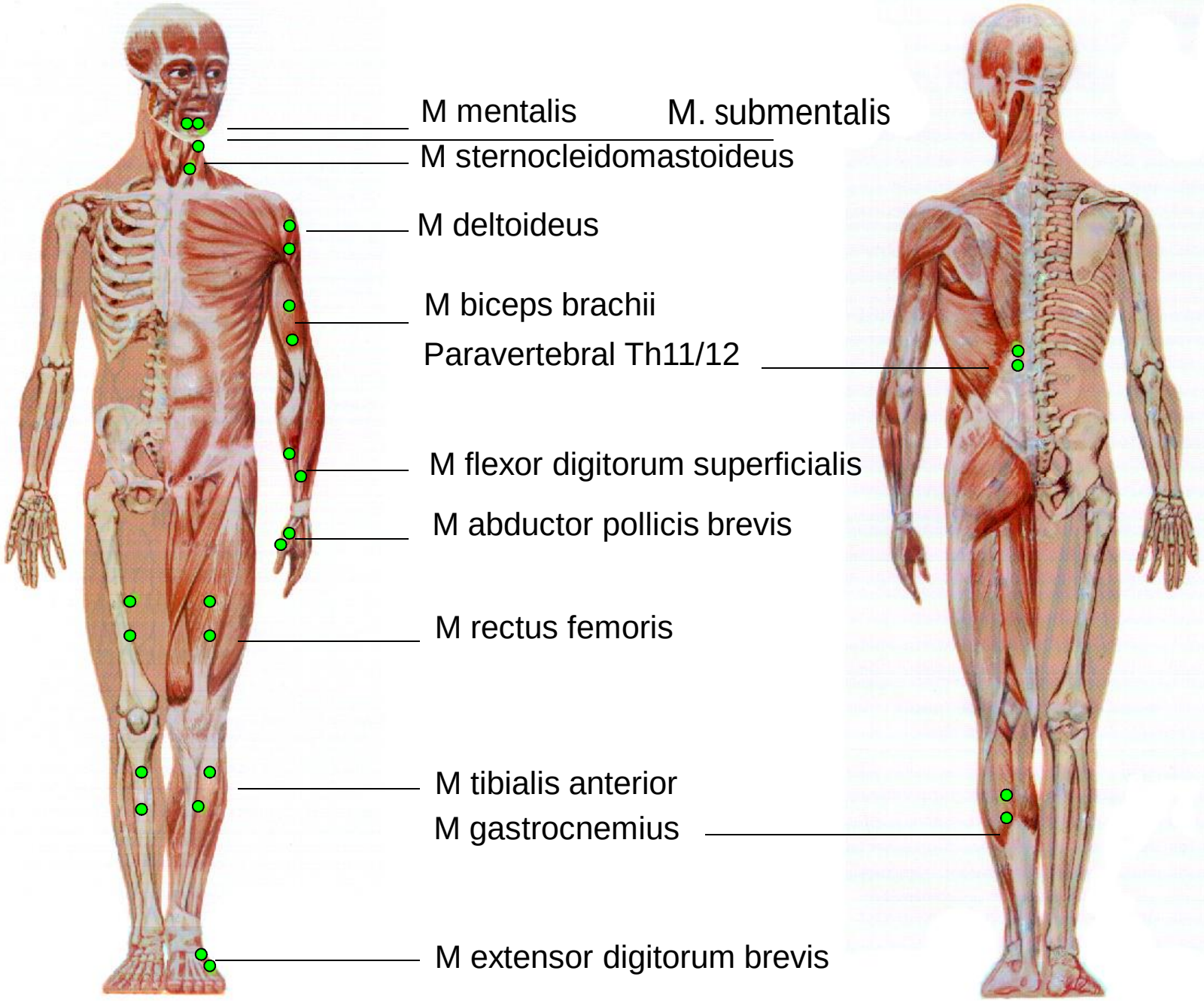
Sleep, In Press

PSG Muscle Analysis

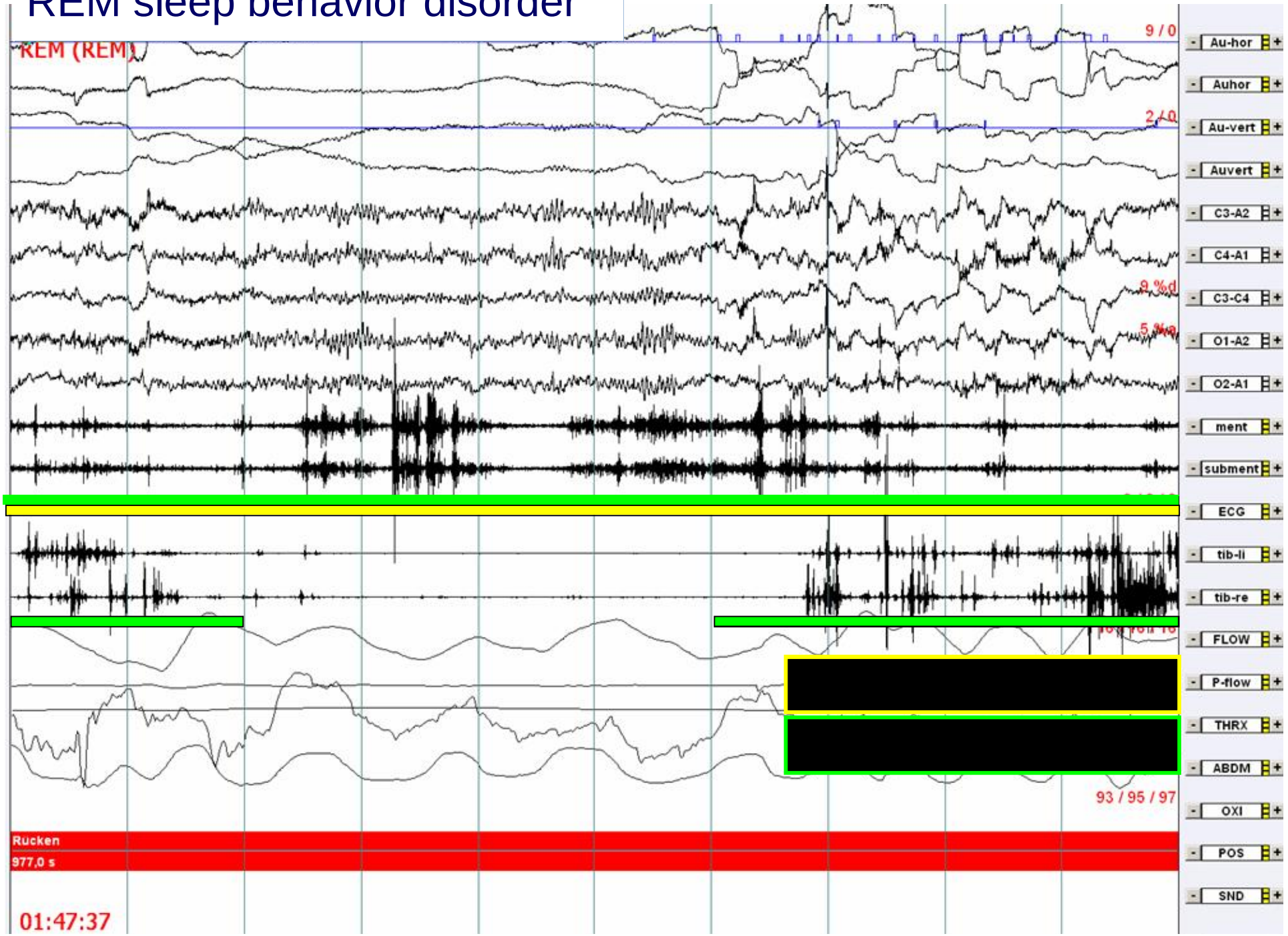
Studies	Muscles which were investigated	Type of muscle activity	Definition of events for analysis		Epoch
			Duration	Amplitude	
Bliwise 2006, 2008, 2010	Mental, biceps, tibialis anterior	"Phasic electromyographic metric" (PEM)	≥ 0.1 s and detectable return to baseline within 2.5 s mini-epoch	> 4x background	2.5 s
Consens 2005	Chin	Phasic Tonic RBD score	0.1 - 5 s 50 % tonic Phasic + tonic score / 2	> 4x background not indicated	3/30 s
Eisensehr 2003	Mental, submental, tibialis anterior	Short-lasting Long lasting	> 10 short-lasting events with a duration between 0.1-5 s > 0.5 s for more than 1 s of epoch	50 % amplitude increase 50 % amplitude increase	10 s
Frauscher 2008	Mental, sternocleidomastoid, deltoid, biceps, flexor dig. sup., abductor pollicis brev, thoracolumbar paraspinal, rectus femoris, gastrocnemius, tibialis anterior, extensor dig. brevis	Phasic	0.1 - 5 s	> 2x background	3 s
Iranzo & Frauscher 2011	Mental, flexor dig. sup., tibialis anterior, extensor dig. brevis	Phasic	0.1 - 5 s	> 2x background	3 s
Lapierre & Montplaisier 1992	Submental	Phasic Tonic	0.1 - 5 s > 50 % tonic EMG	> 4x background not indicated	2/20 s
Montplaisir 2010	Submental, tibialis anterior	Phasic Tonic LMSI	0.1 - 10 s > 50 % tonic EMG 0.1-10 s	> 4x background > 2x background /10 µV > 4x background	2/20 s
Zhang 2008	Chin, extensor forearm, tibialis anterior	Phasic Tonic 0.1-5 s REMREEA	0.1 - 5 s > 50 % tonic % of phasic and tonic MA	> 4x background > 4x background	3/30 s

Table 1. *Summary of scoring methods for quantification of EMG activity during REM sleep*
Legend. s, second; MA muscle activity; dig., digitorum; sup., superficialis; LMSI, leg movement in sleep index; REMREA, REM related EMG activity

Frauscher and Högl, in: Chokroverty, Allen, Walters, Montagna (eds). Sleep and Movement Disorders, 2nd ed. In press


M mentalis
M. submentalis
M sternocleidomastoideus
M deltoideus
M biceps brachii
Paravertebral Th11/12
M flexor digitorum superficialis
M abductor pollicis brevis
M rectus femoris
M tibialis anterior
M gastrocnemius
M extensor digitorum brevis

REM sleep behavior disorder



SLEEP, Vol. 31, No. 5, 2008

REM SLEEP BEHAVIOR DISORDER

Quantification of Electromyographic Activity During REM Sleep in Multiple Muscles in REM Sleep Behavior Disorder

Birgit Frauscher, MD[1]; Alex Iranzo, MD[2]; Birgit Högl, MD[1]; Jordi Casanova-Molla, MD[2]; Manel Salamero, MD[3]; Viola Gschliesser, MD[1]; Eduardo Tolosa, MD[2]; Werner Poewe, MD[1]; Joan Santamaria, MD[2] for the SINBAR (Sleep Innsbruck Barcelona) group

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Aim: To determine which muscle or combination of muscles (either axial or limb muscles, lower or upper limb

Sleep Medicine 12 (2011) 284–288

Contents lists available at ScienceDirect

Sleep Medicine

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

Original Article

Usefulness of the SINBAR electromyographic montage to detect the motor and vocal manifestations occurring in REM sleep behavior disorder

Alex Iranzo [a,1], Birgit Frauscher [b,1], Helena Santos [a], Viola Gschliesser [b], Luca Ratti [a], Tina Falkenstetter [b], Caroline Stürner [b], Manel Salamero [c], Eduardo Tolosa [a], Werner Poewe [b], Joan Santamaria [a], Birgit Högl [b,*], for the SINBAR (Sleep Innsbruck Barcelona) Group

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NORMATIVE REM SLEEP EMG VALUES FOR THE DIAGNOSIS OF RBD

http://dx.doi.org/10.5665/xxxxxxxxxxxxxxx

Normative EMG Values during REM Sleep for the Diagnosis of REM Sleep Behavior Disorder

Birgit Frauscher, MD*[1]; Alex Iranzo, MD*[2]; Carles Gaig, MD[2]; Viola Gschliesser, MD[1]; Marc Guaita, MD[2]; Verena Raffelseder, MD[1]; Laura Ehrmann, MD[1]; Nuria Sola, MD[2]; Manel Salamero, PhD[3]; Eduardo Tolosa, MD[2]; Werner Poewe, MD[1]; Joan Santamaria, MD[2]; Birgit Högl, MD[1] for the SINBAR (Sleep Innsbruck Barcelona) Group

*Drs Frauscher and Iranzo contributed equally to this work.

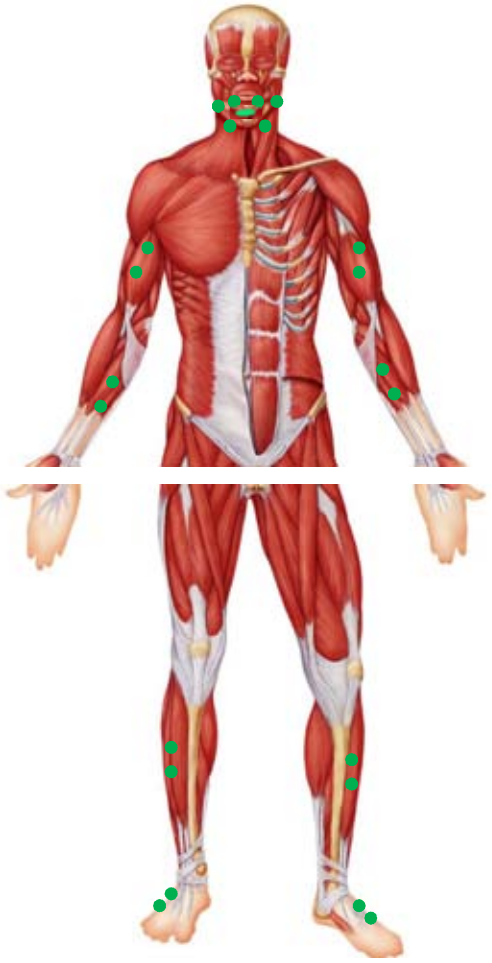
Sleep, Vol. 35, No. 6, 2012

Patients and methods:

30 RBD patients (15 idiopathic, 15 RBD with Parkinson disease)])
30 matched control patients (recruited from patients with effectively treated sleep related breathing disorders) .

Surface EMG from 11 different body muscles

Analysis in 3 and 30 second epochs:
Tonic, phasic and any muscle acitivity



Normative EMG Values during REM Sleep for the Diagnosis of REM Sleep Behavior Disorder

Methods

Analysis of EMG Activity

Tonic

Scored only in the mentalis channel using 30-sec epochs.
Epoch scored as “tonic” when

increased sustained EMG activity was present in more than 50% of the total 30-sec with amplitude of at least twice the background EMG muscle tone or > 10 ?V.

Phasic

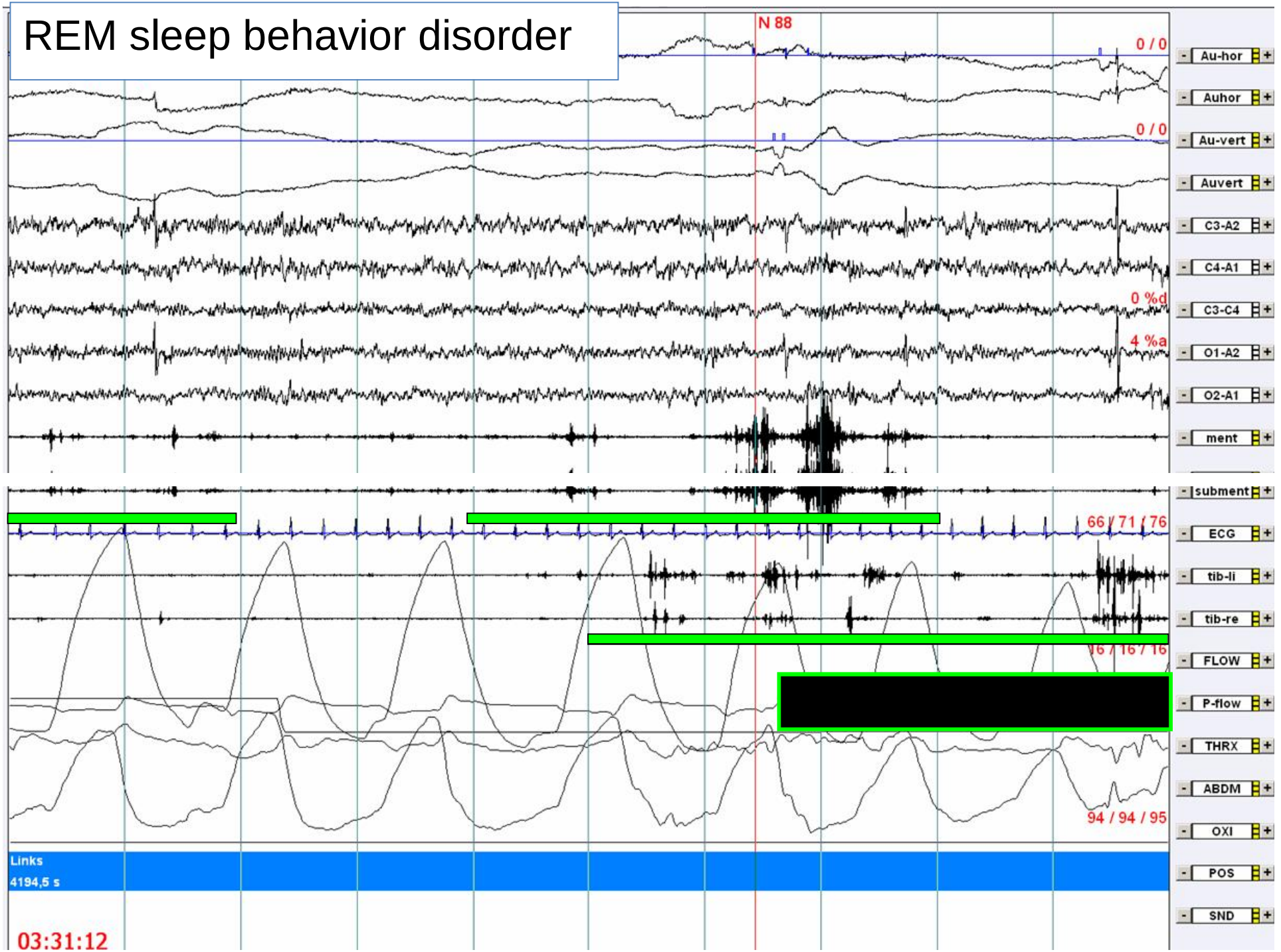
Epoch divided into 3-sec miniepochs.
Phasic EMG activity defined as any burst of EMG activity lasting between 0.1 and 5.0 sec with an amplitude exceeding twice the background EMG activity irrespective of its morphology.
Each 3-sec miniepoch was scored as having or not having “phasic” EMG activity.

``Any``

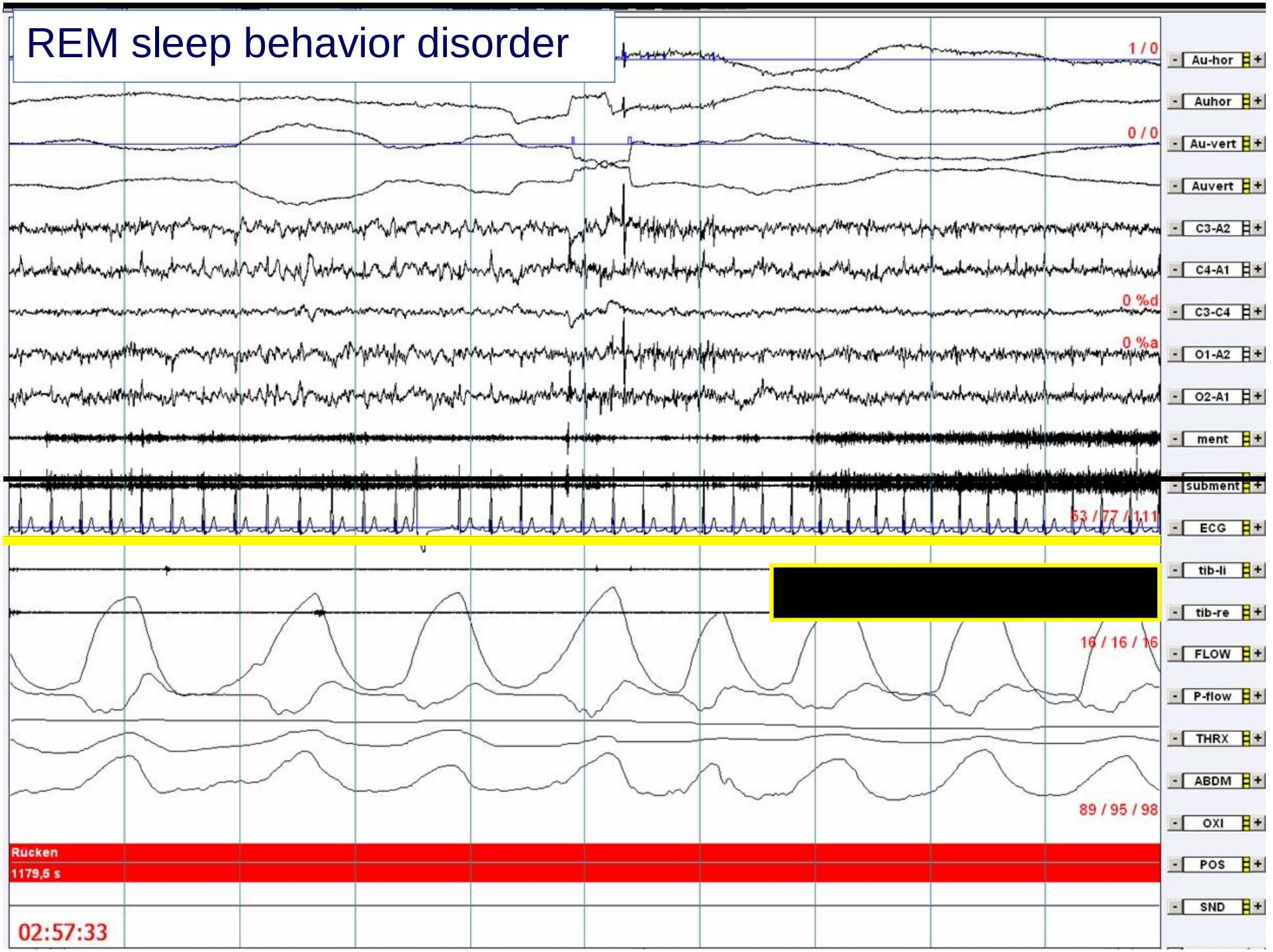
To simplify and to include periods of phasic EMG activity between 5 and 15 sec, each 3-sec miniepoch as having or not having “any” EMG activity, irrespective of whether it contained tonic, phasic, or a combination of both EMG activities.

Frauscher, Iranzo and the SINBAR group Sleep (2012)

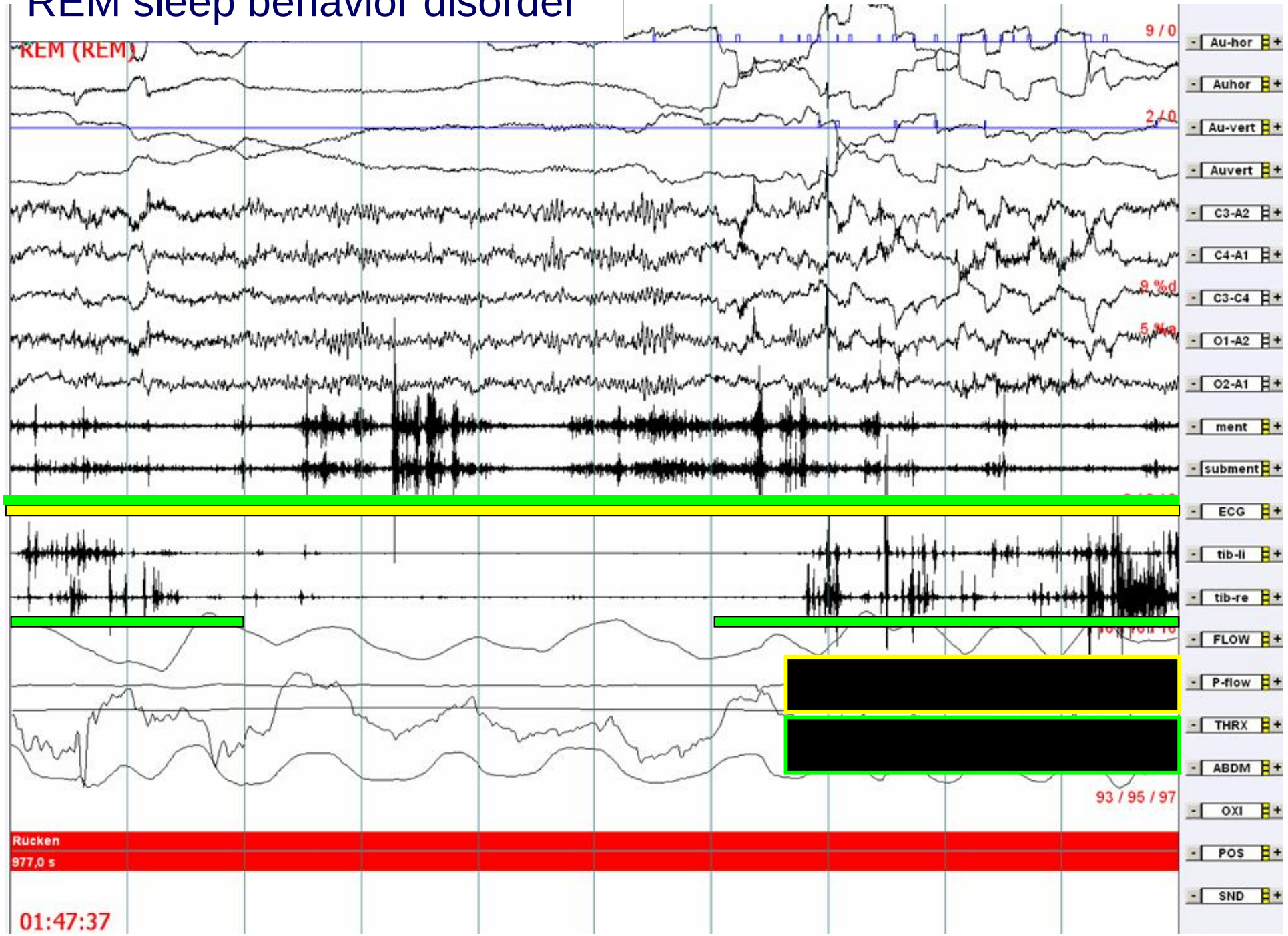
REM sleep behavior disorder



REM sleep behavior disorder



REM sleep behavior disorder



Normative EMG Values during REM Sleep for the Diagnosis of REM Sleep Behavior Disorder

Results (V)

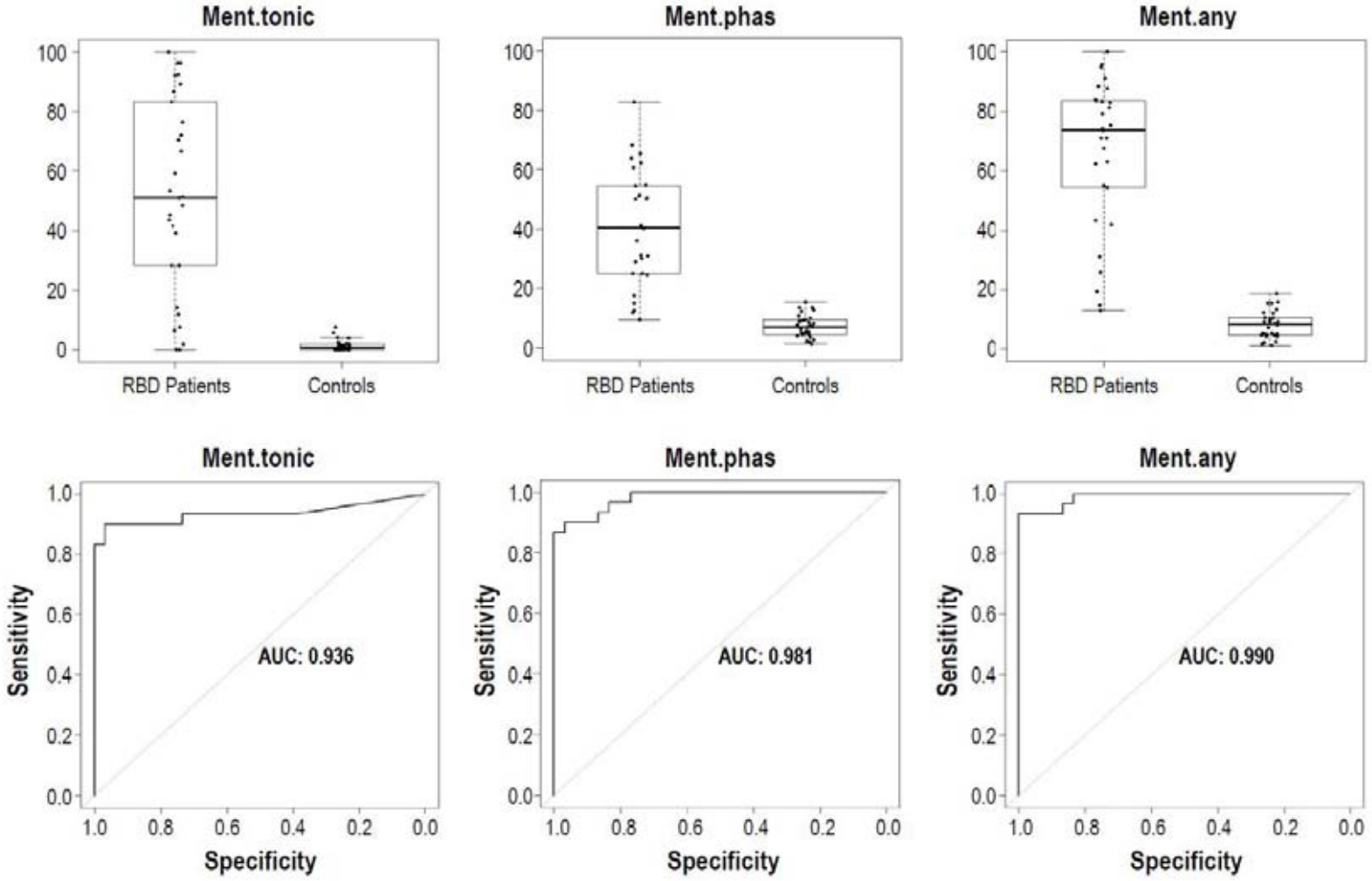
Rates of 3-sec miniepochs with phasic and “any” EMG activity

	Phasic EMG activity		``Any`` EMG activity	
	RBD patients (n=30)	Controls (n=30)	RBD patients (n=30)	Controls (n=30)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Ment	40.9 ± 19.0	7.3 ± 3.7	66.5 ± 25.2	8.4 ± 4.6
L Ster	14.3 ± 9.7	1.1 ± 1.0	41.7 ± 30.7	1.3 ± 1.2
R Ster	13.6 ± 9.3	1.4 ± 2.5	42.2 ± 31.0	1.8 ± 2.9
L Bic	13.1 ± 8.8	0.5 ± 0.5	17.2 ± 13.7	0.6 ± 0.5
R Bic	13.6 ± 11.4	0.5 ± 0.5	18.0 ± 16.2	0.5 ± 0.5
L FDS	19.8 ± 10.2	2.4 ± 2.4	23.1 ± 14.3	2.5 ± 2.4
R FDS	18.9 ± 8.7	2.2 ± 1.7	22.1 ± 11.3	2.3 ± 1.8
L AT	19.1 ± 11.8	6.8 ± 5.2	19.6 ± 12.2	6.8 ± 5.2
R AT	19.1 ± 12.1	6.9 ± 5.3	19.9 ± 13.2	6.9 ± 5.3
L EDR	17.5 ± 13.5	6.1 ± 3.9	18.1 ± 14.3	6.1 ± 3.8
R EDB	18.9 ± 13.3	6.6 ± 5.0	19.4 ± 14.0	6.7 ± 5.0

Frauscher; Iranzo SINBAR. Sleep (2012)

Normative EMG Values during REM Sleep for the Diagnosis of REM Sleep Behavior Disorder

Results (VI)

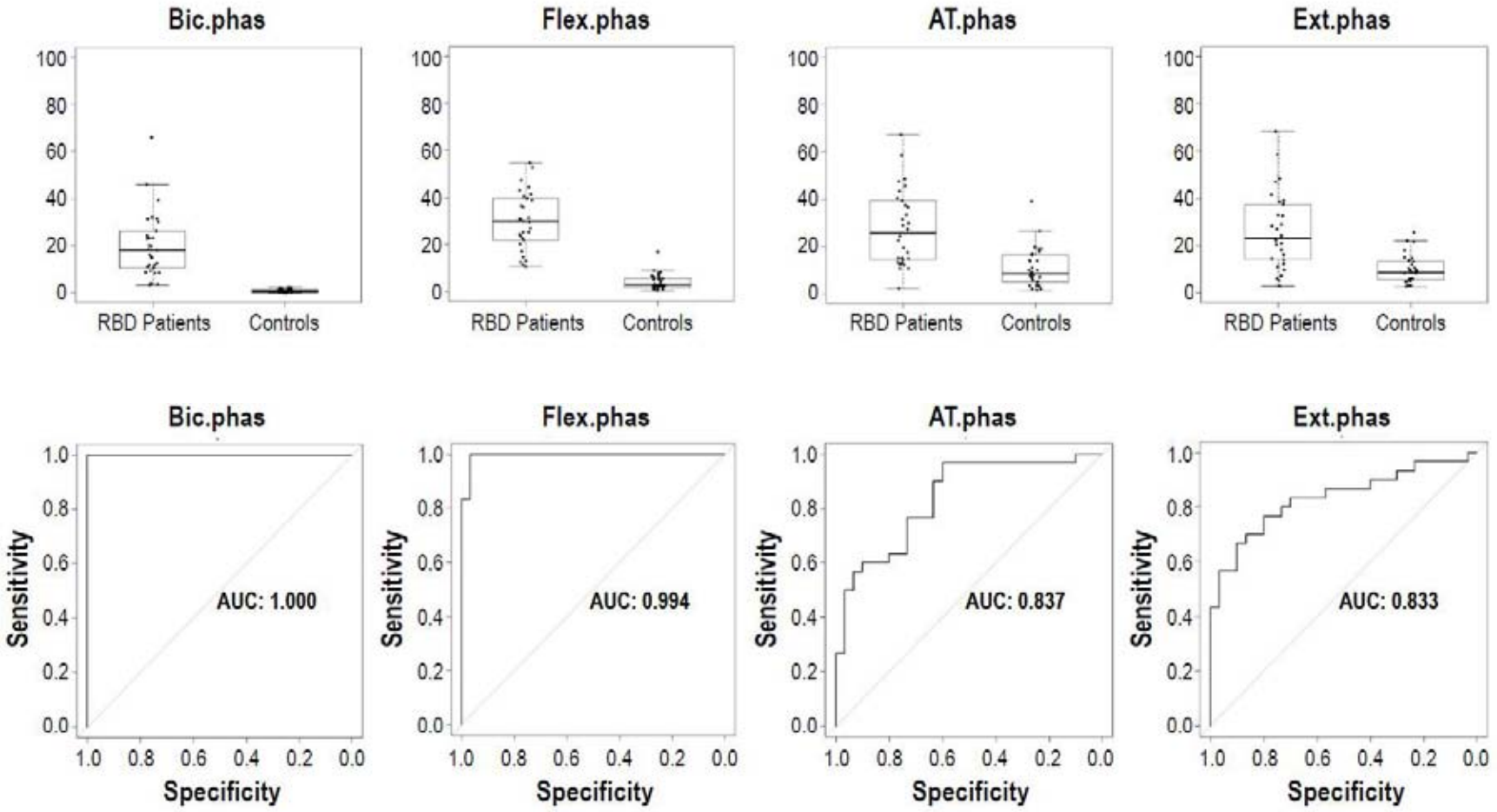


Boxplot representation of the percentages of different types of mentalis muscle EMG activity (tonic, phasic, “any”) measured in 3-sec miniepochs in patients with RBD and controls.

Frauscher et al. Sleep (2012)

Normative EMG Values during REM Sleep for the Diagnosis of REM Sleep Behavior Disorder

Results (VII)



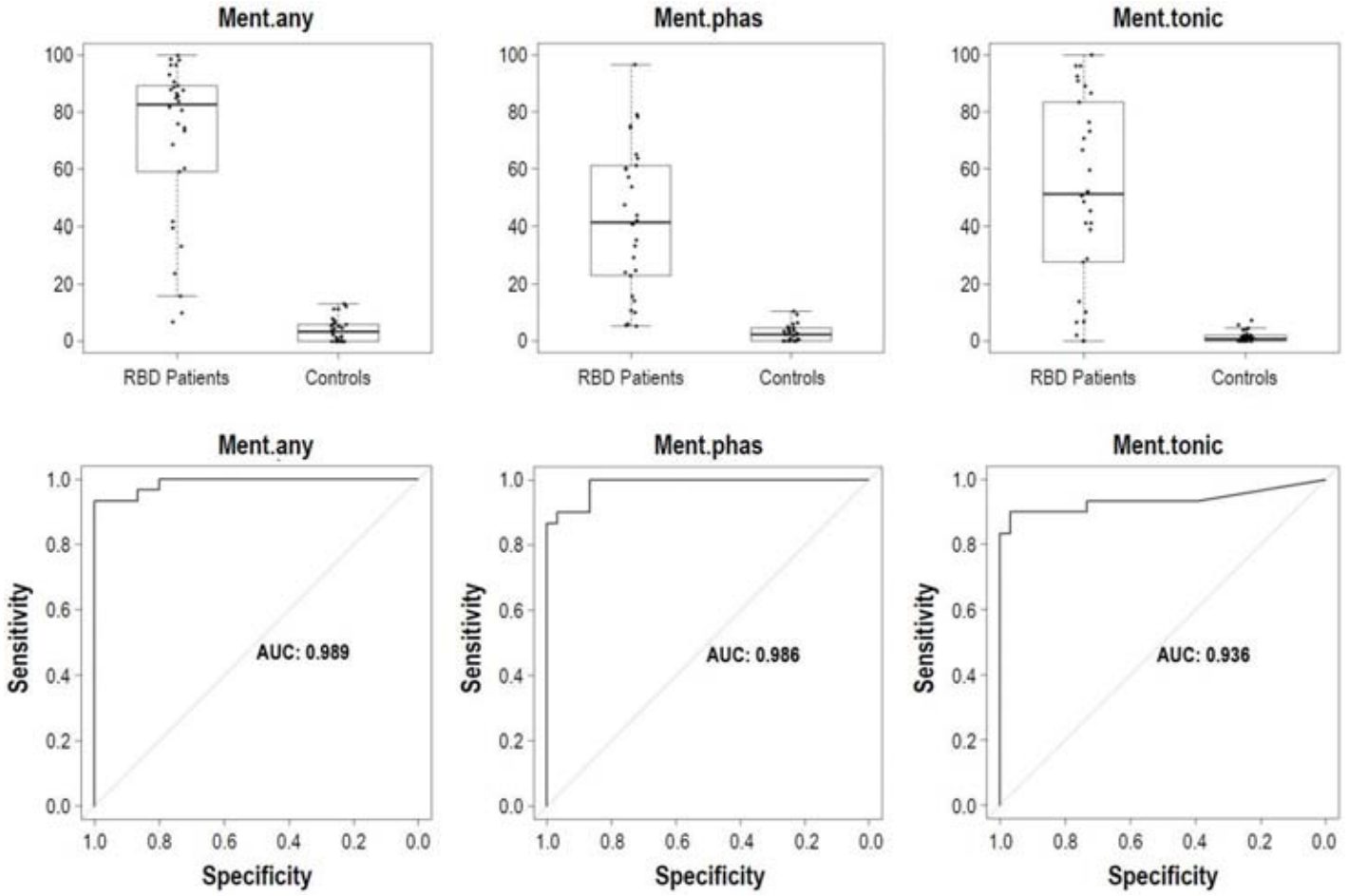
Boxplot representation of the percentages of different types of phasic EMG activity measured in 3-sec miniepochs in the 4 bilateral limb muscles of the upper and lower limbs in patients with RBD and controls, and corresponding receiver operating characteristic curves. All muscles were evaluated bilaterally.

Frauscher et al. Sleep (2012)

Normative EMG Values during REM Sleep for the Diagnosis of REM Sleep Behavior Disorder

Results (XII)

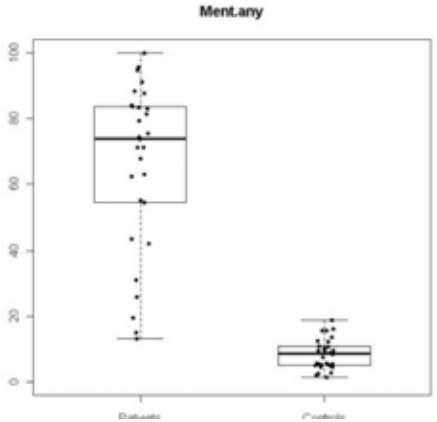
3 or 30-sec analyses ?

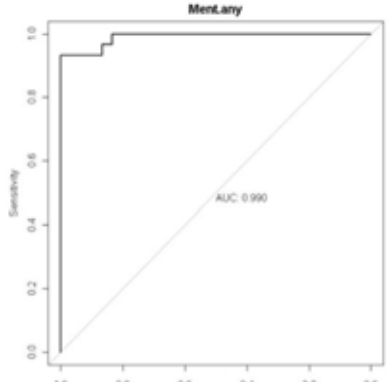


Boxplot representation and the corresponding receiver operating characteristic curves of the mentalis muscle EMG activity values measured in 30-sec epochs.

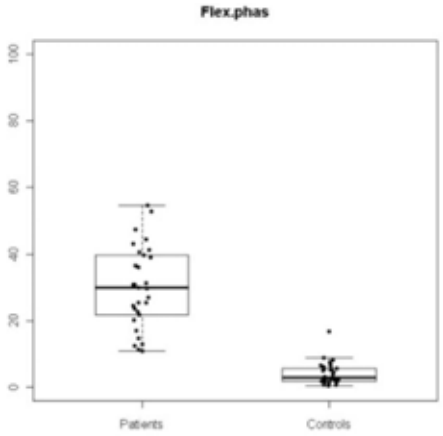
SINBAR Sleep (2012)

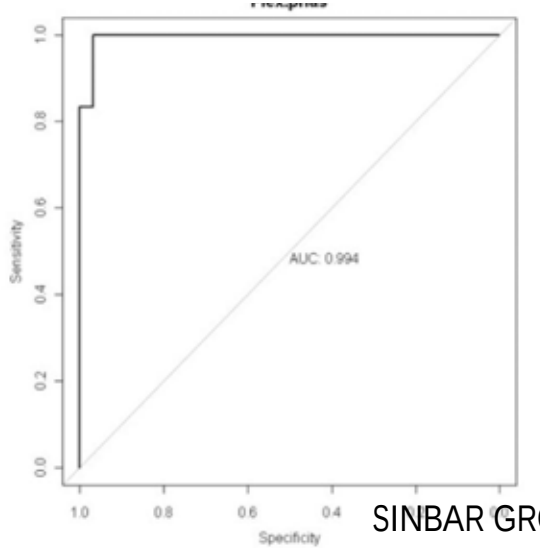
Quantitative diagnosis of RBD: Cutoff to discriminate RBD and controls





SINBAR EMG cut-off (Mentalis, FDS Flexor digitorum superficialis muscles l+r): 32% (AUC 0.998)





SINBAR GROUP 2012

Next steps?

Automatic detection of RBD

- First algorithms for automatic detection of RBD have been developed
- Many consider mental EMG signal only
- High quality recording and skillful manual artifact clearance essential

Night-to-Night Variability of Automatic Quantitative Parameters of the Chin EMG Amplitude (Atonia Index) in REM Sleep Behavior Disorder

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Study Objective:

§ To analyze the night-to-night variability of REM sleep electromyographic (EMG) features of REM sleep behavior disorder (RBD) by using the automatic quantitative method known as ***atonia index*** **(AI)**, and to evaluate the improvement in sensitivity and specificity of AI for the diagnosis of RBD when a second recording night is available.

Methods:

§ All participants were recruited retrospectively

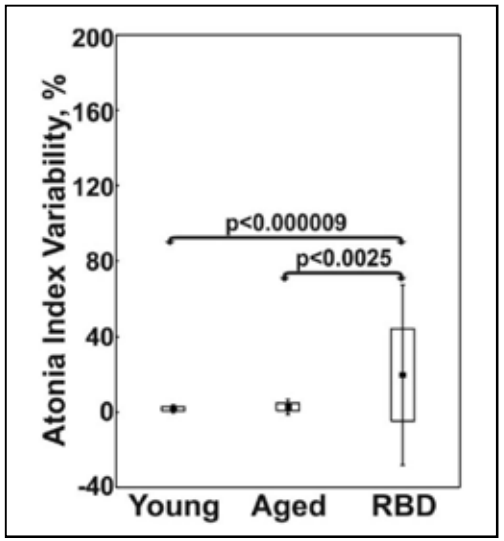
§ 17 iRBD (3 f/14 m) 2 non-consecutive nights (time lag 2.5±1.17 years); all on clonazepam

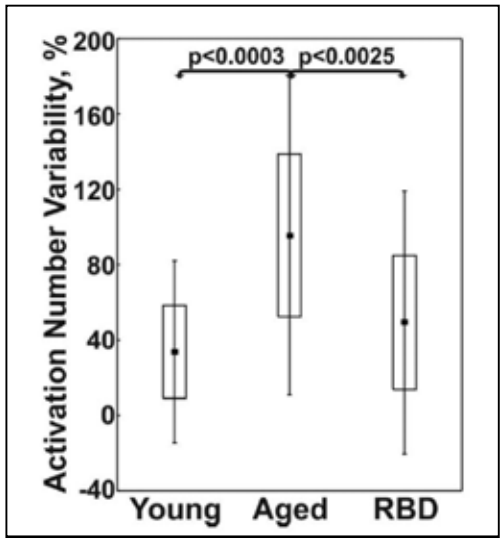
§ 30 normal controls (15 f/ 15 m) 2 consecutive nights:
- <45 years: 16 subjects
- >45 years: 14 subjects

§ Automatic chin EMG analysis: AI; number of chin EMG activations/h

§ Night to night variability quantified as absolute difference between the 2 nights standardized as the percentage of their mean

Results





- Night to night variability of AI higher in iRBD (iRBD vs. Young vs. Aged 19.7% vs. 1,8% vs. 2.8%)
- Variability of chin EMG activations was higher than variability of AI, especially in Aged controls

	AI ≤ 0.9		Sensitivity, %	Specificity, %	PPV, %	NPV, %
	yes	no				
1st night						
iRBD	14	3	82.3	86.7	87.5	80
Aged	2	12				
2nd night						
iRBD	15	2	88.2	92.8	93.7	86.7
Aged	1	13				
Combined nights						
iRBD	16	1	88.9	92.3	94.1	85.7
Aged	2	12				

Sensitivity and Specificity for AI ? 0.9

- **Single night:** Sensitivity 82.3% (minimum); Specificity 86.7% (minimum)
- **Combined night:** Sensitivity 88.9%; Specificity 92.3%

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Conclusion

- Night to night variability of AI is very low in normal controls and < 20 % in iRBD patients
- Sensitivity and Specificity of a threshold value of AI ? 0.9 increases only moderately when a second night is available.

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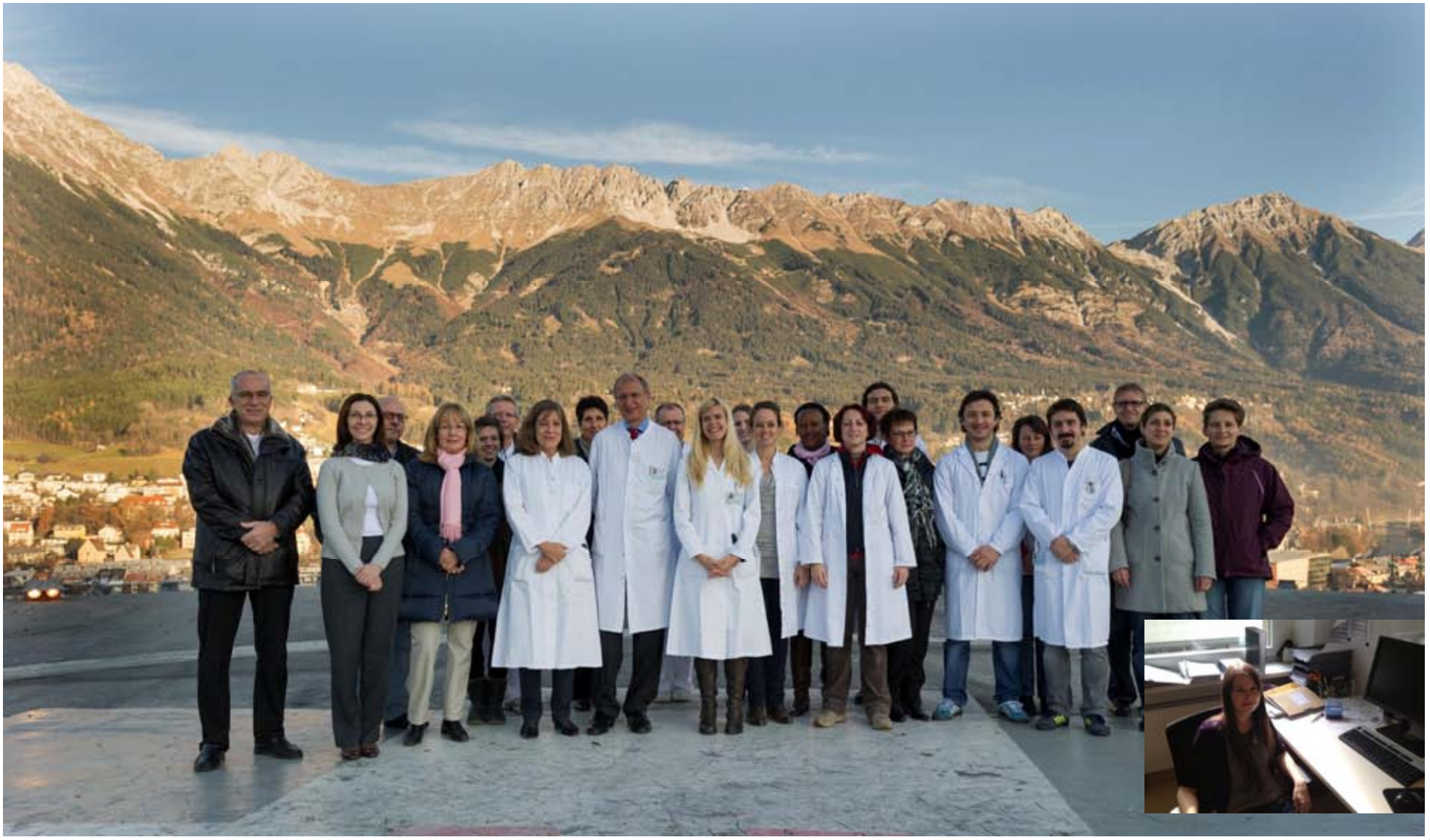
Overview of studies with computer-assisted quantification of REM sleep without atonia

Authors	EMG measure	Definition	Evaluated muscle	Validation	N subjects (patients/controls)
Burns 2005	STREAM	variance of the EMG signal per 3 sec epochs	chin	manual scoring according to Lapierre & Montplaisir: sens 100%, spec 71%	17 / 6
Ferri 2008	REM atonia index	ratio between the percentage of EMG mini epochs with average amplitude ?ƶ1 µV and the total mini epochs	chin	manual scoring according to Lapierre & Montplaisir: high correlation (rho>0.75)	31 / 34
Ferri 2010		index improvement			49 / 35 + 5 OSAS
Frauscher and Högl in preparation	SINBAR	Tonic, phasic, any	Chin, FS	validated against manual scoring	20 / 60
Mayer 2008	Short and long lasting muscle activity	Short: 0.1-0.5 sec Long: > 0.5 sec	chin	not validated against manual scoring	48 / 25
Kempfner 2010	Pattern recognition technique	Advanced signal processing with a statistical classifier	chin	validated against STREAM: sens 100 %, spec 100 %	6 / 6

Legend: STREAM, supra-threshold REM EMG activity metric; sens, sensitivity; spec, specificity; PD, Parkinson disease; sec, second

Modified from Birgit Frauscher & Birgit Högl
Quality control of RBD diagnosis
in ***Sleep in Parkinson´s Disease. Videnovic A, Högl B (eds.), in preparation***

Thank you for your attention!



References

American Academy of Sleep Medicine. International Classification of Sleep Disorder (ICSD), 2nd ed: Diagnostic and Coding Manual, 2005

Sixel-Döring F, Schweitzer M, Mollenhauer B, et al.Intraindividual variability of REM sleep behavior disorder in Parkinson's disease: a comparative assessment using a new REM sleep behavior disorder severity scale (RBDSS) for clinical routine. J Clin Sleep Med. 2011;7(1):75-80

Postuma RB, Arnulf I, Hogl B, et al. A single-question screen for rapid eye movement sleep behavior disorder: a multicenter validation study. Mov. Disord. 2012;27(7):913-6

Frauscher B, Iranzo A, Gaig C, et al.Normative EMG values during REM sleep for the diagnosis of REM sleep behavior disorder. Sleep 2012;35(6):835-47

Stiasny-Kolster K, Mayer G, Schäfer S, et al. The REM sleep behavior disorder screening questionnaire – a new diagnostic instrument.Mov Disord. 2007;22(16):2386-93

Li SX, Wing YK, Lam SP, et al. Validation of a new REM sleep behavior disorder questionnaire (RBDQ-HK). Sleep Med. 2010;11(1):43-8

Postuma RB, Arnulf I, Hogl B, et al. A single-question screen for rapid eye movement sleep behavior disorder: a multicenter validation study. Mov Disord. 2012;27(7):913-6

Boeve BF, Molano JR, Ferman TJ, et al. Validation of Mayo sleep Questionnaire to screen for REM sleep behavior disorder in an aging and dementia cohort. Sleep Med. 2011;12(5):445-53

References

Stiasny-Kolster K, Mayer G, Schäfer S, et al. The REM sleep behavior disorder screening questionnaire – a new diagnostic instrument.Mov Disord. 2007;22(16):2386-93

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