

# Understanding EMG/NCS

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# Overview

- When to order an EMG/NCS?
- What to tell patients about EMG/NCS.
- EMG/NCS interpretation basics.

# When to order an EMG/NCS?



# When to order an EMG/NCS?

- To include or exclude dysfunction of:
  - Peripheral Nerve (Neuropathic)
  - Neuromuscular Junction
  - Motor Neuron Disease
  - Muscle (Myopathic)

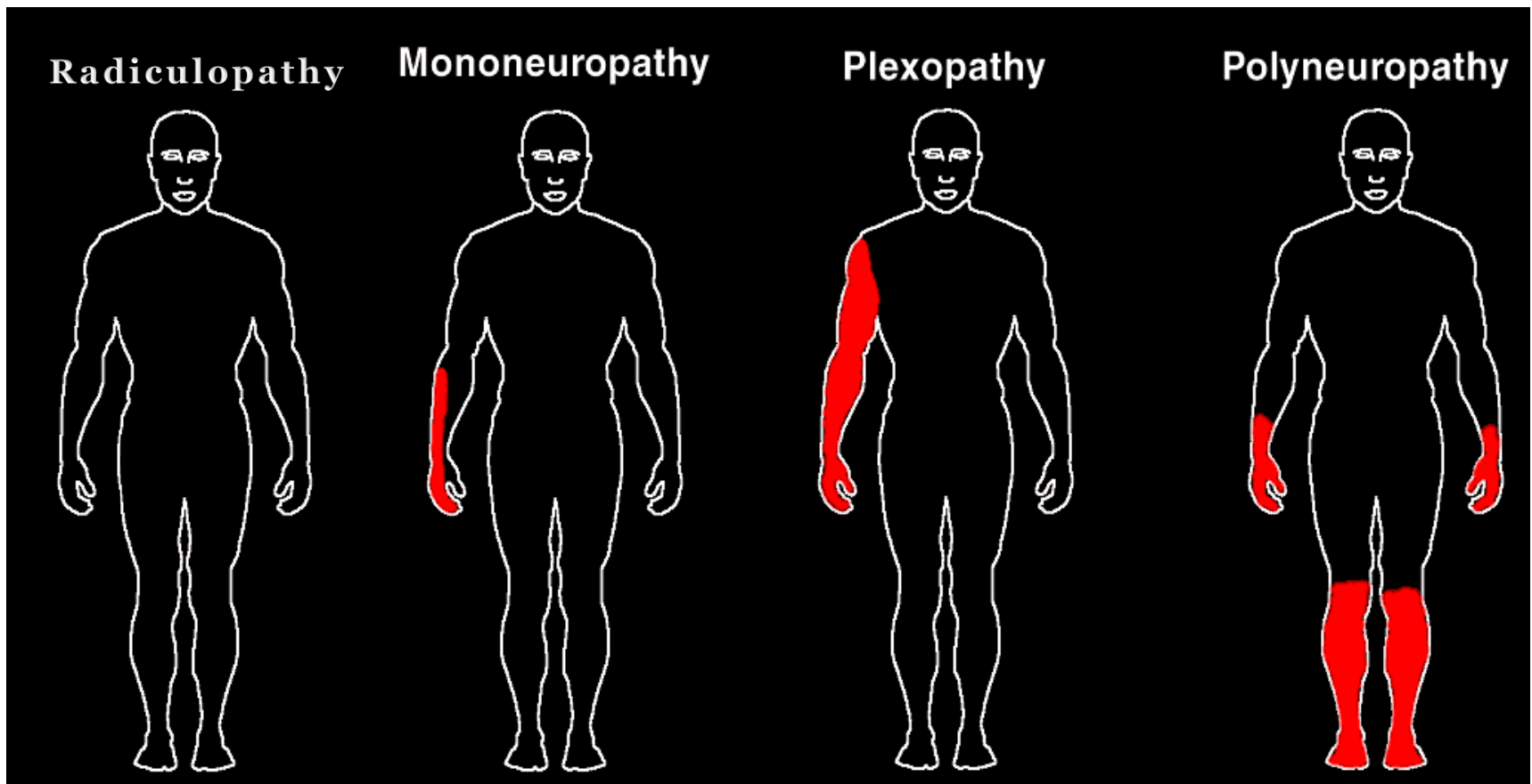
# Typical Nerves Studied

- **Upper Extremity**
  - Median (motor and sensory)
  - Ulnar (motor and sensory)
  - Radial (sensory)
- **Lower Extremity**
  - Sural (sensory)
  - Tibial (motor)
  - Peroneal (motor)

# EMG Identifies and Discriminates between Peripheral Nerve Injuries

- Mononeuropathy
- Polyneuropathy
- Plexopathy
- Radiculopathy

# The Pattern of Peripheral Nerve Injury Dictates Diagnosis



# Peripheral Nerve Injury Characteristics

- Type of Injury
  - Axonal (axonal loss) vs Demyelination (loss of myelin) vs mixed
- Course- Acute or Chronic
  - EMG normal prior to Wallerian degeneration
- Severity



# Peripheral Nerve Injury Pearls

- Not all nerves are testable
  - Location, body habitus, casting or burns
- Typically not helpful in the hyper-acute period
- EMG is a helpful diagnostic tool (not treatment)
- EMG can compliment other work-up (i.e. MRI/ultrasound)

# Identification of Neuromuscular Junction Dysfunction

- Presynaptic – Botulism and LEMG
  - Exercise Testing
  - 50Hz repetitive stimulation
- Post Synaptic - Myasthenia Gravis
  - 2-3Hz repetitive stimulation (sensitivity: generalized 75%, bulbar 50%)<sup>1</sup>
  - Single fiber study (sensitivity > 95%)<sup>1</sup>

# Helpful in the Diagnosis of Motor Neuron Disease

- EMG is abnormal long before weakness
- Helps identify mimics
- EMG only useful in combination with history

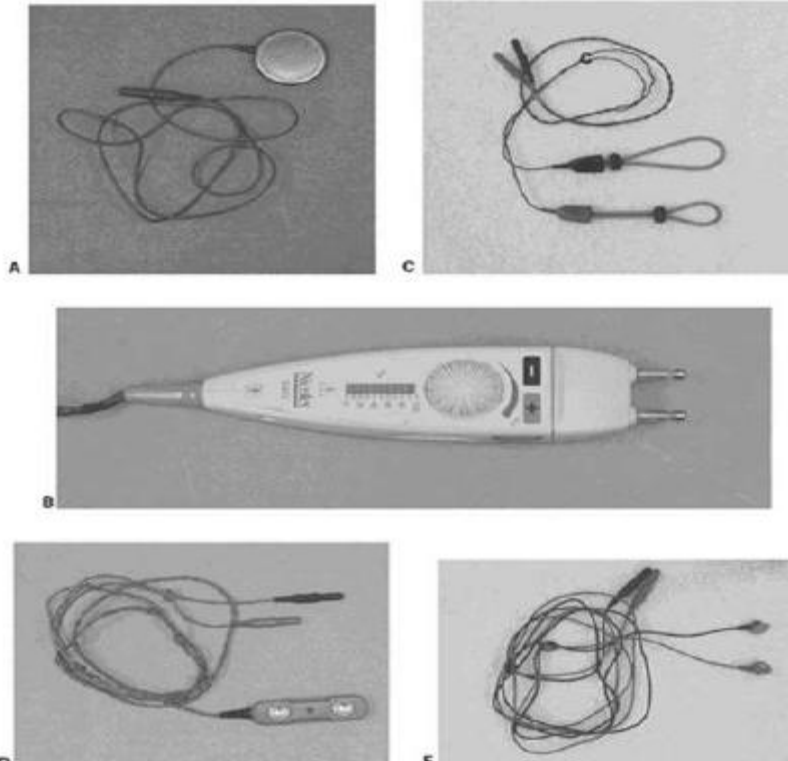
# Helps in the Diagnosis of a Myopathic Disorders

- Pattern of affected muscles
- Selection for muscle biopsy
- Specific discharges (i.e. myotonia)

# What to tell a patient about EMG/NCS



# What to tell a patient about EMG/NCS



# Patient EMG Video

- <http://www.tubechop.com/watch/2621946>

# Patient Instructions

- **Medication-** be aware of blood thinners and acetylcholinesterase inhibitors
- **Lotion-** avoid using day of test
- **Health conditions-** Report bleeding disorders, swelling and pacemaker
- **Study-** Custom designed- length varies



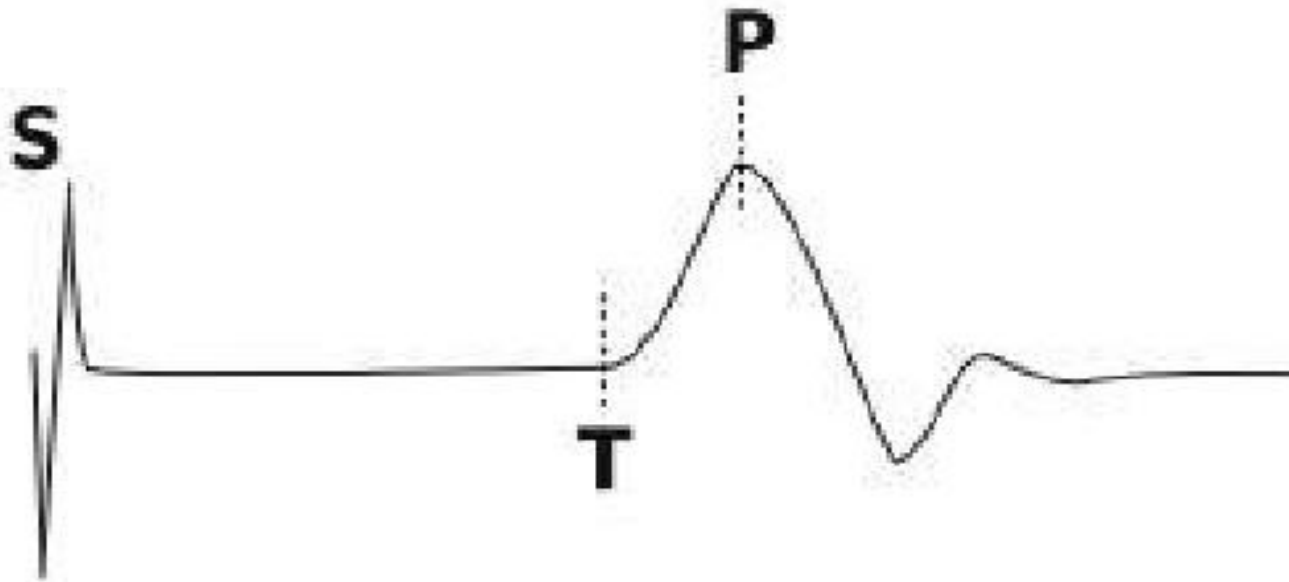
# NCS/EMG Interpretation Basics

- Nerve Conduction Studies
- Needle EMG
- Technical Factors

# Responses- NCS

- Compound Muscle Action Potentials (CMAP)
- Sensory Nerve Action Potential (SNAP)
- F-waves
- H-reflex
- Repetitive stimulation

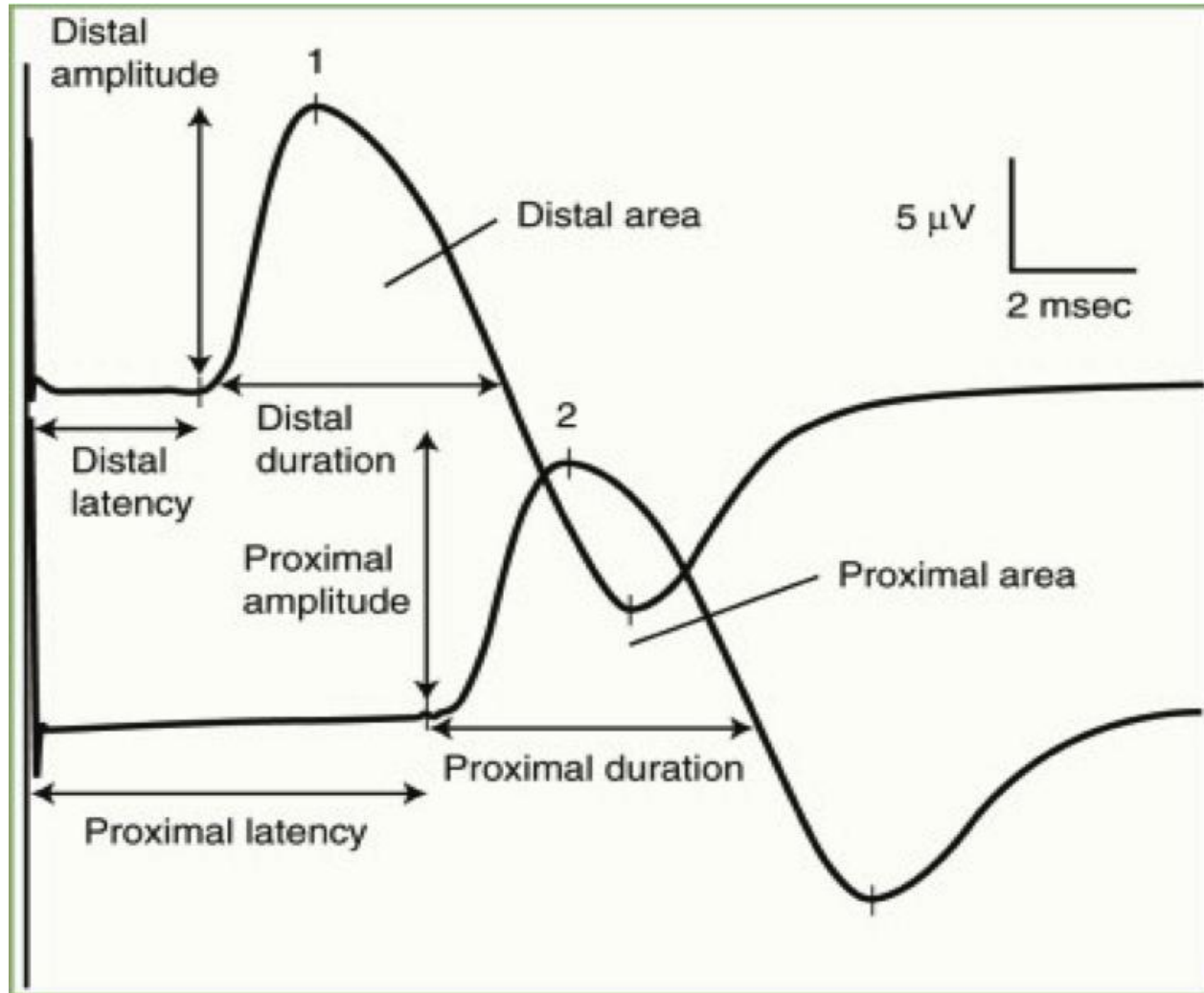
# Sensory Response



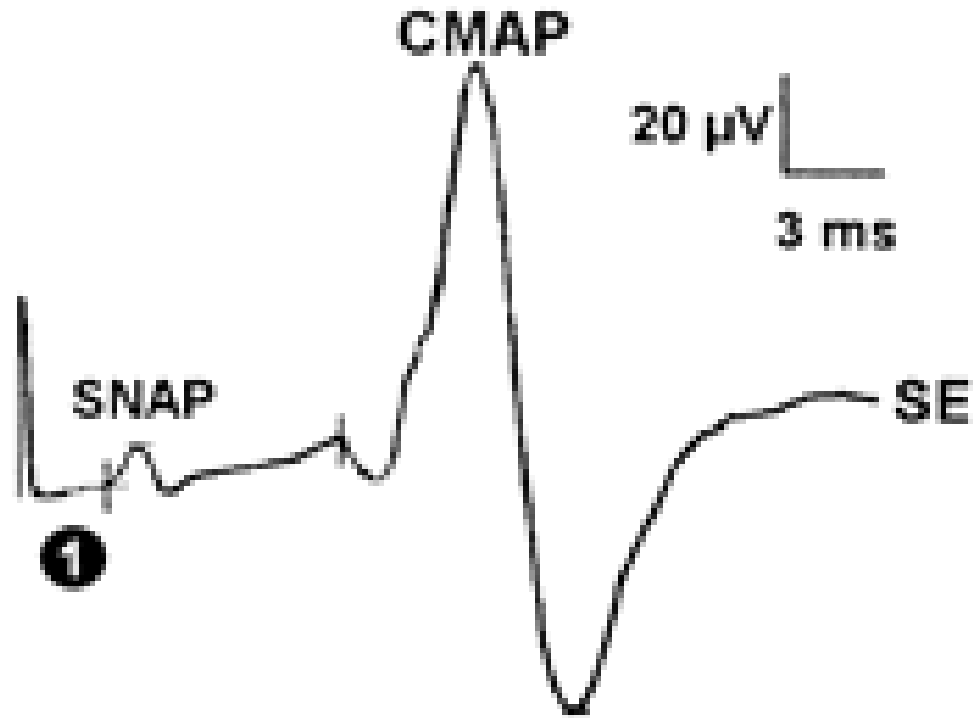
**S** = Stimulus point, **T** = Takeoff point, **P** = Peak

The time (latency) from **S** to **T** is typically about 3 milliseconds.  
The amplitude would be measured in microvolts ( $\mu\text{V}$ ).

# Motor Responses



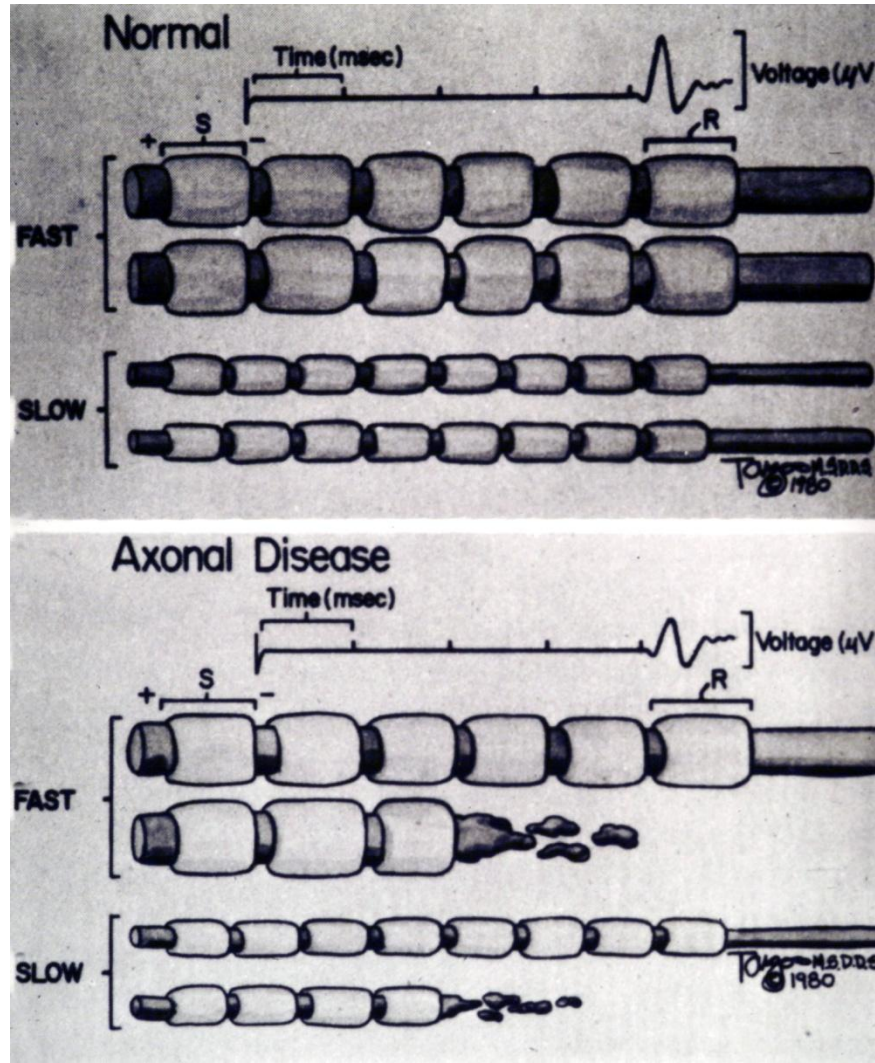
# Sensory and Motor Responses



# Waveform Changes Determine Type of Injury

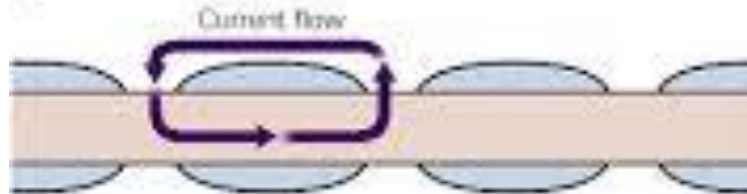
- Amplitude (Axonal)
- Velocity and Latency (Demyelinating)

# Reduced Amplitude in Axonal Injury



# Reduced Distal Latency and Conduction Velocity in Demyelinating Lesions

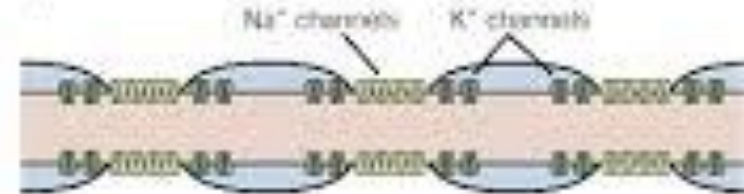
A<sub>1</sub> Normal



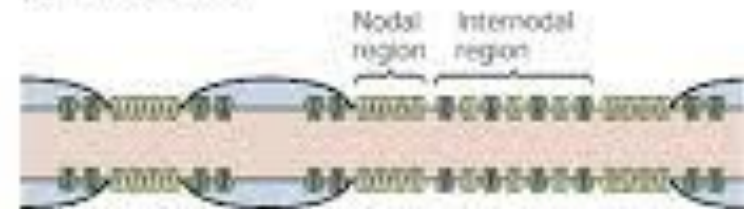
A<sub>2</sub> Partially demyelinated



B<sub>1</sub> Normal

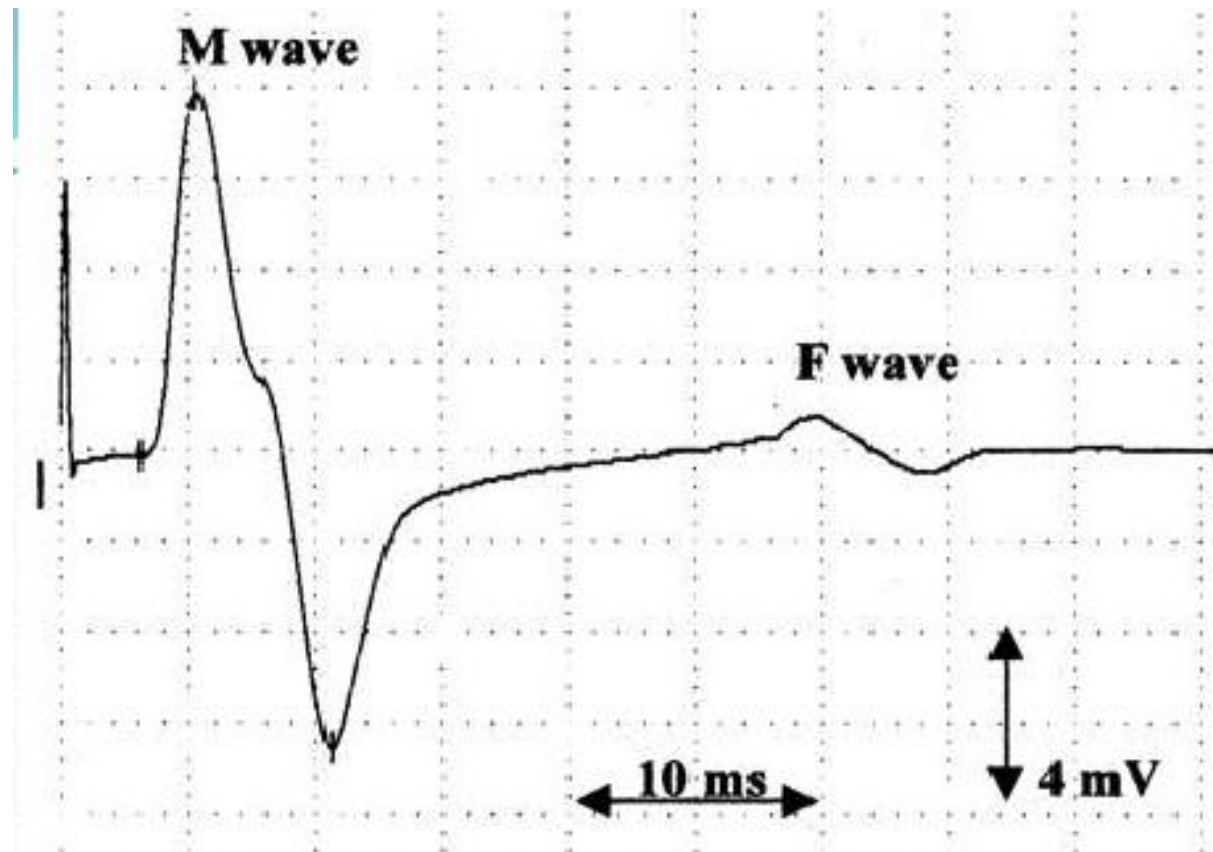


B<sub>2</sub> Demyelinated

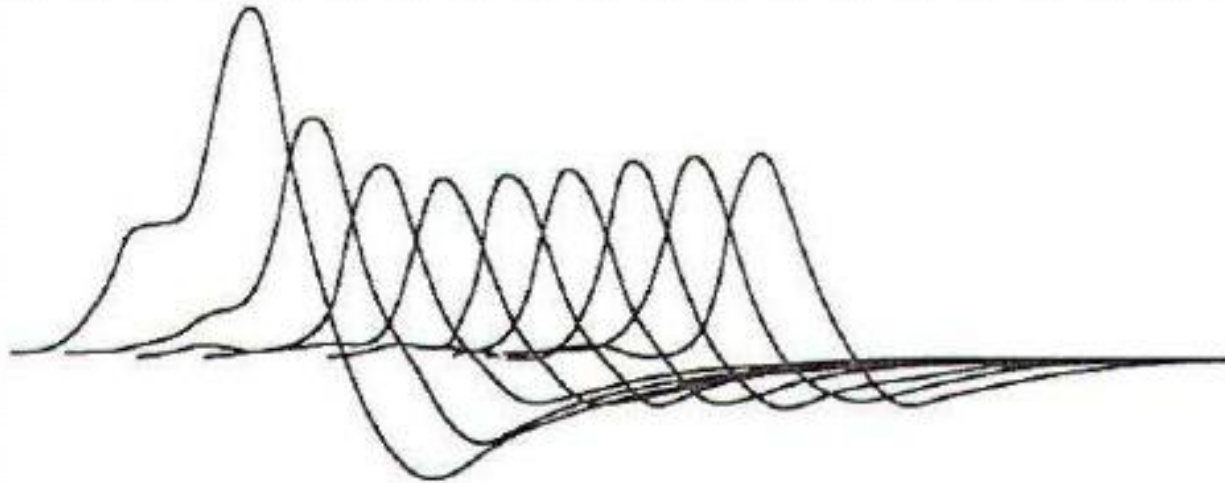




# F- Wave



# Repetitive Stimulation Study



# Repetitive Stimulation Study

- Looks for evidence of a defect in the neuromuscular junction
- Decrement of more than 10% is abnormal
- U-shape
- 2-3Hz train of 5-10
- If low amplitude then do exercise testing- LEMG

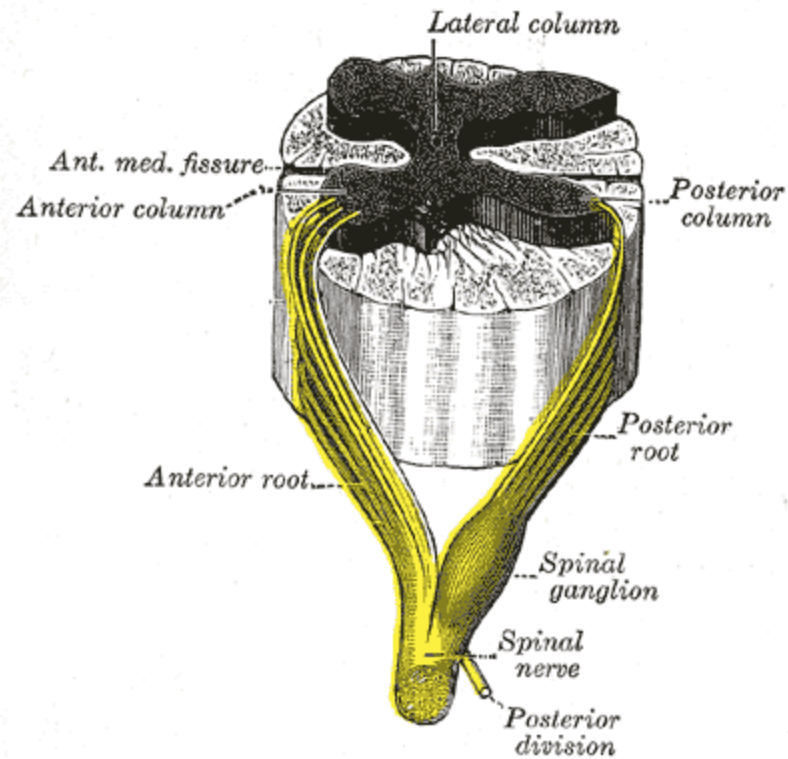
# Technical Factors- NCS

- **Low Temperature**
  - Decreased Conduction Velocities
  - Increased Amplitude
- **Increased Height**
  - Prolonged F-responses
- **Increased Age**
  - Decreased Conduction Velocities
  - Decreased Amplitude
  - Loss of responses (Sural Sensory)

# Needle EMG

- Relaxed Phase
  - Spontaneous Activity- most abnormal
  - Usually indicates an active issue
- Activation Phase
  - Voluntary motor responses
  - Amplitude, Frequency, Complexity
  - Seen in subacute and chronic issues

# Radiculopathies



# Single Fiber EMG



Normal SFEMG



Increased jitter: MG patient

# Technical Factors- Needle EMG

- **Temperature/Height**
  - **Not an issue**
- **Prior injuries**
- **Findings can be Patchy**
  - **Particularly in radiculopathies**



Questions?

