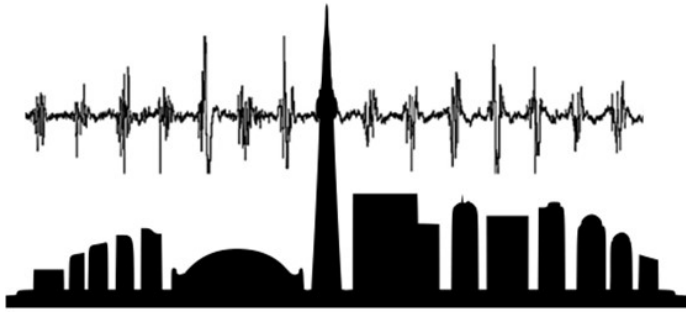


Pan American Movement Disorders Clinical Neurophysiology Course
May 1-3, 2025 | BMO Education & Conference Centre

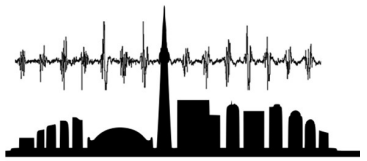
Overview of Basic and Advanced Neurophysiological techniques

Talyta Grippe, MD, PhD

Movement Disorders Centre - Toronto Western Hospital

Faculty/Presenter Disclosure

- **Relationships with commercial interests:**
  - **None**



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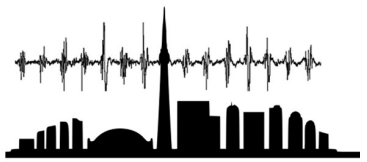
Disclosure of Commercial Support

- This program has received financial support from Abbvie, Ipsen, Natus, Cadwell and Medtronic in the form of sponsorship to support logistic costs.

- Potential for conflict(s) of interest:
  - None

Main Applications

- Evaluate Jerky movement
  - Tremor
  - Myoclonus
  - Categorize Subtypes
  - Tics
  - Dystonia
  - Chorea
- Confirm Functional movement
  - Jerky movement
  - Tremor
- Assess Orthostatic instability
  - Orthostatic tremor
  - Orthostatic myoclonus
- Others
  - Stiff Person spectrum
  - Myorhythmia



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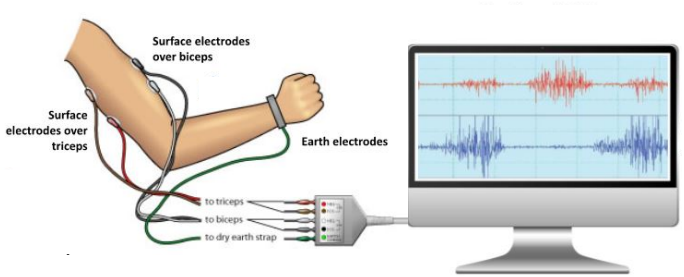
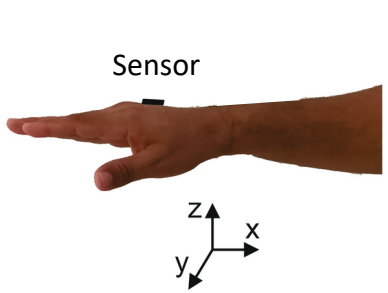
Grippe T, Callister M, Vial F, Shabbir M, Chen R. Clin Neurophys. under review

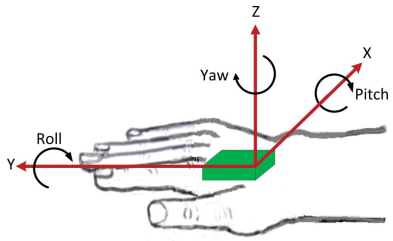
Basic Equipment

Surface EMG



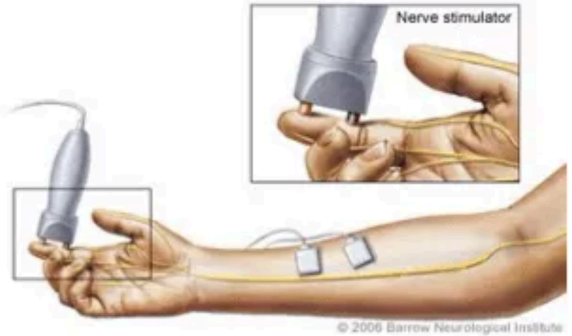
Accelerometer / Goniometer





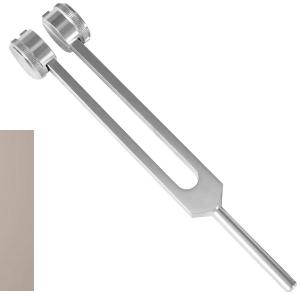
Electroencephalography

Nerve/Electrical stimulation



Camera

Sound, metronome, Tuning fork, Cup, others



Polymyography

- QUESTION: Tremor or myoclonus?

Camera

Surface EMG

Channels - Four to Sixteen

Muscle selection - Agonist/Antagonist, important to include muscles involved in the movement

Sampling rate - 1 - 4kHz

Filter - 20Hz - 250Hz/2.5kHz

Electrodes placement - Longitudinal axis, 2-4 cm apart
Belly - belly, if small muscle belly - tendon (avoid crosstalk)

Accelerometer

Triaxal vs. Uniaxial

Placement - Most affected body part, bone structure

Sampling rate - minimal 100Hz

Filter - 2 - 30Hz

Not equivalent to amplitude

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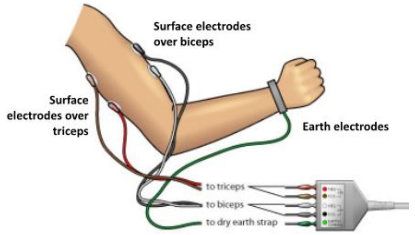
Vial F et. al. Clin Neurophysiol Pract. 2019
Chen KS et al. J Mov Disord. 2020

Polymyography

- QUESTION: Tremor or myoclonus?

Surface EMG



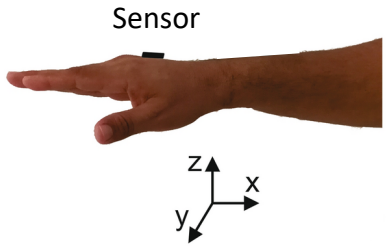
Channels (4 - 16)

Electrodes placement

Muscle selection

Sampling rate and Filter

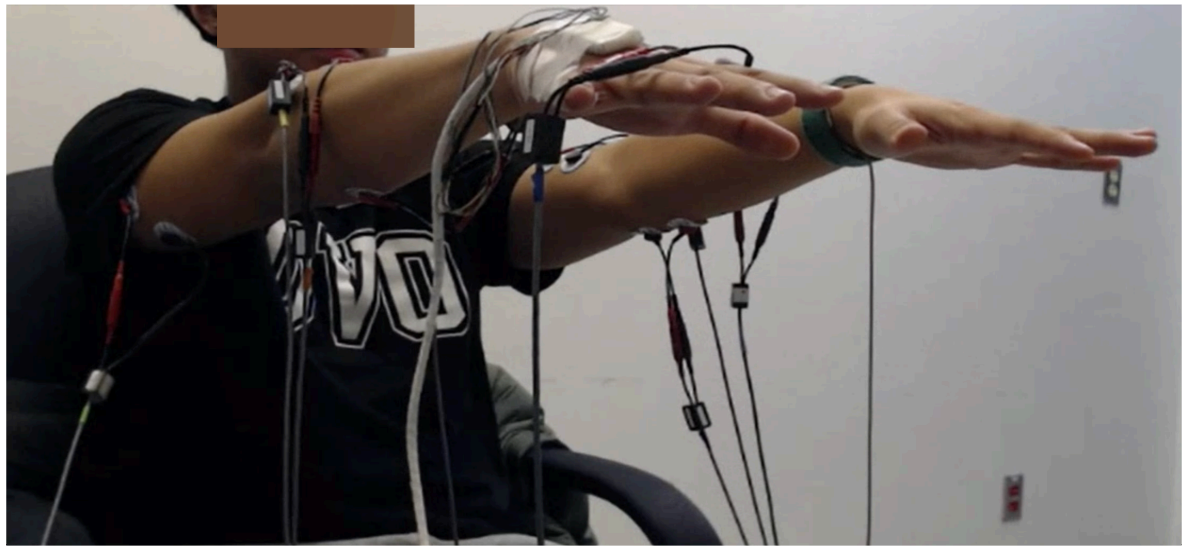
Accelerometer

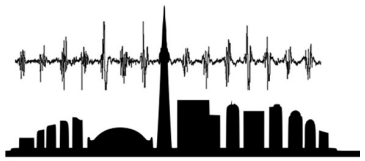


Triaxal vs. Uniaxial

Placement

Not equivalent to amplitude





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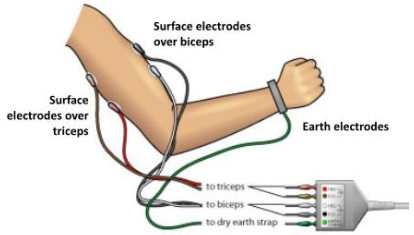
Polymyography

- QUESTION: Tremor or myoclonus?

Surface EMG



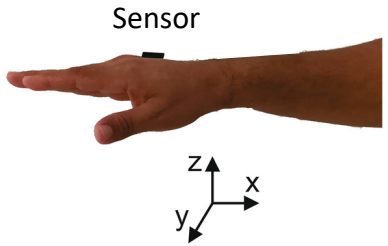
Channels (4 - 16)

Electrodes placement

Muscle selection

Sampling rate and Filter

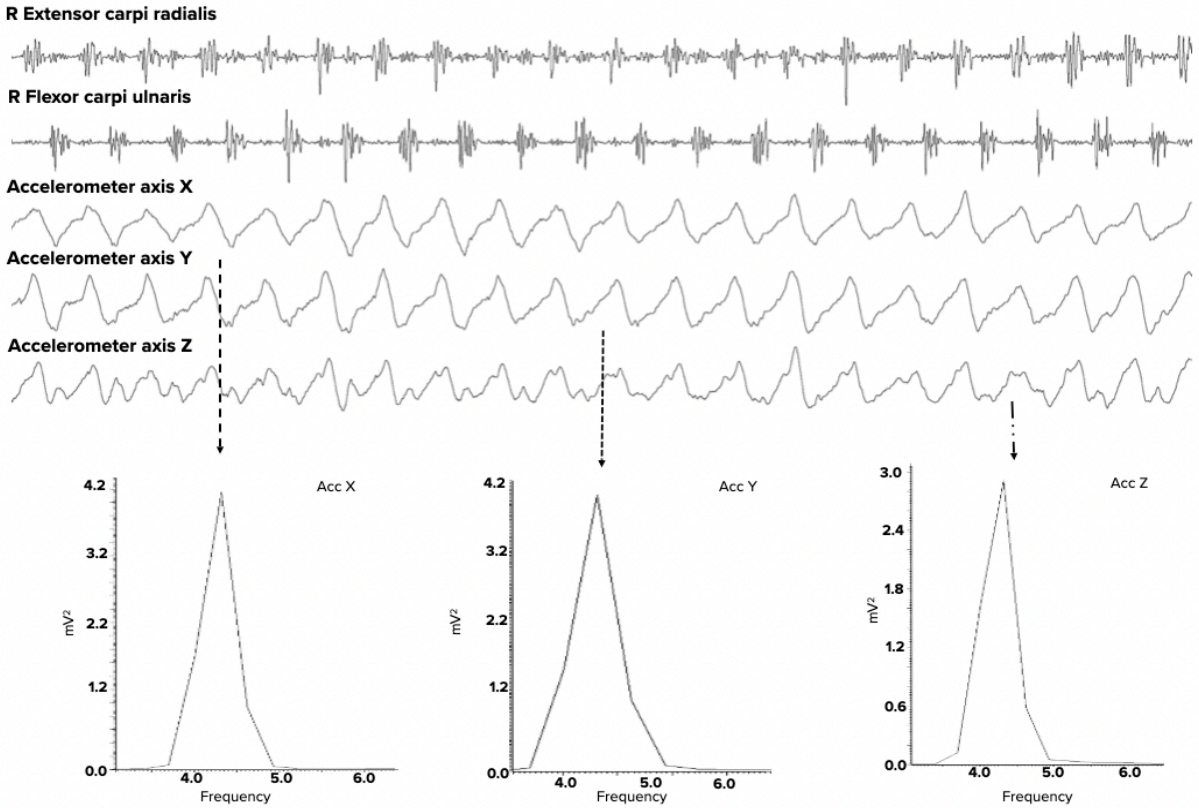
Accelerometer



Triaxal vs. Uniaxial

Placement

Not equivalent to amplitude



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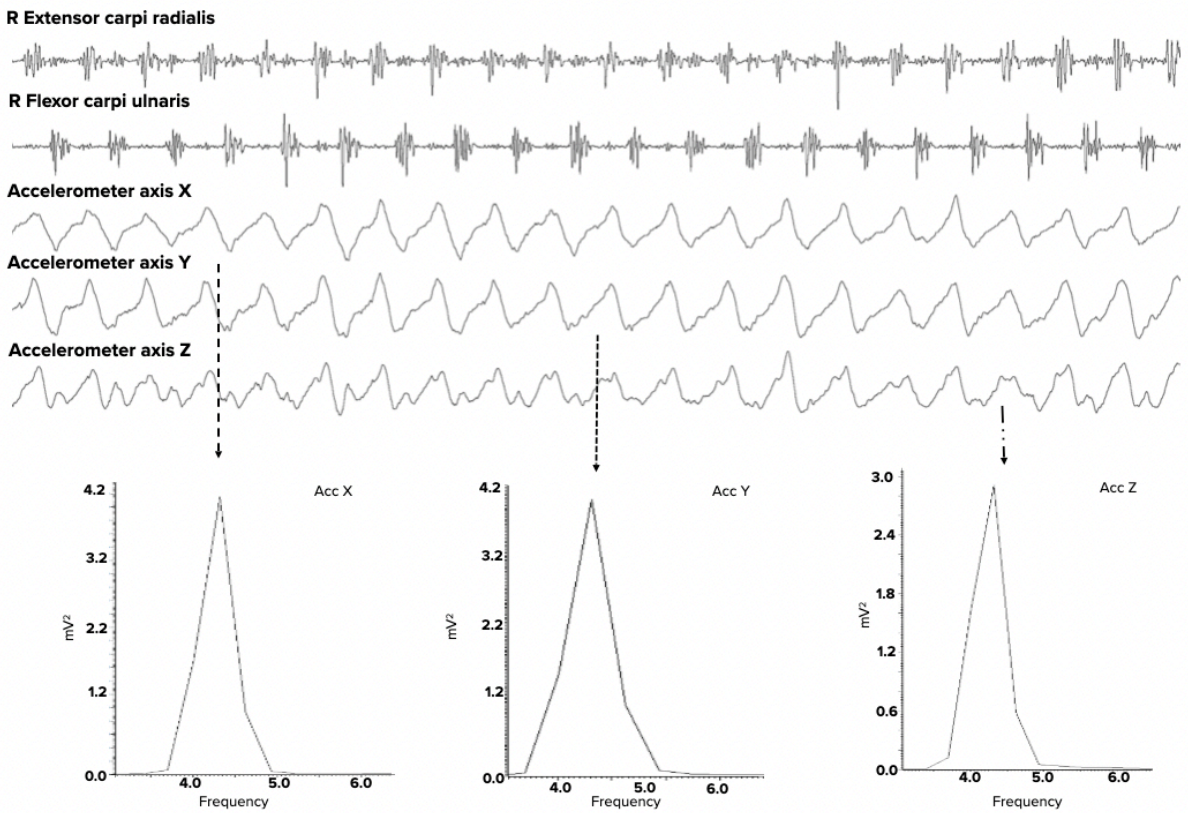
Polymyography

- QUESTION: Tremor or myoclonus?

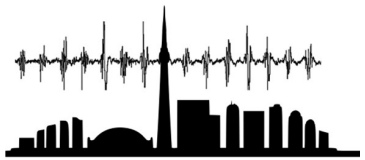


Pattern - Alternating

Burst duration

Tremor

Fourier transformation - Frequency (narrow peak) - Rhythmic



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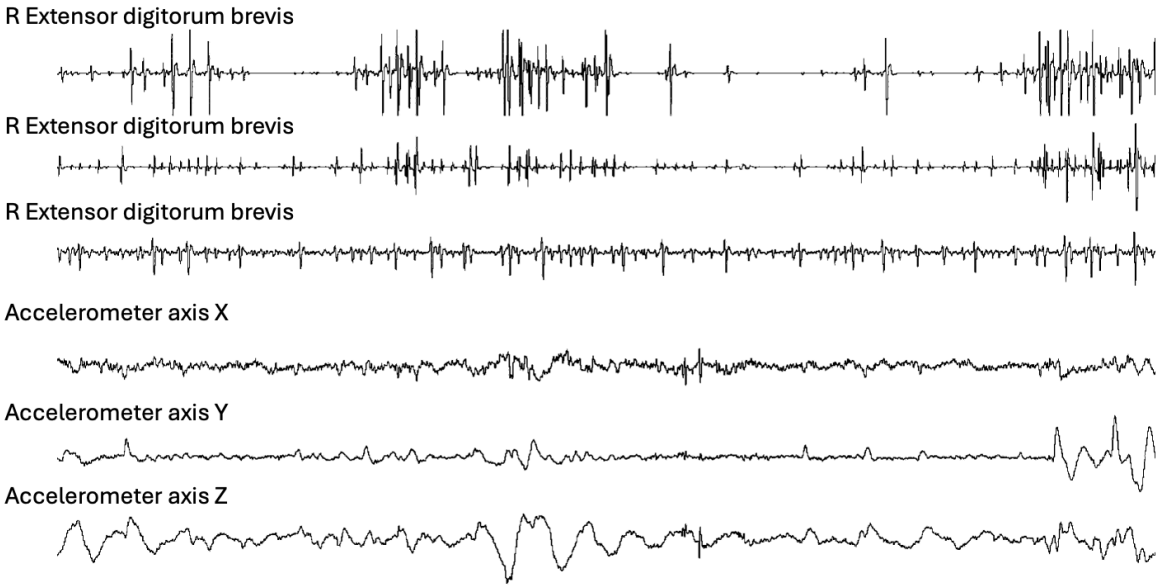
Polymyography

- QUESTION: Tremor or myoclonus?



Pattern - Irregular

Burst duration - 50 ms

More prominent distally

Myoclonus

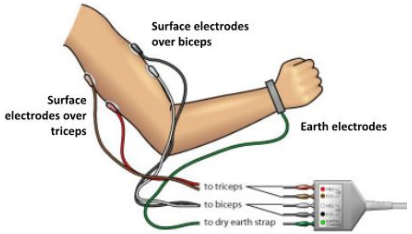
No peak in Fourier Transformation

Polymyography

- QUESTION: Functional tremor?

Camera

Surface EMG

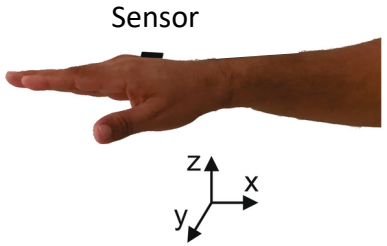


Channels (4 - 16)

Electrodes placement

Muscle selection

Accelerometer



Triaxal vs. Uniaxial

Placement

Not equivalent to amplitude

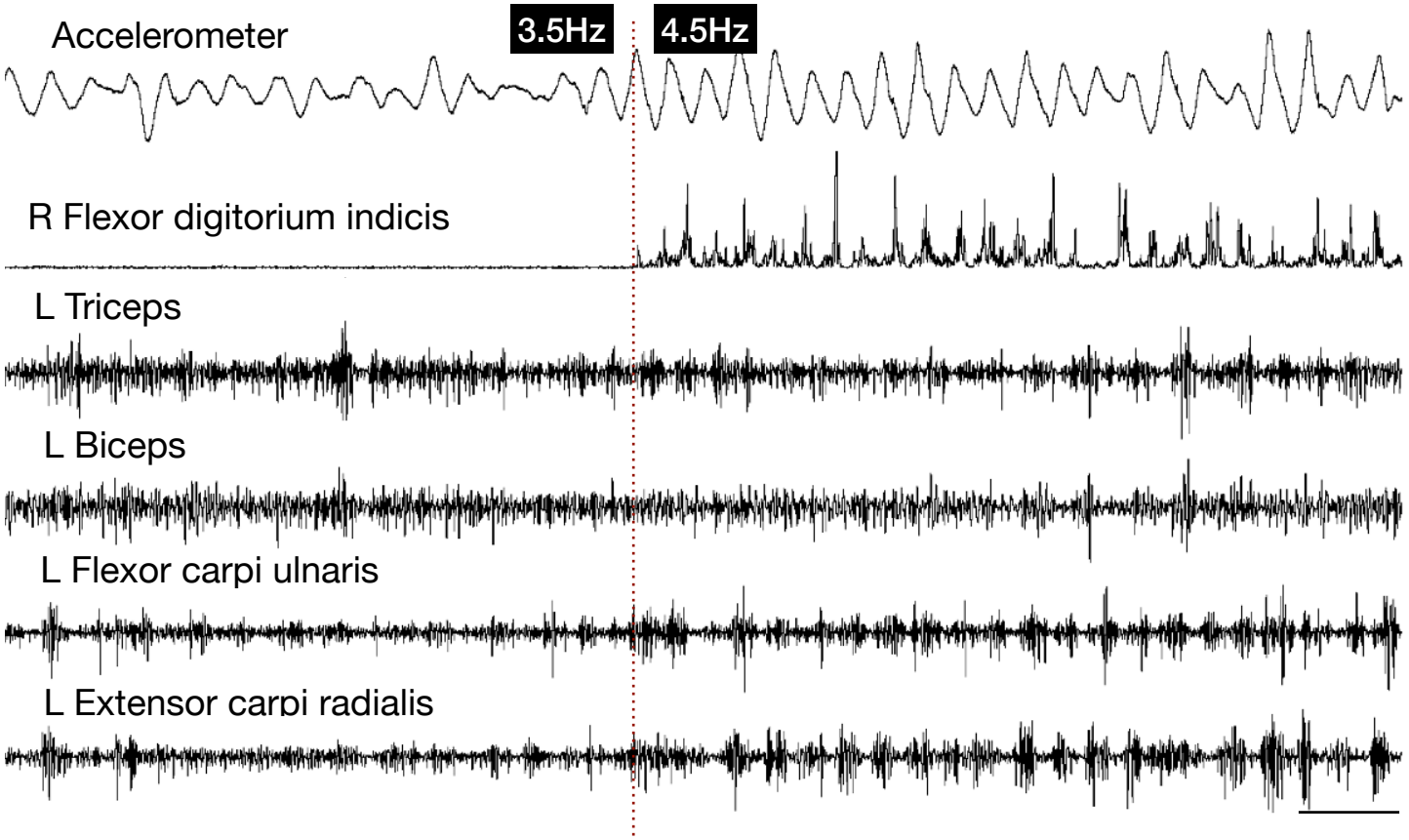
Metronome / Tuning fork

Evaluate tapping of contralateral hand - Suppressibility/Entrainment

Placing tuning fork on the affected body part Suggestibility

Polymyography

- QUESTION: Functional tremor?

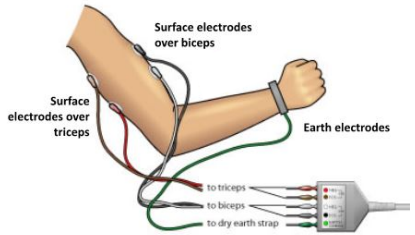


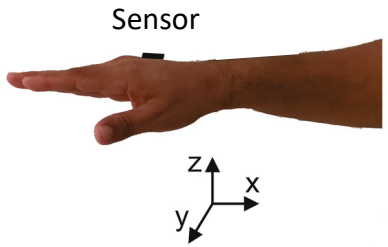
Entrainment

Polymyography

- QUESTION: Orthostatic tremor?

Surface EMG ⊕ Accelerometer





Channels (4 - 16)

Electrodes placement

Muscle selection

Triaxal vs. Uniaxial

Placement

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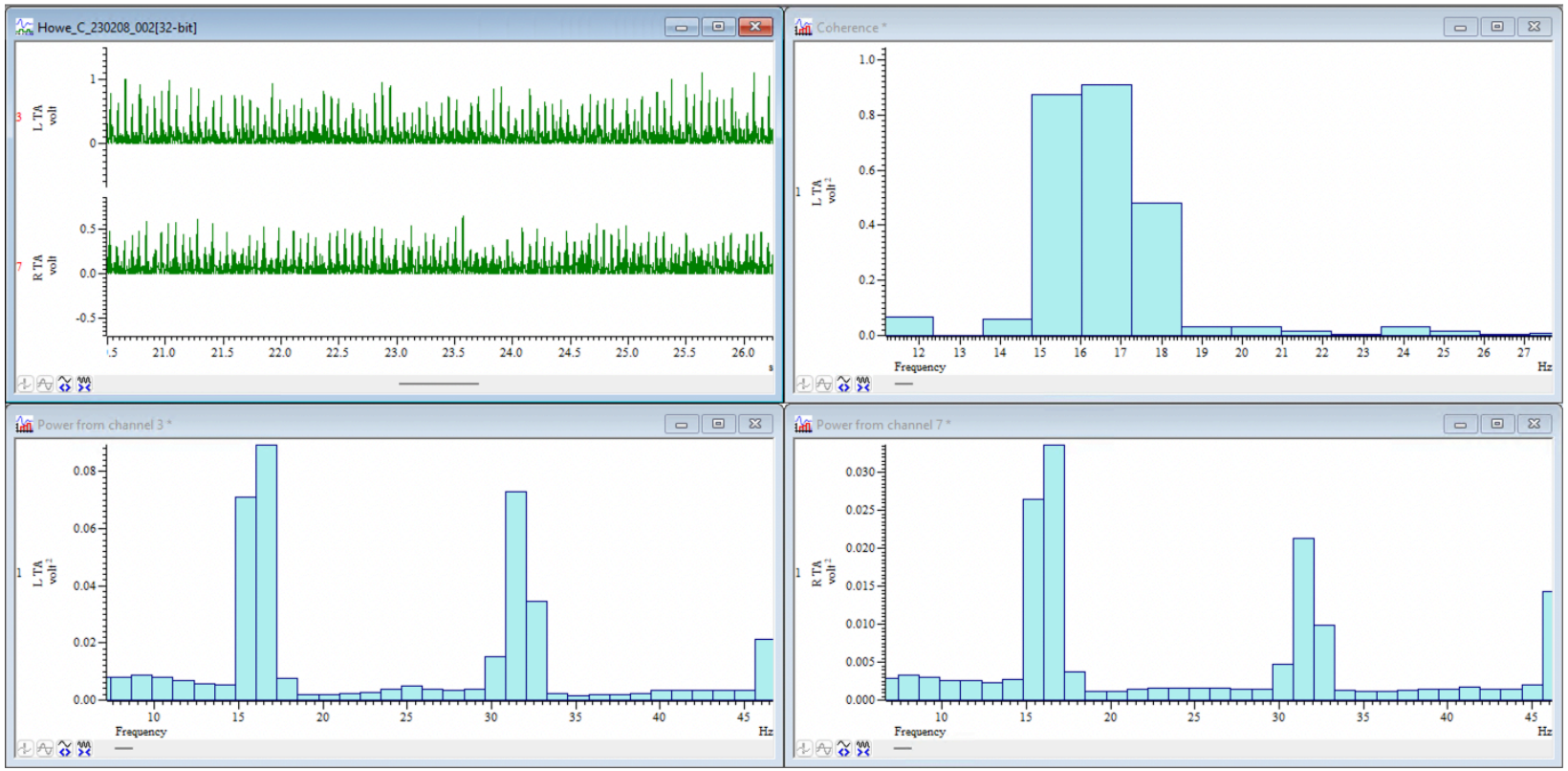
Polymyography

- QUESTION: Orthostatic tremor?

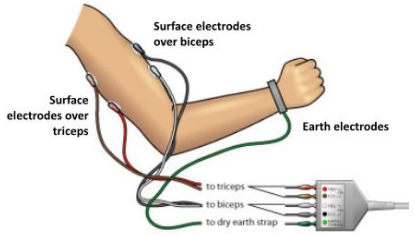


High coherence

Polymyography /Sound

- QUESTION: Exaggerated startle reflex?

Surface EMG



Channels (4 - 16)

Electrodes placement

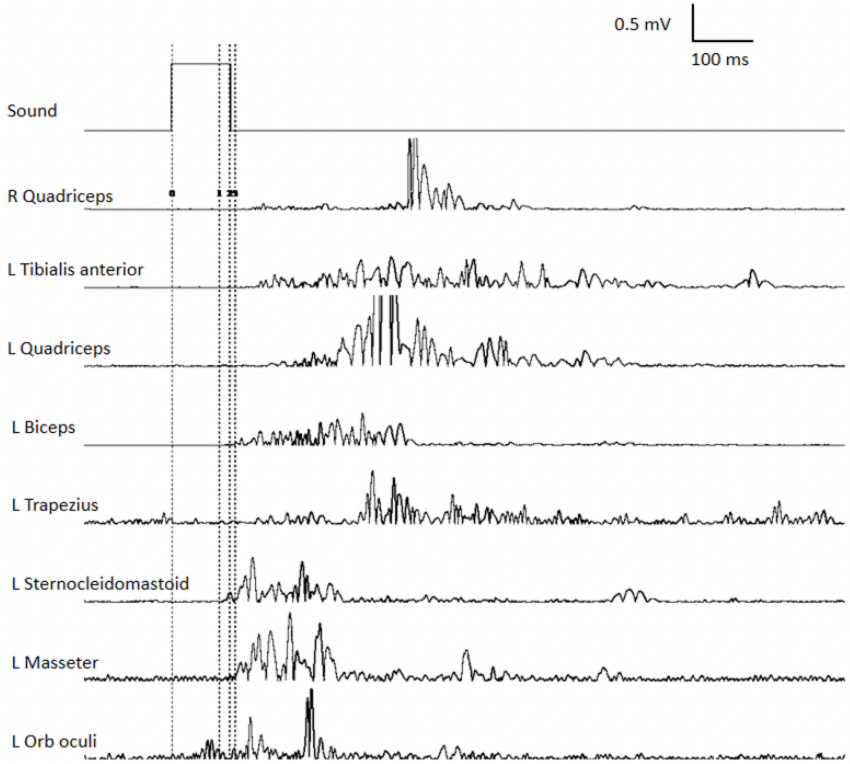
Muscles: **Orb oculi, Masseter, SCM**

Sound

1000 Hz square wave, 50 ms duration and 124 dB

Evaluate latency 30 - 200 ms, duration (500ms)

Interval ~30s



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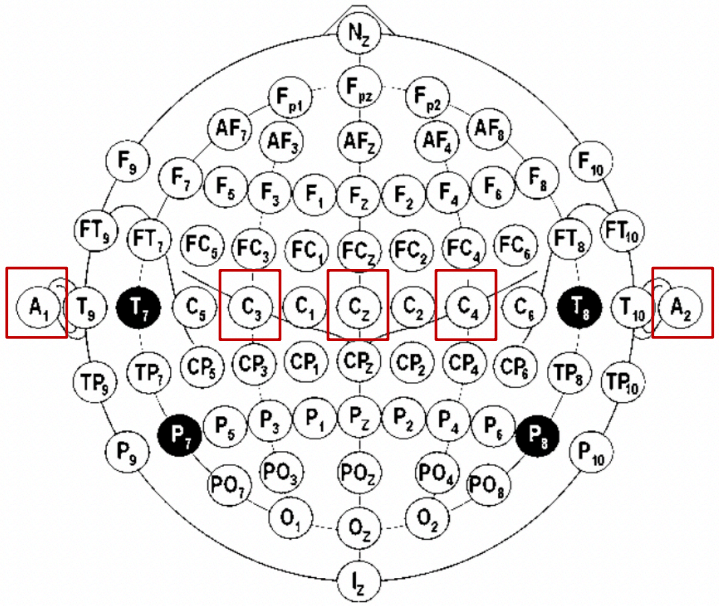
Dreissen YE, Bakker MJ, Koelman JH, Tijssen MA. Clin Neurophysiol. 2012

Brown P et al. Brain. 1991

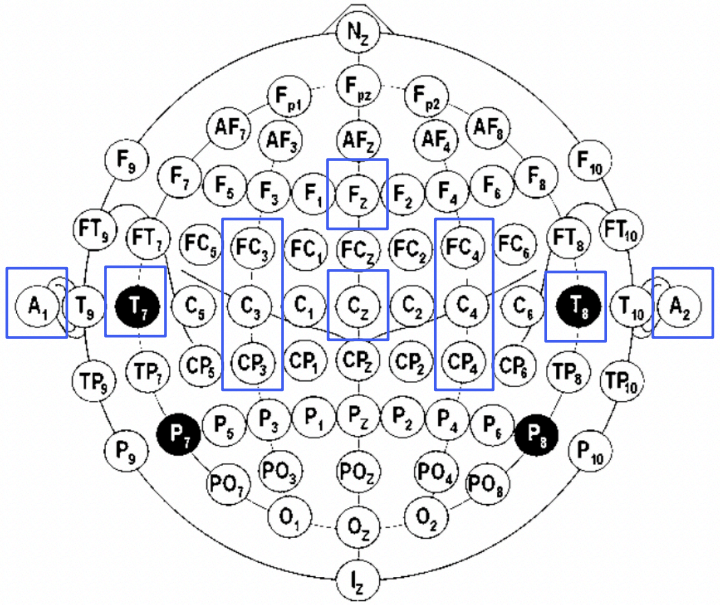
Valls-Solé J et al.Brain Res. 1997

EEG + EMG (BACKAVERAGING)

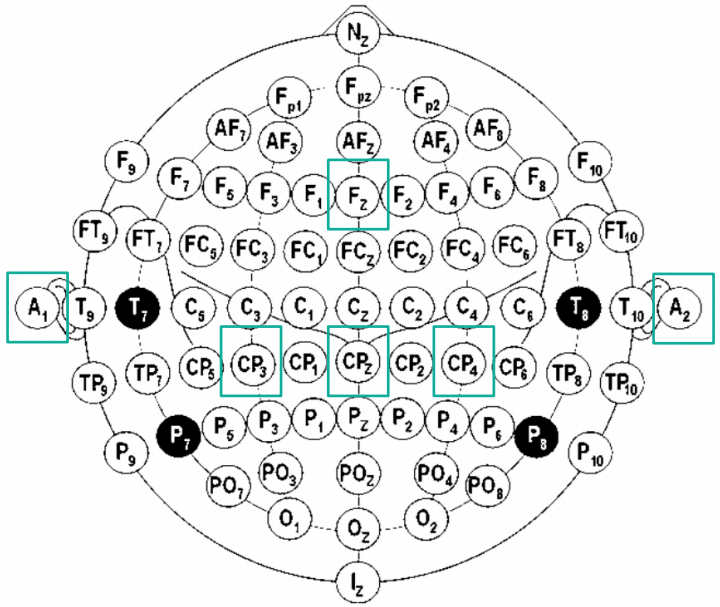
Premotor potential
Bereitschaftpotential



Cortical Transient



SSEP

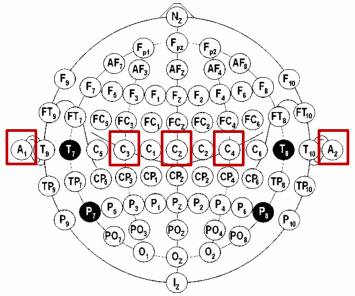


Chen KS et al. J Mov Disord. 2020

EEG + EMG (BACKAVERAGING)

- QUESTION: Is this jerky movement functional?

EEG



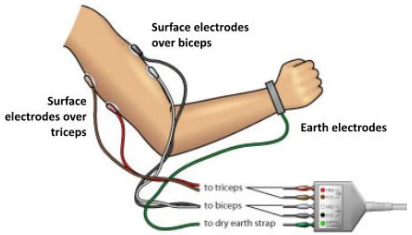
Filter (DC - 1000 Hz for collection, process can go to 30 Hz)

Sampling rate (2 - 10 KHz)

Attention to muscle artifact

Limitation - Time between movements
Ideal - more than 4.5 seconds

Surface EMG



Filter 10 - 1000 Hz

4 channels or more

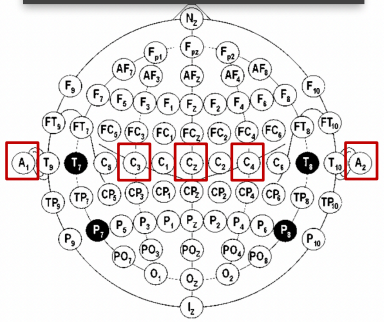
Muscle selection - Important to represent both sides

Can add orb oculi electrode

EEG + EMG (BACKAVERAGING)

- QUESTION: Is this jerky movement functional?

EEG

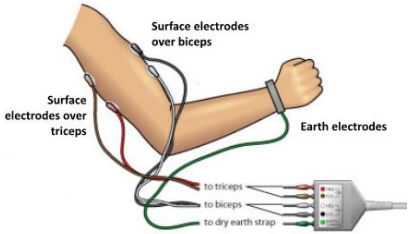


Filter

Sampling rate

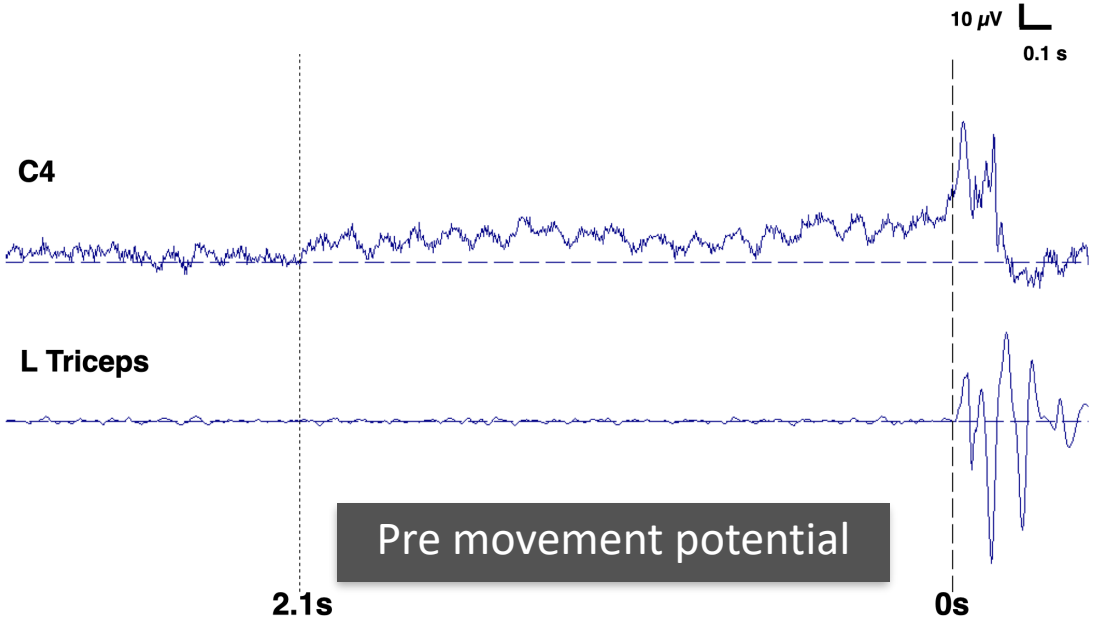
Time between movements

Surface EMG



4 channels or more

Muscle selection

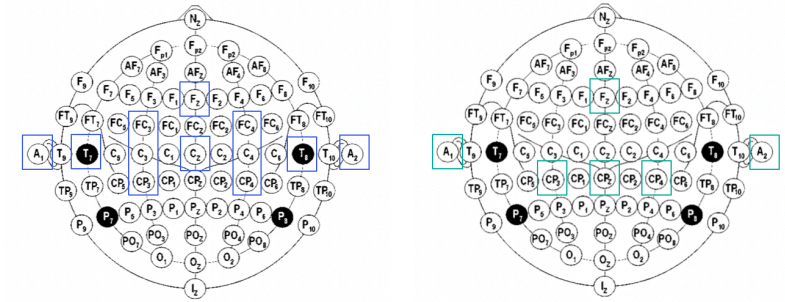


Functional etiology

EEG + EMG / Nerve stim

- QUESTION: Is this myoclonus cortical?

EEG - Cortical transient and SSEP



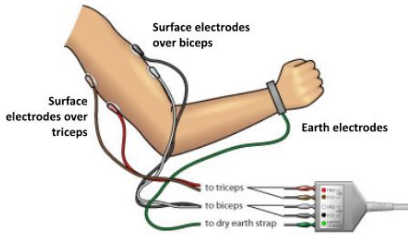
Filter - High band pass (0.01 - 1000 Hz)

Sampling rate (2 - 10 KHz)

SSEP - 3 Hz stimulation at median on the most affected side (3 min)

Transient - amplified montage to increase sensitivity - min 40 events

Surface EMG



4 channels or more

Muscle selection - Important to represent both sides and distal muscles

APB electrode to evaluate C Reflex during SSEP recording

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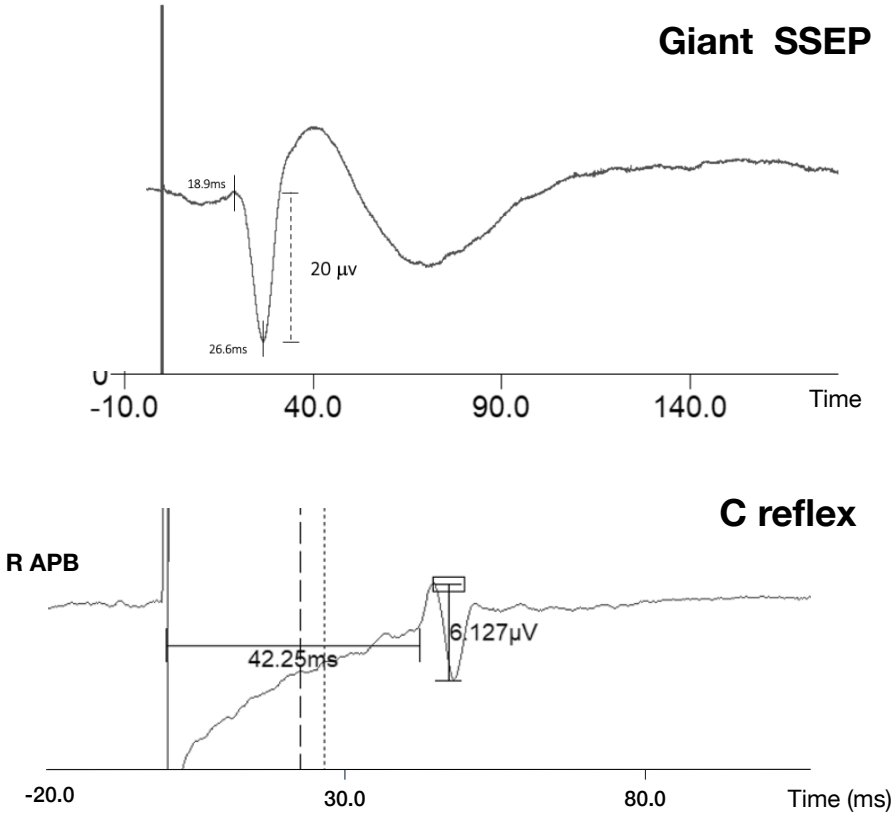
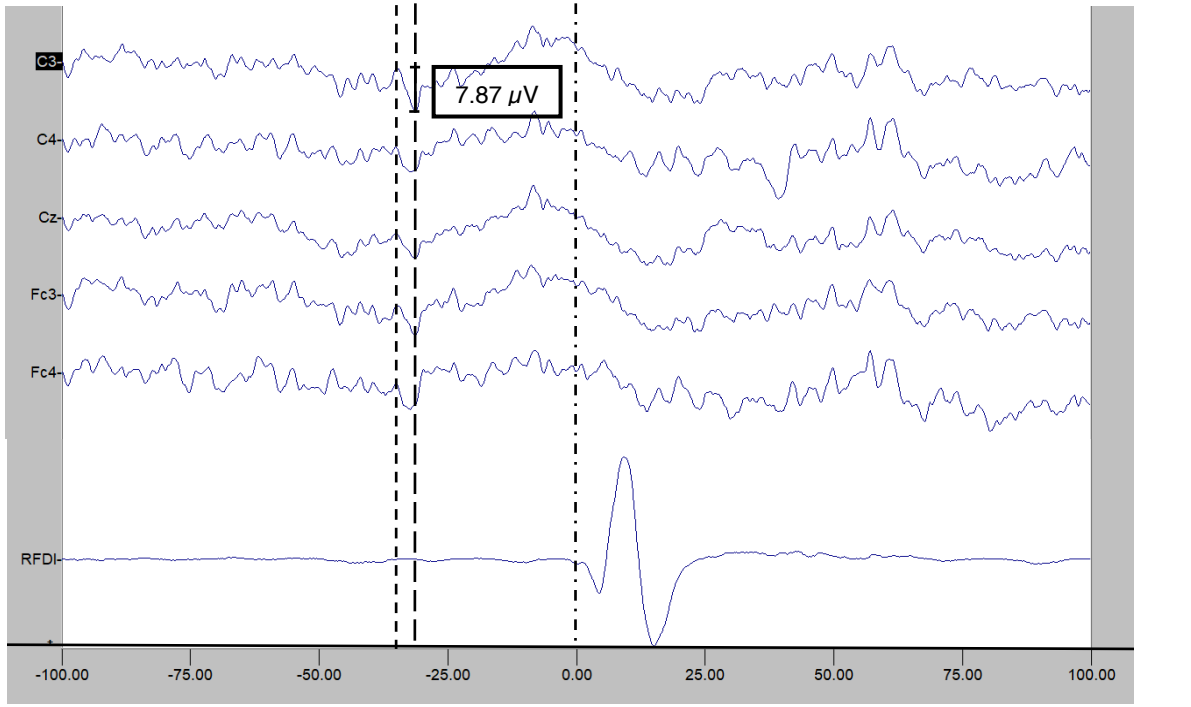
EEG + EMG / Nerve stim

- QUESTION: Is this myoclonus cortical?





Focal EEG transient 31ms before the myoclonus

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Cortical myoclonus

Electrical stimulation

- QUESTION: Confirm the diagnosis of Stiff person

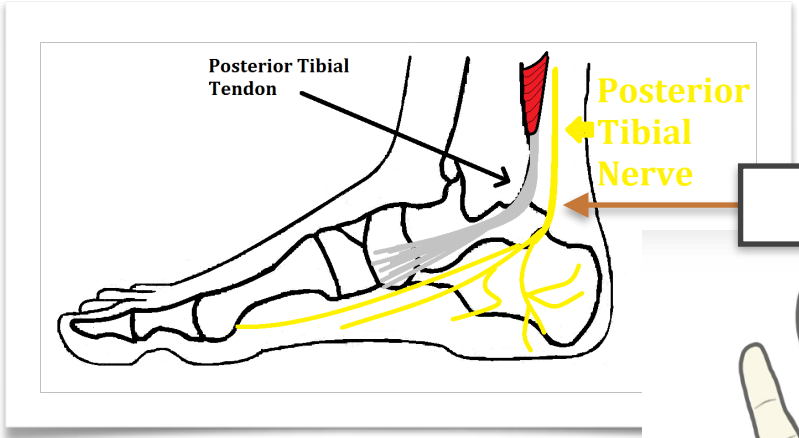
Electrical stimulation - Exteroceptive reflex

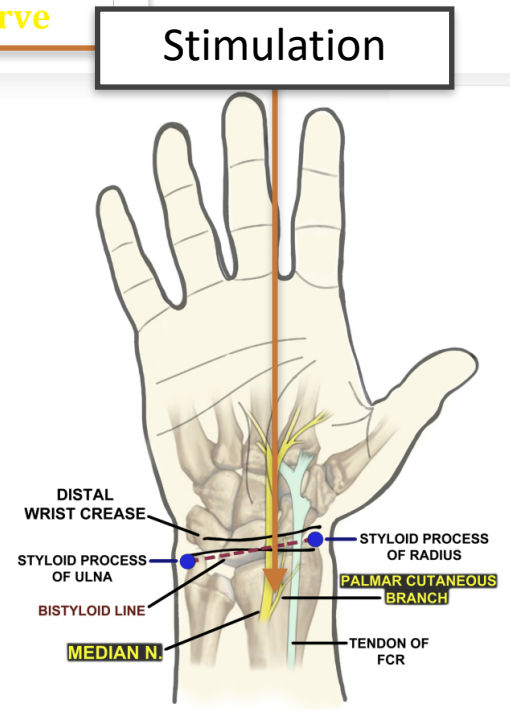
Median - Abductor pollicis brevis
Tibial posterior - Gastrocnemius

Rest and 20-30% muscle contraction

4 electrical stimuli at 500 Hz with an inter-train interval of about 10 s

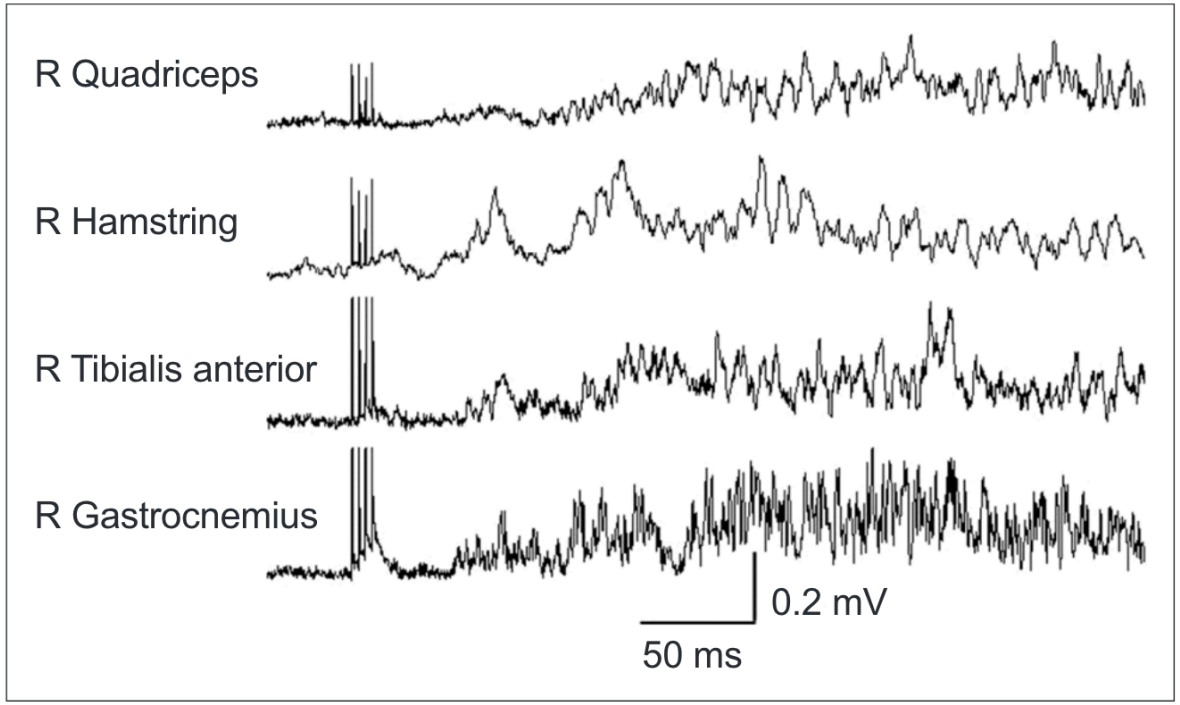
Stimulation strength is three times sensory threshold.





Electrical stimulation

- QUESTION: Confirm the diagnosis of Stiff person



Brief initial response - 50 ms

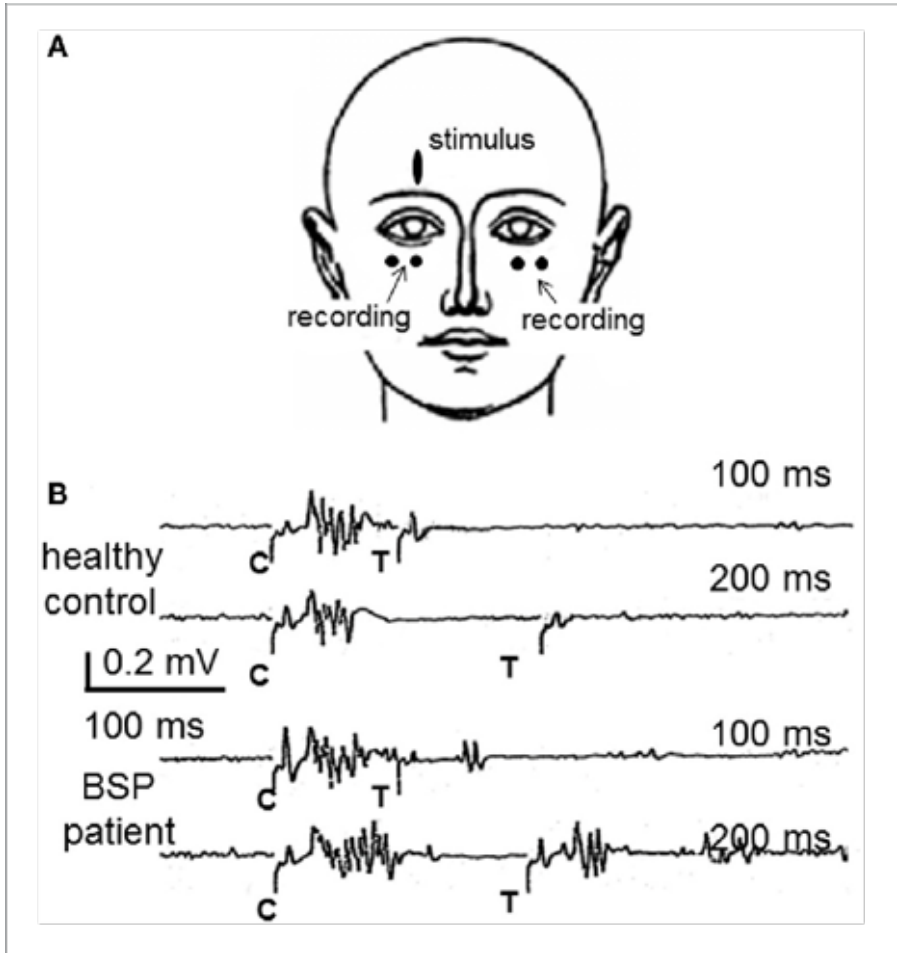
Exaggerated second phase - more than 50 ms, up to 100 ms

Exaggerated Exteroceptive response

Espay AJ, Chen R.Muscle Nerve 2006

Electrical stimulation

- Evaluate latency of the jerky movement
- Brainstem reflexes

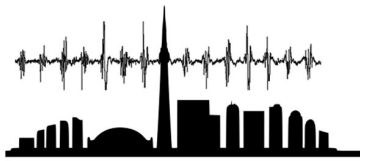


Valls Sole J et al. Frontiers in Neurology. 2016

Summary

- Most used techniques include
  - Surface EMG, Accelerometer, EEG, Nerve stimulation
- Camera is important to evaluation of the recordings offline
- Other equipment help with specific responses/protocol
  - Tuning fork, sound, metronome, reflex hammer, cup, etc.

Protocol should be tailored base on the clinical question



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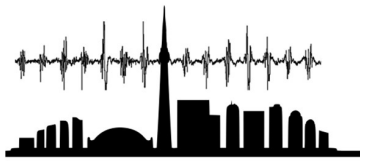
Thank you!



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