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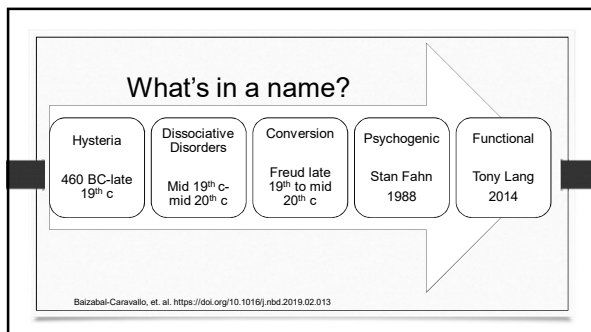
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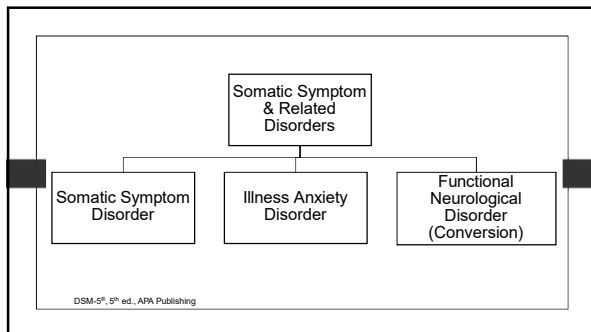
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**Functional Neurological Disorder (FND)**

Clinical motor or sensory symptoms incompatible with recognized neurological or medical conditions

Significant distress

Subtypes

DSM-5®, 5th ed., APA Publishing

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**Functional Neurological Disorder (FND)**

**Incidence: 4-12/100,100**  
**FMD: 4-5/100,000**

**Prevalence: 50/100,000**

**F: 60-75%**

**Peak: 35-50 yr**

**Comorbid Neurological illness: 10%**

**\$256 billion per annum**

Carson & Lehn Handbook of Clinical Neurology, vol 139 (3rd series) Functional Neurologic Disorders, M. Hallett, J. Stone, and A. Carson, Ed.

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ICD 10  
F44.4

**FND**

- Weakness/Paralysis
- Abnormal Movement** (circled)
- Swallowing Symptoms
- Speech Symptoms
- Attacks/Seizures
- Anesthesia/Sensory Loss
- Special Sensory Symptoms
- Mixed symptoms

Functional Movement Disorder (FMD)

DSM-5®, 5th ed., APA Publishing

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### FMD

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- Functional neurological disorder with abnormal movements [not compatible with a known movement disorder]
- Significant distress to warrant treatment
- Phenomenology based diagnosis

DSM-5<sup>®</sup>, 5<sup>th</sup> ed., APA Publishing, Barbey & Aybek *Curr Opin Neurol* 2017, 30:427 – 434

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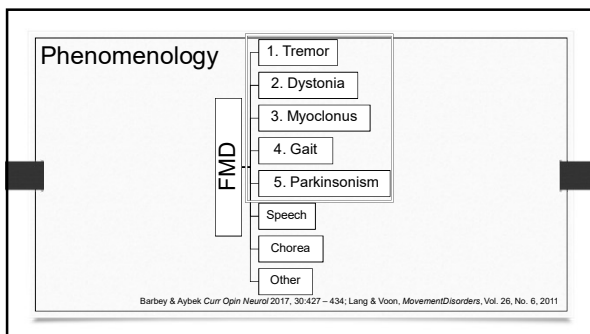
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**Diagnosis of FMD**

Historic clues
• Sudden abrupt onset
• Spontaneous remissions/cures
• Psychiatric comorbidities
• Risk factors (abuse, trauma)
• Psychological stressors
• Other Somatic symptom disorder

Gasca-Salas & Lang, Handbook of Clinical Neurology, vol 139 (3rd series) Functional Neurologic Disorders, M. Hallett, J. Stone, and A. Carson, Ed.

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**Diagnosis of FMD**

Phenomenology	Signs of FMD
Tremor	Distractibility Entrainment Variability in speed & direction Whack a mole sign
Dystonia	Distractible Fixed postures Non-patterned movement
Myoclonus	Slow Nonphysiological triggers Spinal myoclonus with vocalizations Full body jerks

Barbey & Aybek, Curr Opin Neurol 2017, 30:427 – 434

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**Diagnosis of FMD**

Phenomenology	Signs of FMD
Parkinsonism	Easy Exhaustion Active resistance Wide based gait Astasia Abasia
Gait	Uneconomic postures Mixed features Knee buckling Exaggerated compensatory maneuvers
Other	Otherwise normal neurological exam Variability between visits

Barbey & Aybek, Curr Opin Neurol 2017, 30:427 – 434

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### Diagnosis of FMD

Neurological signs
• Verbal gibberish, baby talk, foreign accent, stuttering
• False (give-way) weakness, Hoover sign
• Non-anatomic sensory loss
• Delayed exaggeration when testing reflexes
• Extreme emotionality
• Inconsistency between visits

Gasca-Salas & Lang, Handbook of Clinical Neurology, vol 139 (3rd series) Functional Neurologic Disorders, M. Hallett, J. Stone, and A. Carson, Ed.

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“Off hand, I’d say you’re suffering from an arrow through your head, but just to play it safe, I’m ordering a bunch of tests.”

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### Investigation in FMD

Brain MRI	
Electrophysiology	• EEG-EMG jerk-locked back averaging for Myoclonus • EMG for tremor • EEG
Dopamine transporter scan (DaTscan™)	

Barbey & Aybek, Curr Opin Neurol 2017, 30:427 – 434, Oravittanakul, Mov Dis Clin Prac. doi:10.1002/mdc3.12261

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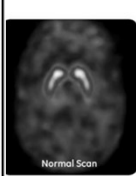
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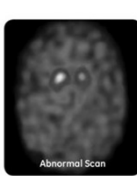
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Normal Scan  
"Comma"-shaped  
Possible essential tremor



Abnormal Scan  
"Period"-shaped  
Possible parkinsonian syndrome

### DaTscan™

- Oravivattanakul, S (2015)
  - Pre scan
    - Functional parkinsonism: 14
  - Post scan
    - Normal scan: 7
    - Abnormal scan: 7

<https://www.gehealthcare.com/products/nuclear-imaging-agents/datscan>; Oravivattanakul, S. *Movement Dis Clin Prac*. doi:10.1002/mdc3.12261

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### Risk factors for FMD

- Higher rates of mood disorder
- Higher rates of (childhood ) trauma
- Modeling behavior
- No clear genetic or epigenetic markers
- Neurophysiological markers: correlation or...  
...causation??
- Overrepresentation of women with FMD

Baizabal-Cavallo, et. al. *Neurobiology of Disease* 127 (2019) 32-44

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### Biopsychosocial hypothesis of FND/FMD

- Multifactorial internal and external stressors:
  - Adverse life events
  - Reduced awareness of and insight into stressor impact
  - Maladaptive learning
  - ?Biological vulnerability
    - ?Hormonal influences

Pick S, et al. *J Neurol Neurosurg Psychiatry* 2019;90:704-711;

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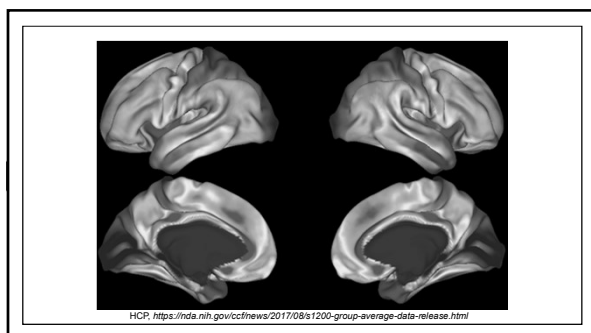
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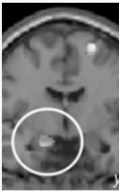
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### Brain fMRI in FMD



Amygdala influences motor output by its connections to the supplemental motor area (SMA) by responding to sensory stimuli

↓

Impaired R Amygdala activity in FMD

↓

Abnormal connection of Amygdala with the SMA in FMD

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As a result, FMD subjects do not recognize abnormal movements as under their control → loss of **self-agency**

Voon, et. al. Brain 2010; 133: 1526–1536

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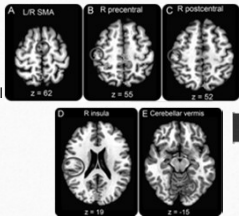
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### fMRI in FMD

- Self-agency: Perception of having control over volitional movements
- R temporoparietal junction (rTPJ) governs self-agency
- rTPJ shows abnormal activity in its connections with other areas of the brain in FMD
- Thus, self-agency is abnormal in FMD



Maurer, et. al. Neurology® 2016;87:564–570

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### FMD: Other experimental studies

Hyperarousal state

Protracted '*intentional binding*' time: abnormal perception of the effect of intentional action (measure of self-agency)

Abnormal *sensory attenuation* of somatosensory cortex potential: leads to the belief abnormal movements are not under volitional control

Abnormal cognitive processing, neural physiology and cerebral volume

Baizabal-Cavallo, et al. *Neurobiology of Disease* 127 (2019) 32-44

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network

Limbic circuits (emotional processing)

FMD

Cortical motor circuits (motor output and control)

Hallett, *Parkinsonism & Related Disorders*, 2019, January, 45(Suppl. 1), S26-S32

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### FMD-QOL

- QOL in FMD impacted as in other movement disorders
- Study of 21 functional v organic dystonia
  - QOL worse in functional than organic dystonia
- Study of 30 functional v idiopathic PD
  - QOL comparable in functional and PD
- FMD unemployed more overall

Gendre, et al. *Journal of Psychosomatic Research* 116 (2019) 10-16

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**Movement Disorders**  
CLINICAL PRACTICE

**How Do I Explain the Diagnosis of Functional Movement Disorder to a Patient?**  
Jim Stone, FRCP FRCP<sup>TM</sup> and Ingrid Hoeritzauer, MD PhD MRCP

*Itz'it Films and Wiley: <https://youtu.be/w4lqr4Mo32M>*

- Messaging
  - Destigmatize the symptoms
  - Listen attentively and compassionately
  - Explain FMD in a scientific manner
  - [www.neurosymbols.org](http://www.neurosymbols.org);
  - <https://fndhope.org>
- Identify comorbidities
- Team-based approach

Stone & Hoeritzauer, *Movement Dis Clin Prac* 2019; 6(5): 419; Hallett, *Parkinsonism Relat Disord* 2018 January; 46(Suppl 1): S80-S82

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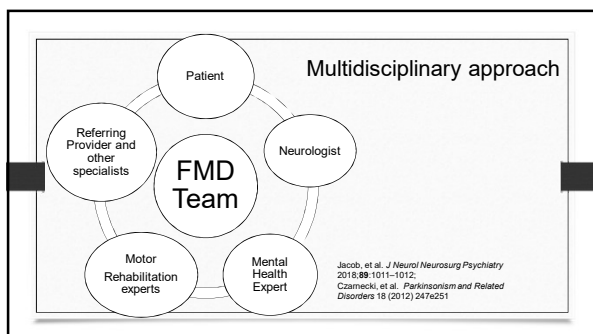
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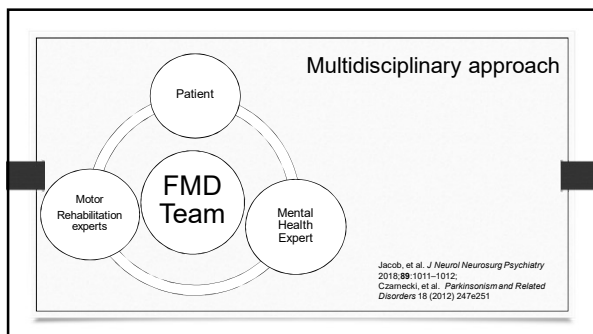
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### Mental Health Counseling (LMHC, Psychologist)

- CBT
  - self-help workbook\*
  - Movement control
  - Mood-cognition-environment triggers
  - Automatic thoughts
  - Somatic misinterpretations
- ? Hypnosis

LaFrance & Friedman Movement Disorders Vol. 24, No. 12, 2009, pp. 1848-1866  
\*Williams & Chelingsworth. CBT: A clinician's guide to using the five areas approach. Hodder Arnold, 1<sup>st</sup> Ed 2010

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### Neurorehabilitation

- Motor retraining
  - Not conventional 'PT, OT, ST'
  - Outpatient or Inpatient (Concomitant with CBT)
  - High rates of success...but outcome measures differ
    - Mayo Clinic, MN: 60 % improvement @ 2 y
    - U of Louisville, KY: 69% @ 6 m

Jacob, et al. J Neurol Neurosurg Psychiatry 2018;89:1011-1012;  
Czarnecki, et al. Parkinsonism and Related Disorders 18 (2012) 247e251

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### Predictors of good outcomes

Female gender

Mood is well treated

Pain is well treated

Accepting of diagnosis, motivated to participate, compliant

Daily Spells (not sporadic spells)

Somatic symptoms don't interfere with treatment

Jacob, et al. J Neurol Neurosurg Psychiatry 2018;89:1011-1012;  
Czarnecki, et al. Parkinsonism and Related Disorders 18 (2012) 247e251

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### 56 y/o RH man

- Chief complaint: Tremor x 2-3 years, difficulty walking
- Myelodysplastic syndrome
- GVH disease from mismatched bone marrow transfer
- Multiple other medical issues and problems
- Lots of stress
- Numerous prior investigations: normal or 'nondiagnostic'

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### 25 y/o RH soldier

- Chief complaint: tongue tremor, difficulty speaking x 1yr
- Had a cold a yr. prior followed by:
  - Gradually developing tongue tremor
  - Throat pain
  - Speech problems
- Prior investigation, Neuroimaging normal

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### Treatment of FMD

- Treatment starts at diagnosis with correct messaging
- Team based approach is critical for successful outcomes
- Comorbidities should be treated effectively
- Resources & Awareness

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Resources & Awareness

- More mental health experts
- Neurorehabilitation experts
- Care coordination
- Educational Programs for patients and providers

**VIEWPOINT** "It's All in Your Head" – Medicine's Silent Epidemic

Burke, M. JAMA Neurology, December 2019  
Volume 76, Number 12

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Thank you!

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