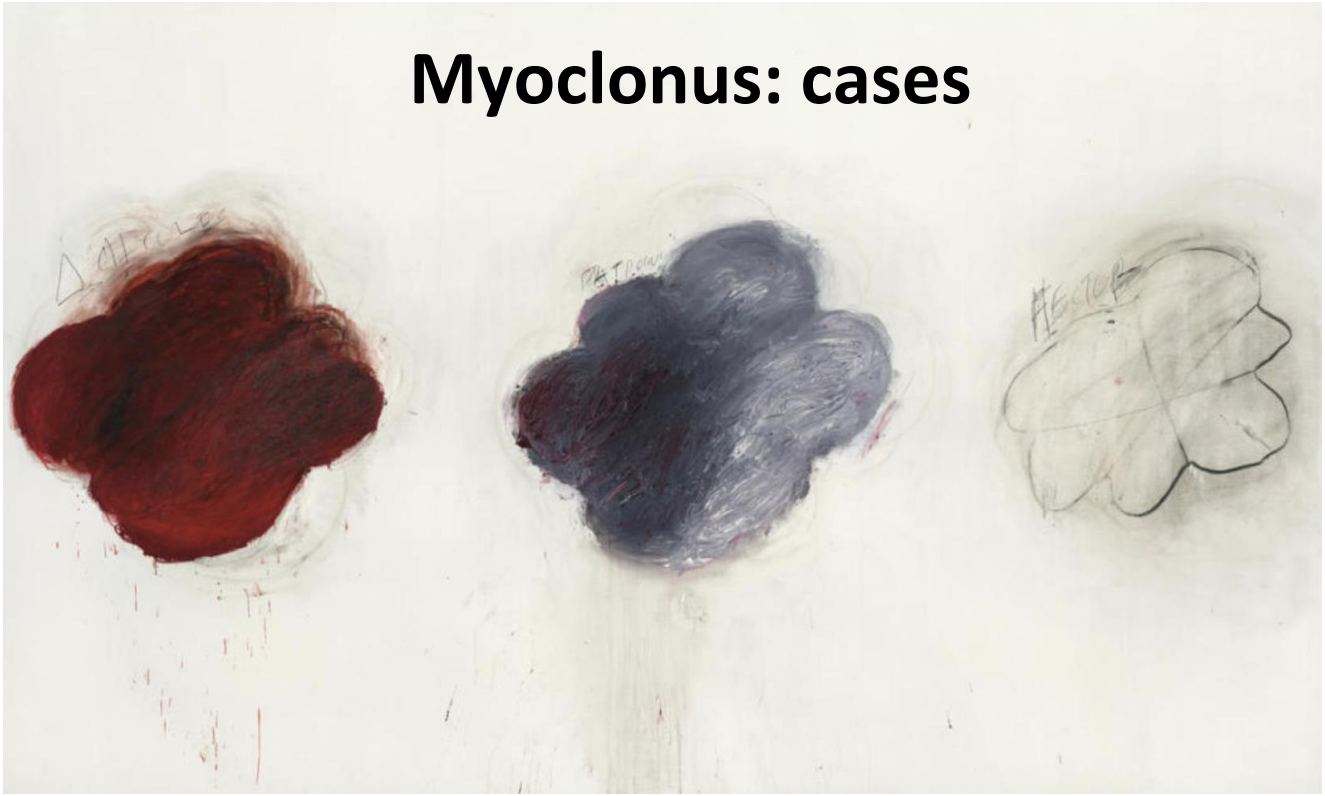
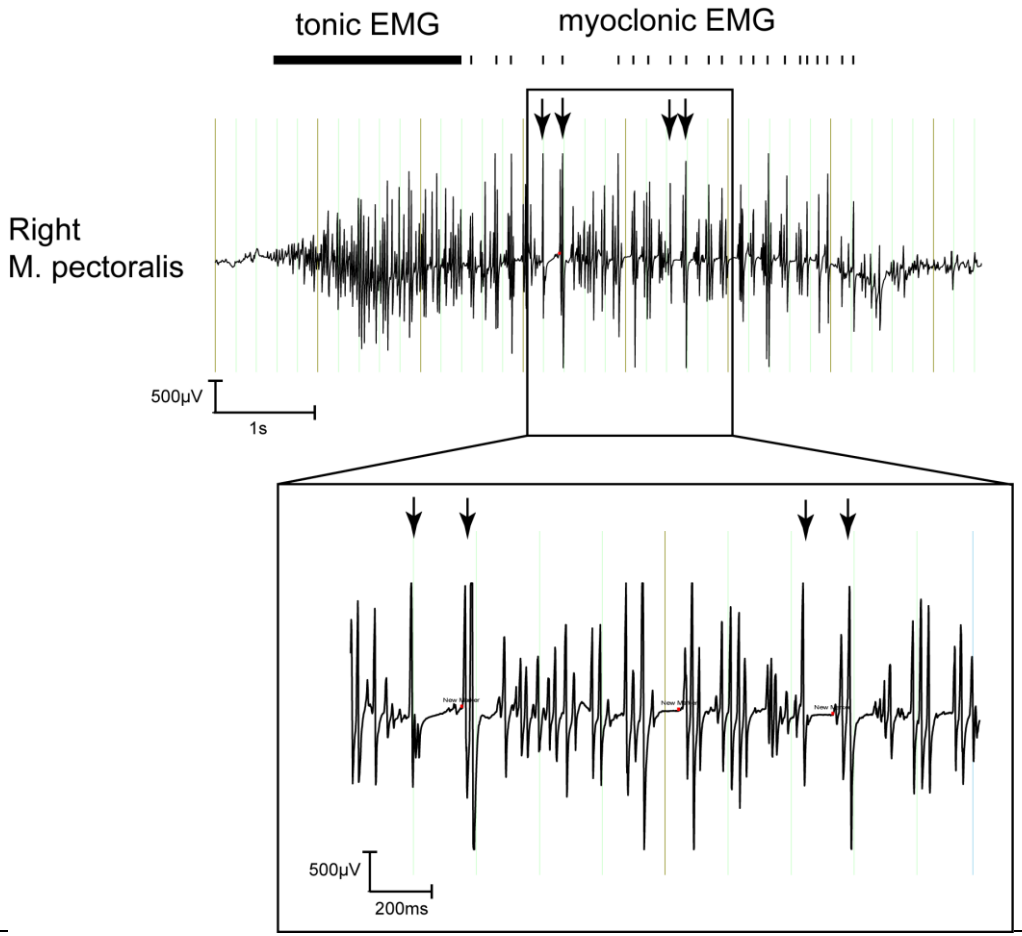
# Myoclonus: cases



Christos Ganos
Wolf Chair in Neurodevelopmental Psychiatry
Associate Professor of Neurology, University of Toronto
Toronto Western Hospital Movement Disorders Centre

- SPEAKER DISCLOSURES
    - Nothing relevant to this talk


tonic EMG
myoclonic EMG
Right
M. pectoralis
500µV
1s
500µV
200ms

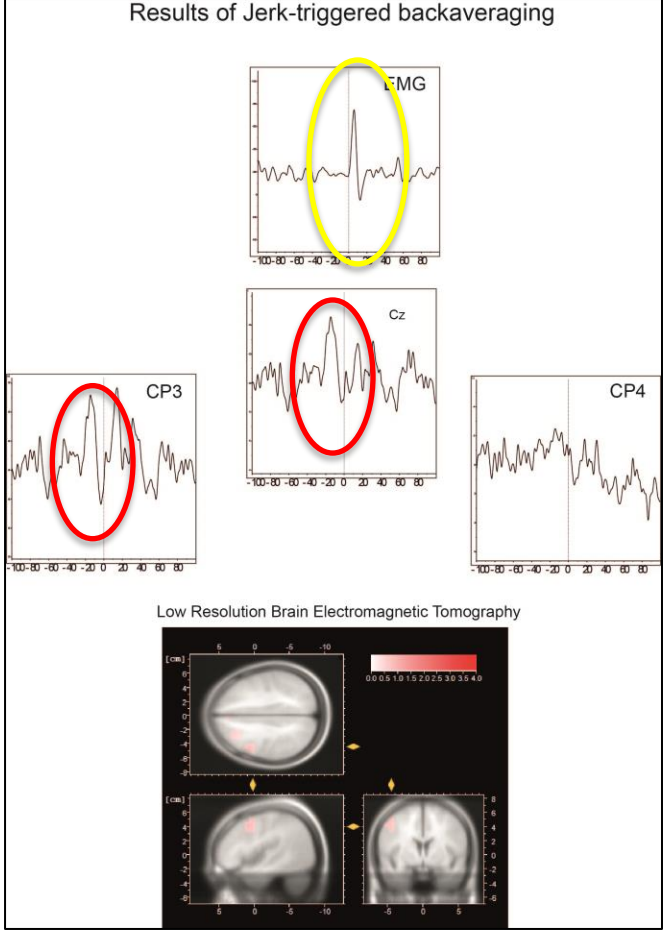
THE SYNDROME OF INTENTION OR ACTION MYOCLONUS AS A SEQUEL TO HYPOXIC ENCEPHALOPATHY[1]

BY

JAMES W. LANCE[2] AND RAYMOND D. ADAMS

*(From the Neurology Service, Massachusetts General Hospital, and the Department of Neurology, Harvard Medical School)*

In summary, the essential clinical picture was that of an **arrhythmic fine or coarse jerking** of a muscle or group of muscles in disorderly fashion,excited mainly by muscular activity, particularly when **a conscious attempt at precision was required,** worsened by emotional arousal, suppressed bybarbiturates, **and superimposed on a mild cerebellar** ataxia. The **parallelism between the degree of myoclonus and cerebellar signs suggests that the mechanisms of the two disorders are closely related....**




PD Christian Moll

Parkinsonism Relat Disord. 1997 Apr;3(2):83-7.

## Familial cortical tremor with epilepsy.

Okuma Y[1], Shimo Y, Hatori K, Hattori T, Tanaka S, Mizuno Y.

**Author information**

1 Department of Internal Medicine (Neurology), Urayasu Hospital of Juntendo University School of Medicine, 2-1-1 Tomioka, Urayasu-city, Chiba 279, Japan.

Mov Disord. 1997 May;12(3):370-7.

## Familial cortical myoclonic tremor as a unique form of cortical reflex myoclonus.

Terada K[1], Ikeda A, Mima T, Kimura M, Nagahama Y, Kamioka Y, Murone I, Kimura J, Shibasaki H.

Mov Disord. 2016 Nov;31(11):1704-1710. doi: 10.1002/mds.26756. Epub 2016 Sep 10.

## Clinical and neurophysiological features of familial cortical myoclonic tremor with epilepsy.

Cen Z[1,2], Huang C[3], Yin H[1], Ding X[1], Xie F[1,4], Lu X[1,5], Ouyang Z[1], Lou Y[1,2], Qiu X[1], Wang Z[1], Xiao J[6], Ding M[1], Luo W[1].

## Expansions of intronic TTTCA and TTTTA repeats in benign adult familial myoclonic epilepsy.

Ishiura H[1], Doi K[2], Mitsui J[1], Yoshimura J[2], Matsukawa MK[1], Fujiyama A[3], Toyoshima Y[4], Kakita A[4], Takahashi H[4], Suzuki Y[2], Sugano S[5], Qu W[2], Ichikawa K[2], Yurino H[6], Higasa K[7], Shibata S[1], Mitsue A[1], Tanaka M[1], Ichikawa Y[8], Takahashi Y[9], Date H[1], Matsukawa T[1], Kanda J[1], Nakamoto FK[1], Higashihara M[10], Abe K[11], Koike R[12], Sasagawa M[13], Kuroha Y[12], Hasegawa N[14], Kanesawa N[15], Kondo T[16], Hitomi T[16,17], Tada M[18], Takano H[19], Saito Y[20], Sanpei K[21], Onodera O[18], Nishizawa M[22], Nakamura M[23], Yasuda T[24], Sakiyama Y[25], Otsuka M[26], Ueki A, Kaida KI[27], Shimizu J[1], Hanajima R[28], Hayashi T[1], Terao Y[29], Inomata-Terada S[1], Hamada M[1], Shirota Y[1], Kubota A[1], Ugawa Y[30], Koh K[31], Takiyama Y[31], Ohsawa-Yoshida N[32], Ishiura S[32,33], Yamasaki R[34], Tamaoka A[35], Akiyama H[36], Otsuki T[37], Sano A[23], Ikeda A[38], Goto J[39], Morishita S[2], Tsuji S[40,41,42].

## Unstable TTTTA/TTTCA expansions in MARCH6 are associated with Familial Adult Myoclonic Epilepsy type 3.

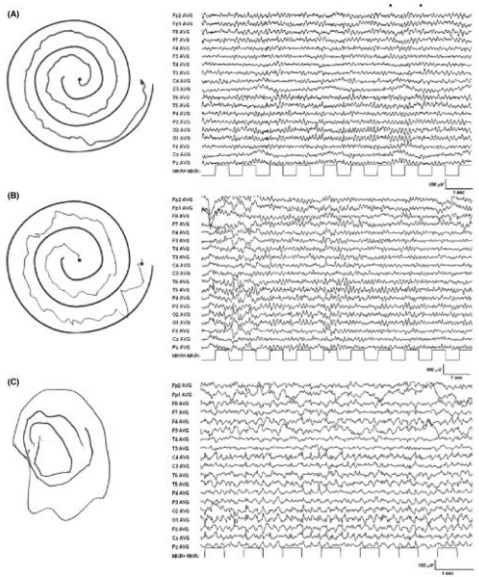
Florian RT[1], Kraft F[2], Leitão E[1], Kaya S[1], Klebe S[3], Magnin E[4], van Rootselaar AF[5], Buratti J[6], Kühnel T[1], Schröder C[1], Giesselmann S[2], Tschernoster N[7], Altmueller J[7], Lamiral A[4], Keren B[6], Nava C[6,8], Bouteiller D[8], Forlani S[8], Jornea L[8], Kubica R[1], Ye T[9], Plassard D[9], Jost B[9], Meyer V[10], Deleuze JF[10], Delpu Y[11], Avarello MDM[11], Vijfhuizen LS[12], Rudolf G[9,13], Hirsch E[13], Kroes T[14], Reif PS[15,16], Rosenow F[15,16], Ganos C[17], Vidailhet M[8,18], Thivard L[18], Mathieu A[19], Bourgeron T[19], Kurth I[2], Rafehi H[20,21,22], Steenpass L[1], Horsthemke B[1]; FAME consortium, LeGuern E[6,8], Klein KM[15,16,23], Labauge P[24], Bennett MF[20,21,22], Bahlo M[20,21], Gecz J[14,25], Corbett MA[14], Tijssen MAJ[26], van den Maagdenberg AMJM[12,27], Depienne C[28,29,30].

## Intronic ATTTC repeat expansions in STARD7 in familial adult myoclonic epilepsy linked to chromosome 2.

Corbett MA[1], Kroes T[1], Veneziano L[2], Bennett MF[3,4,5], Florian R[6], Schneider AL[5], Coppola A[7], Licchetta L[8,9], Franceschetti S[10,11], Suppa A[12,13], Wenger A[14], Mei D[15], Pendziwiat M[16], Kaya S[6], Delledonne M[17], Straussberg R[18,19], Xumerle L[20], Regan B[5], Crompton D[5,21], van Rootselaar AF[22], Correll A[23], Catford R[23], Bisulli F[8,9], Chakraborty S[14], Baldassari S[8], Tinuper P[8,9], Barton K[24], Carswell S[24], Smith M[24,25], Berardelli A[12,13], Carroll R[1], Gardner A[1], Friend KL[23], Blatt I[26], Iacomino M[27], Di Bonaventura C[12], Striano S[28], Buratti J[29], Keren B[29], Nava C[30], Forlani S[30], Rudolf G[31,32,33,34,35], Hirsch E[34], Leguern E[29,30], Labauge P[36], Balestrini S[37,38], Sander JW[37,38], Afawi Z[19], Helbig I[16,39], Ishiura H[40], Tsuji S[40,41,42], Sisodiya SM[37,38], Casari G[43], Sadleir LG[44], van Coller R[45], Tijssen MAJ[46], Klein KM[47,48,49], van den Maagdenberg AMJM[50], Zara F[27], Guerrini R[15], Berkovic SF[5], Pippucci T[51], Canafoglia L[10,11], Bahlo M[3,4], Striano P[52,53], Scheffer IE[5,54], Brancati F[2,55,56], Depienne C[6,31,35], Gecz J[57,58].

# Familial adult myoclonus epilepsy: Clinical findings, disease course, and comorbidities

Beatriz G. Giraldez[1,2] | José M. Serratosa[1,2] | Salvatore Striano[3] | Akio Ikeda[4] | Pasquale Striano[5,6] | Antonietta Coppola[3]



SPECIAL ISSUE ARTICLE

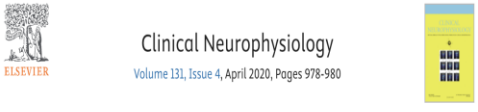
Epilepsia

# Familial adult myoclonus epilepsy: Neurophysiological investigations

Raffaele Dubbioso[1] | Antonio Suppa[2,3] | Marina A. J. Tijssen[4,5] | Akio Ikeda[6]

## 10 | VISUAL EVOKED POTENTIALS

Besides sensory-motor cortex hyperexcitability, FAME/BAFME patients might also display a significant increase of primary visual cortex excitability. The neurophysiological correlate is the significant enlargement of visual evoked potentials (VEPs).[6] In a recent study on BAFME patients carrying the intronic expansions in the *SAMD12* gene,[29] the authors have found giant VEPs as a reliable measure to detect photosensitive myoclonus elicited during flash stimulation.[29] Of interest, in these patients, the authors have observed a clinically overt reflex myoclonus induced by visual stimuli.



ELSEVIER

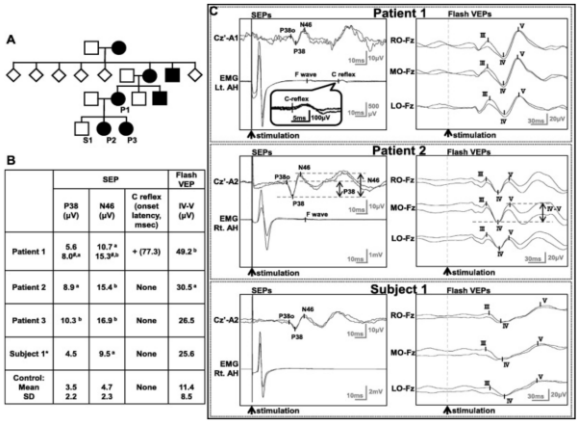
Clinical Neurophysiology

Volume 131, Issue 4, April 2020, Pages 978-980

Letter to the Editor

### Clinical significance of the long-loop reflex and giant evoked potentials in genetically proven benign adult familial myoclonic epilepsy

Ai Demura, Yutaka Demura, Makiko Ota, Takayuki Kondo, Masako Kinoshita




| | SEP | | | Flash VEP |
|---|---|---|---|---|
| | P38 (μV) | N46 (μV) | C reflex (onset latency, msec) | IV-V (μV) |
| Patient 1 | 5.6<br>8.0[A] | 10.7 *<br>15.3[A] | + (77.3) | 49.2 * |
| Patient 2 | 8.9 * | 15.4 * | None | 30.5 * |
| Patient 3 | 10.3 * | 16.9 * | None | 26.5 |
| Subject 1* | 4.5 | 9.5 * | None | 25.6 |
| Control: Mean<br>SD | 3.5<br>2.2 | 4.7<br>2.3 | None | 11.4<br>8.5 |

Parkinsonism Relat Disord. 2014 Mar;20(3):328-31. doi: 10.1016/j.parkreldis.2013.11.011. Epub 2013 Nov 27.

# Dystonia with aphonia, slow horizontal saccades, epilepsy and photic myoclonus: a novel syndrome?

Ganos C[1], Biskup S[2], Krüger S[2], Meyer-Osores A[3], Hodecker S[4], Hagel C[5], Schöls L[6], Bhatia KP[7], Münchau A[8].

## De novo truncating variants in the intronless *IRF2BPL* are responsible for developmental epileptic encephalopathy

F. Tran Mau-Them, MD[1,2], L. Guibaud, MD, PhD[3,4], L. Duplomb, PhD[2], B. Keren, MD, PhD[5], K. Lindstrom, MD[6], I. Marey, MD[5], F. Mochel, MD[5,7,8], M. J. van den Boogaard, MD, PhD[9], R. Oegema, MD, PhD[9], C. Nava, MD, PhD[5], A. Masurel, MD[10], T. Jouan, BS[1,2], F. E. Jansen, MD[11], M. Au, MBE, MS[12], Agnes H. Chen, MD[13], M. Cho, ScM, CGC[14], Y. Duffourd, MsC[2], E. Lozier, MS[15], F. Konovalov, PhD[15], A. Sharkov, MD[15,16], S. Korostelev, MD[15], B. Urteaga, MsC[2], P. Dickson, MD[17], M. Vera, MD, PhD[17], Julián A. Martínez-Agosto, MD, PhD[20], A. Begemann, MD[18], M. Zweier, PhD[18], T. Schmitt-Mechelke, MD[19], A. Rauch, MD[18], C. Philippe, PhD[1,2], K. van Gassen, PhD[9], S. Nelson, MD[20], J. M. GrahamJr, MD, ScD[12], J. Friedman, MD[21], L. Faivre, MD, PhD[2,10], H. J. Lin, MD[17], C. Thauvin-Robinet, MD, PhD[1,10] and A. Vitobello, PhD[1,2]

## *IRF2BPL* Is Associated with Neurological Phenotypes

Paul C. Marcogliese,[1,25] Vandana Shashi,[2,25] Rebecca C. Spillmann,[2] Nicholas Stong,[3] Jill A. Rosenfeld,[1] Mary Kay Koenig,[4] Julián A. Martínez-Agosto,[5,6,7] Matthew Herzog,[5] Agnes H. Chen,[8] Patricia I. Dickson,[8] Henry J. Lin,[8] Moin U. Vera,[8] Noriko Salamon,[9] John M. Graham, Jr.,[6] Damara Ortiz,[10] Elena Infante,[10] Wouter Steyaert,[11] Bart Dermaut,[11] Bruce Poppe,[11] Hyung-Lok Chung,[1] Zhongyuan Zuo,[1] Pei-Tseng Lee,[1] Oguz Kanca,[1] Fan Xia,[1] Yaping Yang,[1] Edward C. Smith,[12] Joan Jasien,[12] Sujay Kansagra,[12] Gail Spiridigliozzi,[13] Mays El-Dairi,[14] Robert Lark,[15] Kacie Riley,[2] Dwight D. Koeberl,[2] Katie Golden-Grant,[16] Program for Undiagnosed Diseases (UD-PrOZA), Undiagnosed Diseases Network, Shinya Yamamoto,[1,17,18,19] Michael F. Wangler,[1,17,18] Ghayda Mirzaa,[20,21] Dimitri Hemelsoet,[22] Brendan Lee,[1] Stanley F. Nelson,[5] David B. Goldstein,[3] Hugo J. Bellen,[1,17,18,19,23,*] and Loren D.M. Pena[2,24,*]

## IRF2BPL mutations cause autosomal dominant dystonia with anarthria, slow saccades and seizures

Christos Ganos [1], Simone Zittel [2], Ute Hidding [2], Claudia Funke [3], Saskia Biskup [3], Kailash P Bhatia [4]

BRIEF COMMUNICATION | Open Access

# *IRF2BPL* as a novel causative gene for progressive myoclonus epilepsy

Elena Gardella, Roberto Michelucci, Hanne M. Christensen, Christina D. Fenger, Chiara Reale, Patrizia Riguzzi, Elena Pasini, Luca Albini-Riccioli, Valentina Papa, Maria Pia Foschini, Giovanna Cenacchi, Francesca Furia, Dragan Marjanovic, Trine B. Hammer, Rikke S. Møller, Guido Rubboli

BRIEF REPORT

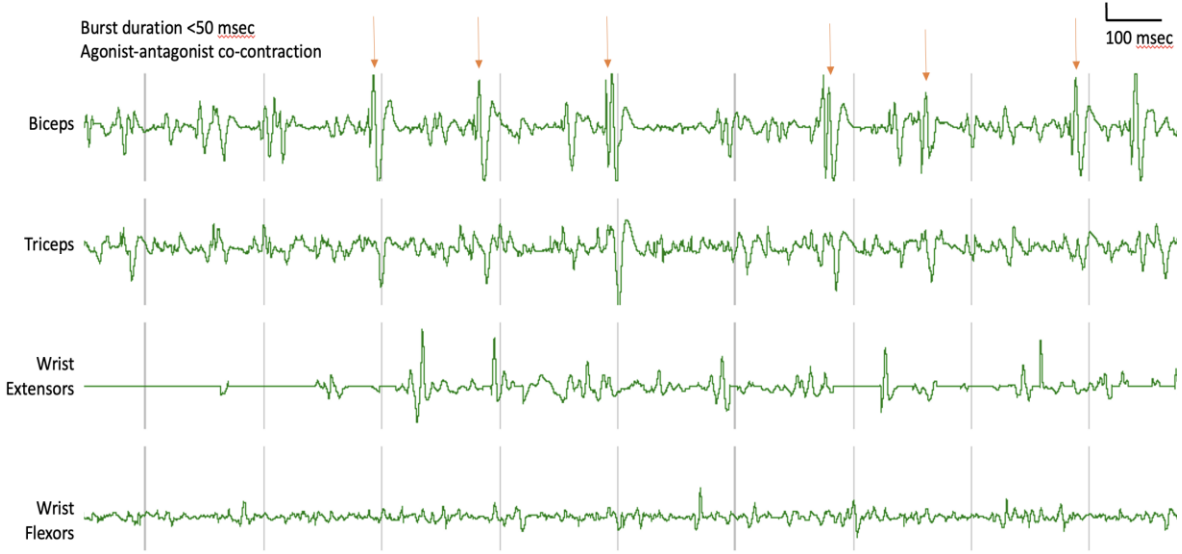
# IRF2BPL-Related Disorder, Causing Neurodevelopmental Disorder with Regression, Abnormal Movements, Loss of Speech and Seizures (NEDAMSS) Is Characterized by Pathology Consistent with DRPLA

> Parkinsonism Relat Disord. 2020 Apr 9;S1353-8020(20)30094-8.
doi: 10.1016/j.parkreldis.2020.03.030. Online ahead of print.

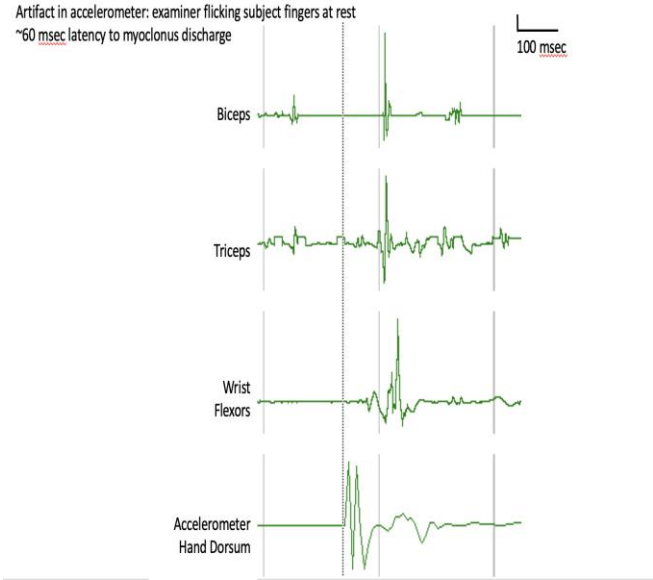
# IRF2BPL Mutation Causes Nigrostriatal Degeneration Presenting With Dystonia, Spasticity and Keratoconus

Lisa Prilop [1], Ralph Buchert [2], Sarah Woerz [3], Christian Gerloff [1], Tobias B Haack [4], Simone Zittel [5]

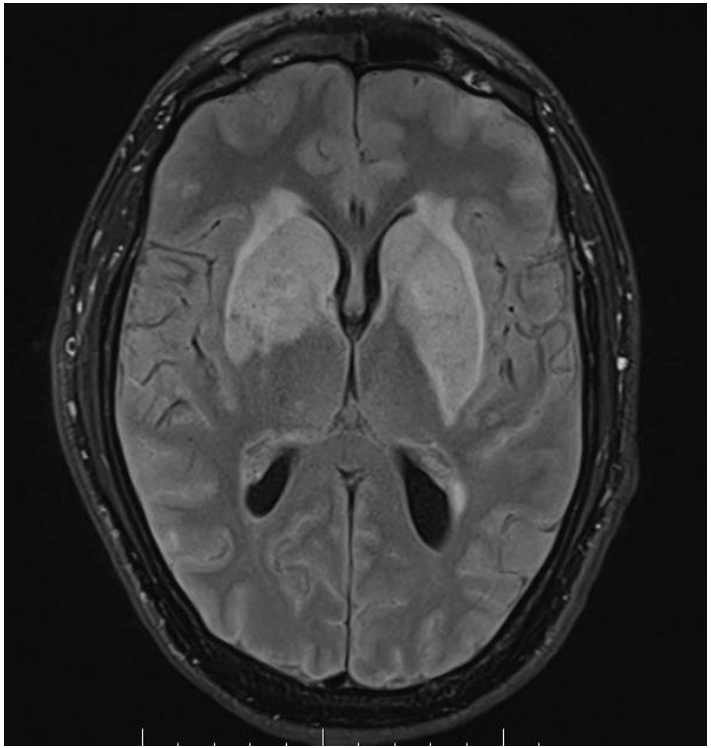
# Myoclonus during postural holding

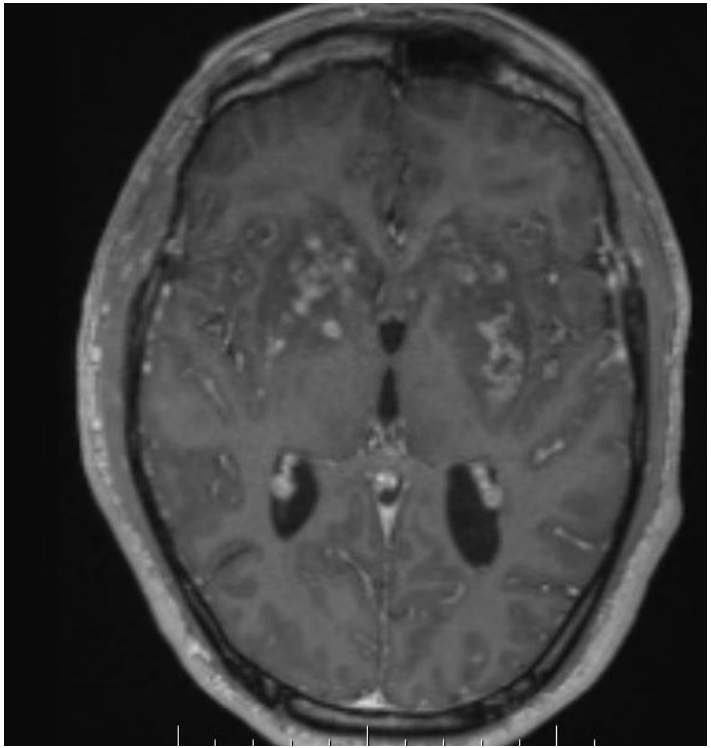



# Myoclonus triggered by tactile stimulus



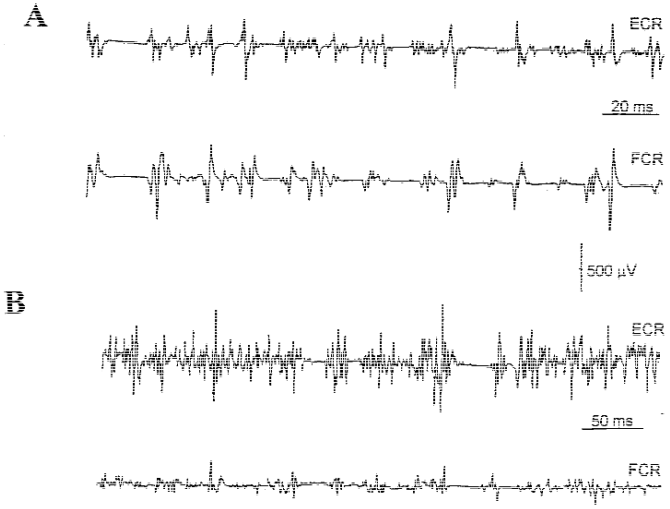
# Cryptococcal Meningoencephalitis

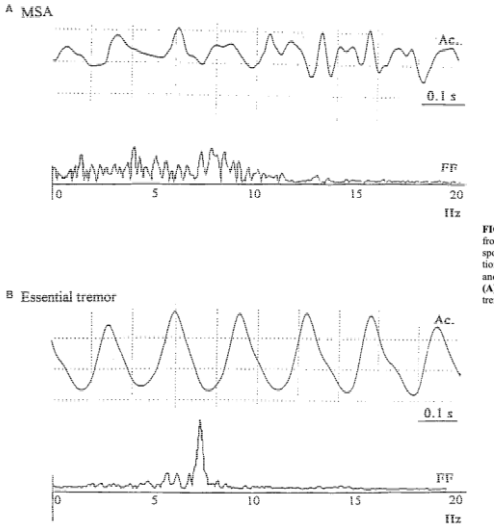




# Postural and Action Myoclonus in Patients With Parkinsonian Type Multiple System Atrophy

Gabriel Salazar, MD, Josep Valls-Solé, MD, Maria J. Martí, MD, Helen Chang, MD, and Eduardo S. Tolosa, MD



Case Series | Free Access

# Stimulus Sensitive Foot Myoclonus: A Clue to Coeliac Disease

Silvia Jesús MD, PhD, Anna Latorre MD, Angel Vinuela MD, Stanley Fahn MD, FAAN, Kailash P. Bhatia FRCP ✉, Bettina Balint MD

Review > Brain. 1995 Oct;118 ( Pt 5):1087-93. doi: 10.1093/brain/118.5.1087.

# Progressive myoclonic ataxia associated with coeliac disease. The myoclonus is of cortical origin, but the pathology is in the cerebellum

K P Bhatia [1], P Brown, R Gregory, G G Lennox, H Manji, P D Thompson, D W Ellison, C D Marsden

# Cortical myoclonus and cerebellar pathology

M.A. J. Tijssen, M. Thom, D.W. Ellison, P. Wilkins, D. Barnes, P.D. Thompson, P. Brown

# The Role of the Cerebellum in the Pathogenesis of Cortical Myoclonus

Christos Ganos, MD,[1,2,3] Panagiotis Kassavetis, MD,[1] Roberto Erro, MD,[1] Mark J. Edwards, MD,[1]
John Rothwell, PhD,[1] and Kailash P. Bhatia, MD, FRCP[1]*

MEDICAL HYPOTHESIS

# Spinal cord α-synuclein deposition associated with myoclonus in patients with MSA-C

UPDATE

# Unravelling the enigma of cortical tremor and other forms of cortical myoclonus

Anna Latorre,[1,2] Lorenzo Rocchi,[1] Francesca Magrinelli,[1,3] Eoin Mulroy,[1] Alfredo Berardelli,[2,4] John C. Rothwell[1] and Kailash P. Bhatia[1]

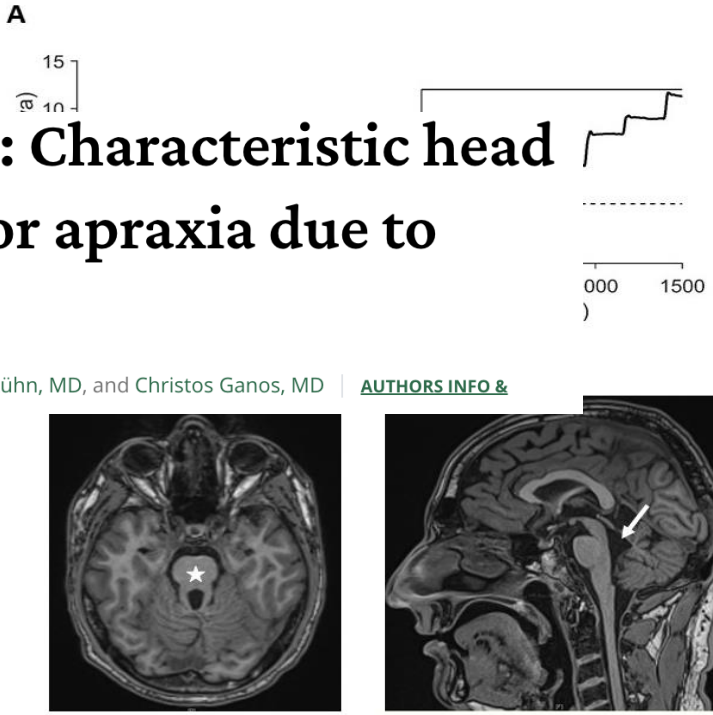
# Myoclonus in SCGE Myoclonus Dystonia syndrome

# What type of jerking is this?

**What type of jerking is this?**

# Teaching Video NeuroImages: Characteristic head jerks in congenital oculomotor apraxia due to Joubert syndrome

Friederike Borngräber, MD, Yangfan Peng, MD, Florian Ostendorf, MD, Andrea A. Kühn, MD, and Christos Ganos, MD | AUTHORS INFO &



# Thank you … !

Medicine
UNIVERSITY OF TORONTO
Neurology

Christos Ganos, Christos.Ganos@uhn.ca
Wolf Chair in Neurodevelopmental Psychiatry
Associate Professor of Neurology, University of Toronto
Toronto Western Hospital Movement Disorders Centre

U of T NEUROLOGY