EMG/NCS
In Management Of Peripheral Nerve Disorders

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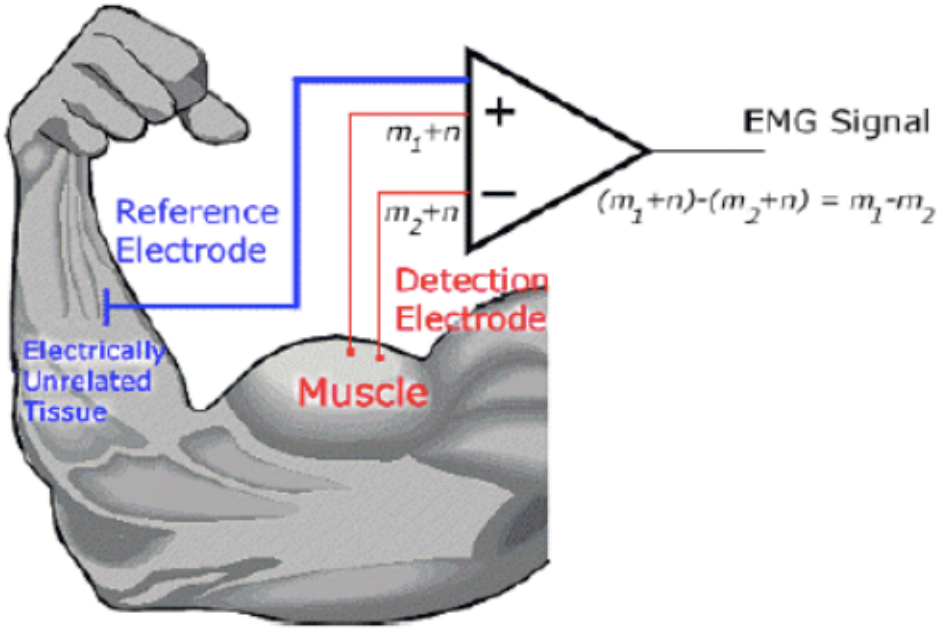
What is electromyography?

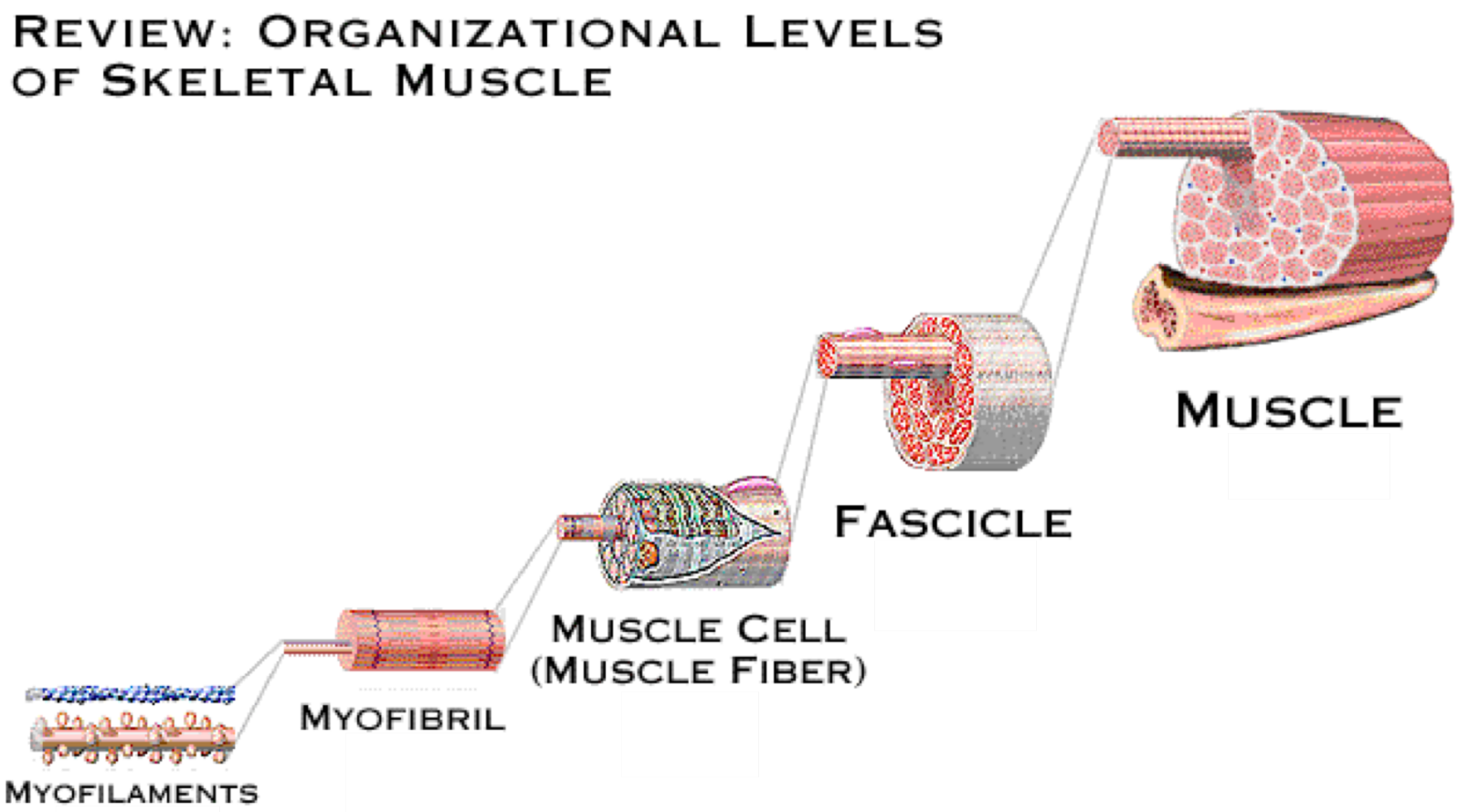
Electromyography (defn.)

- Is the discipline that deals with the detection, analysis and use of the electrical signal that emanates from contracting muscles.
- Often referred to as ‘EMG’ for short



(Deluca, 1998)

Just to Recap…



(Silverthorn, 2004)

EMG

- Is an extension of the neurological examination.
- The EMG examination is a diagnostic tool used in the evaluation of pain, weakness, sensory disturbance, fatigue and atrophy
- The EMG examination includes two components: Nerve Conduction Studies (NCS) and the needle electromyographic (EMG) study.

NCS

- In NCS or electrical studies, response amplitudes and latencies are evaluated.
- Nerve Conduction Velocity (NCV) studies may be used to evaluate axonal, segmental and focal peripheral nerve problems.
- Other NCS techniques may be used to evaluate problems in the neuromuscular junction (NMJ), nerve root and even central nervous system.

- Cardinal Rules of NCS & EMG

  - NCSs & EMG are an extension of the clinical examination.
  - when in doubt, always think about technical factors.
  - when in doubt, reexamine the pt.
  - the findings should be reported in the context of the clinical symptoms and the referring diagnosis.
  - when in doubt, do not overcall a diagnosis.
  - always think about the clinical – electrophysiologic correlation.

Recording

- By placing electrodes over the muscle we can record the signal generated by muscle contraction.
- Voltage is displayed continuously and recorded for analysis.
- The signal includes positive and negative waves and varies rapidly: we also analyse integrated EMG (averages over 20 samples, ignoring the sign)

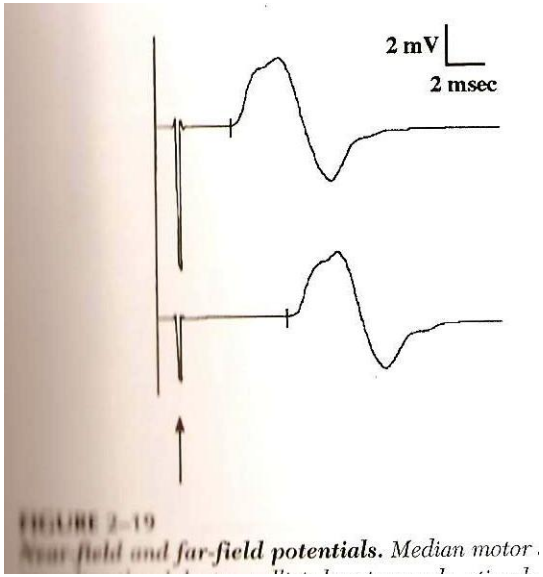
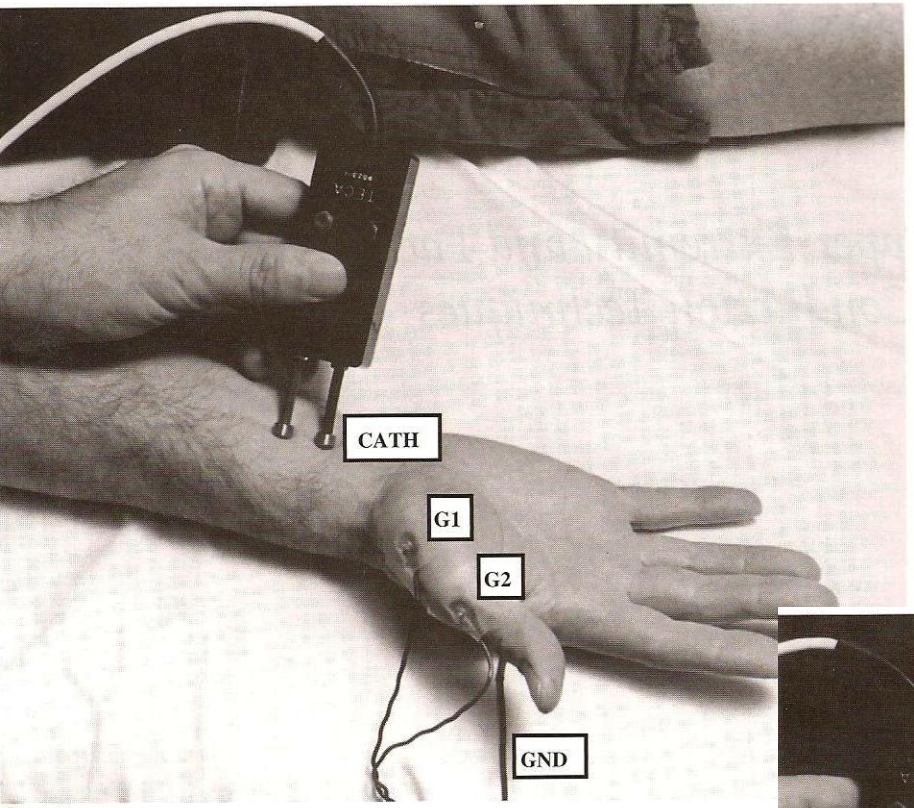


FIGURE 2–19
Near-field and far-field potentials. Median motor



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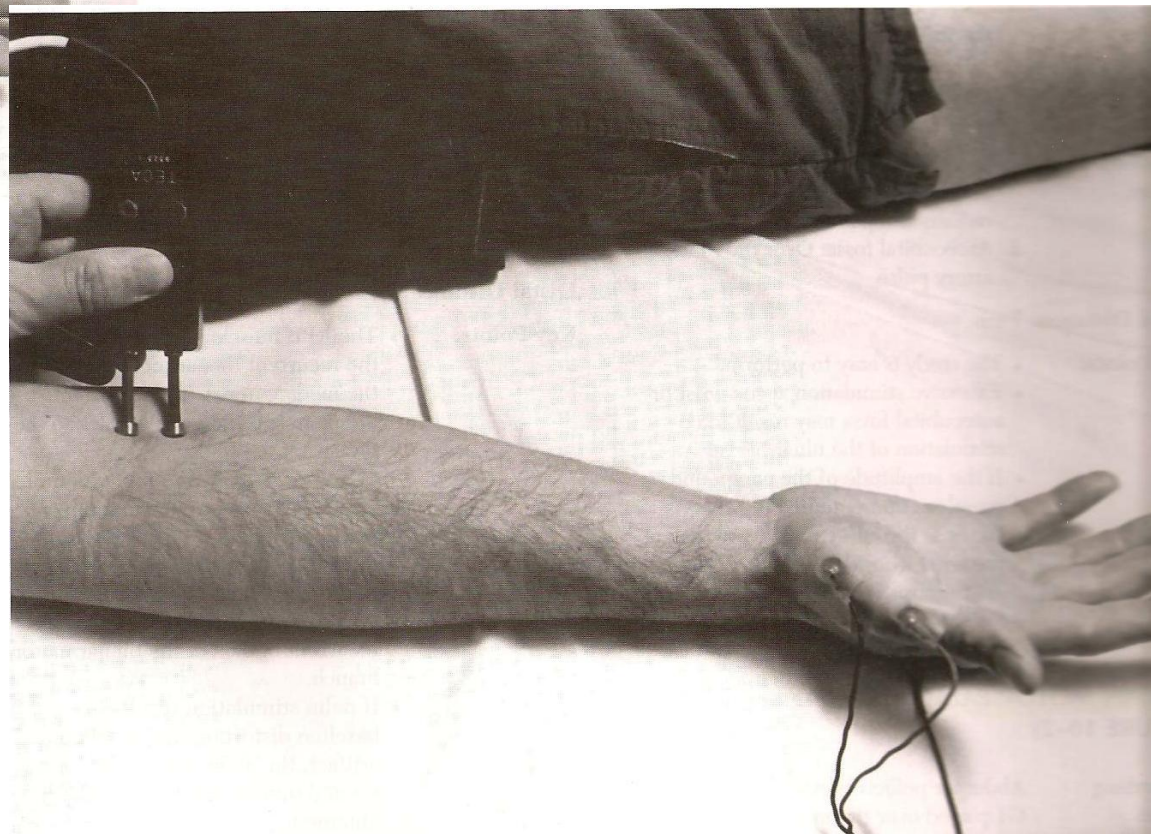


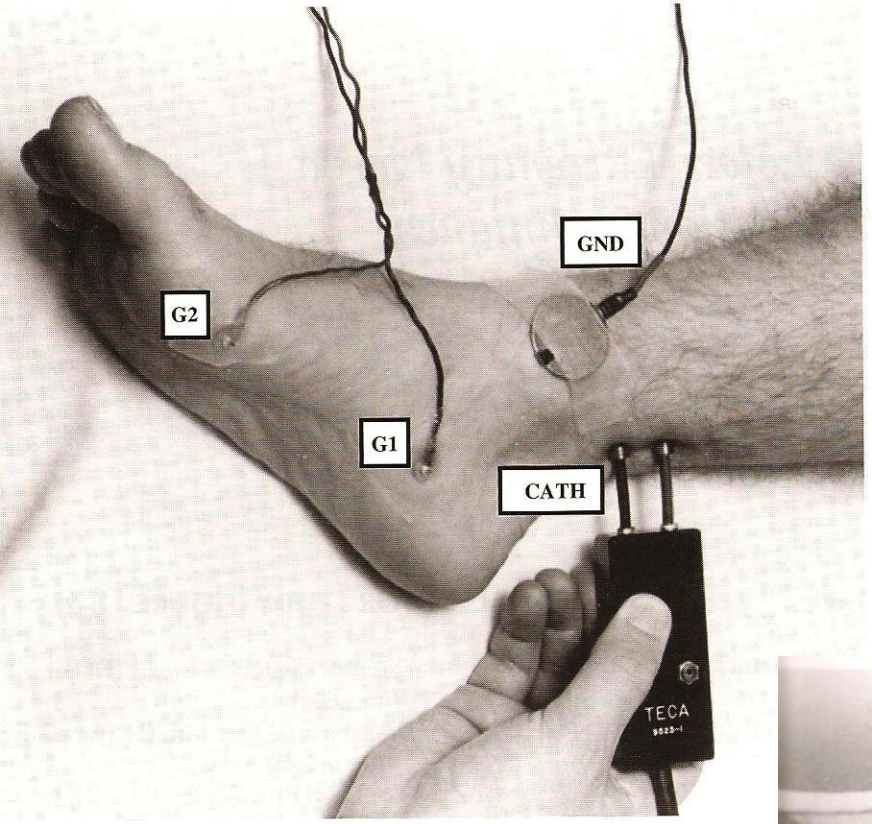
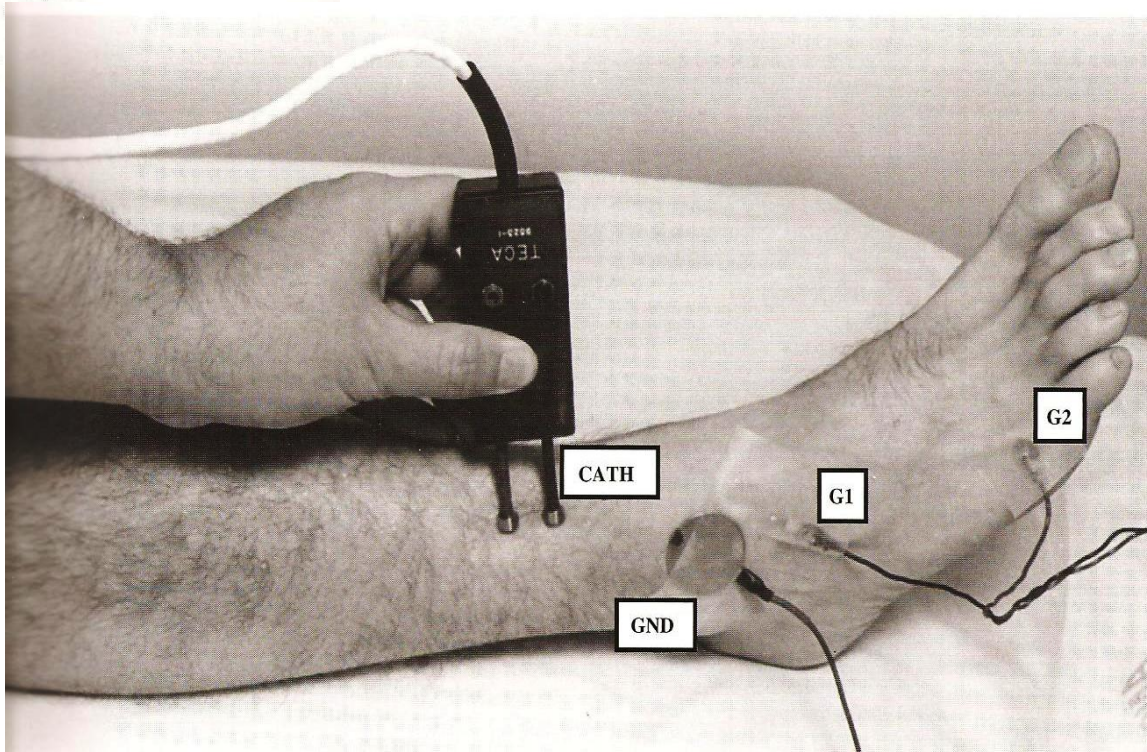


FIGURE 11–1
Tibial motor study. *site above and posteri malleolus, recording th brevis muscle.* ***B:*** *Prox in the middle of the po*



Motor conduction studies

- The recorded potential, Known as the compound muscle action potential (CMAP) witch represents the summation of all underlying individual muscle fiber action potential.
- The CMAP is a biphasic
- Latency
  - Nerve conduction time
  - time delay across the NMJ
  - depolarization time across the muscle
- Amplitude
  - measured from the baseline to the negative beak
  - or from the first negative beak to the next positive beak
  - reflects the number of muscle fibers that depolarized
  - low CMAP (loss of axons, conduction block & NMJ disorders)

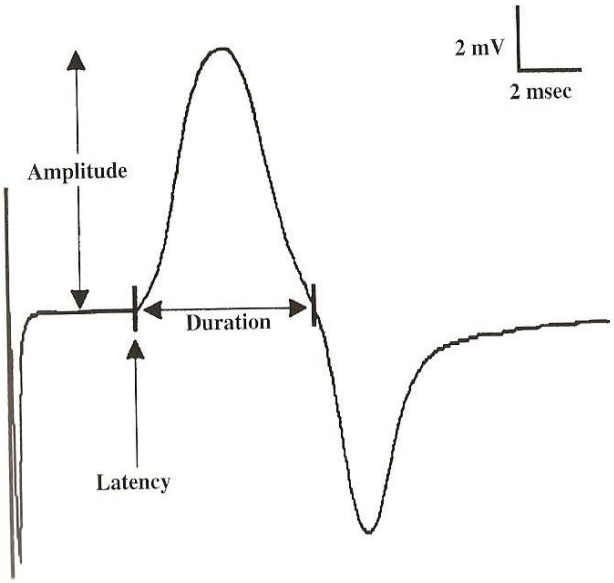


FIGURE 3–2
Compound muscle action potential (CMAP). The CMAP

Motor conduction studies

- Area
  - also reflects the number of muscle fibers that depolarized
- Duration
  - From the initial deflection from the baseline to the first baseline crossing
  - Measure of synchrony
    increases in demyelinating lesions
- Conduction Velocity
  - using 2 stimulation sites

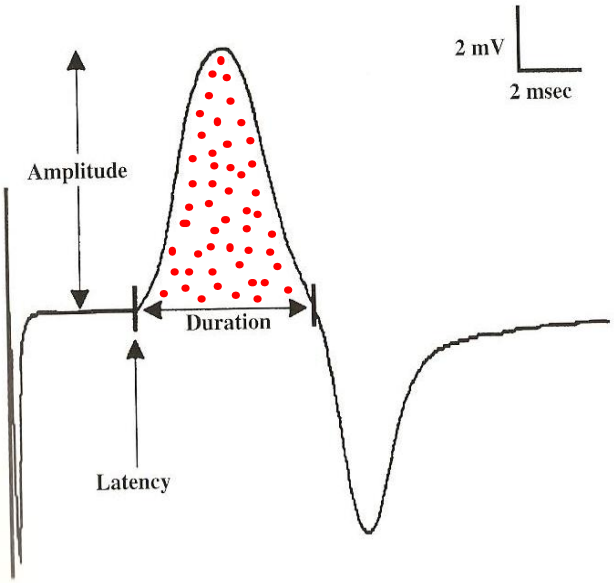


FIGURE 3–2
Compound muscle action potential (CMAP). The CMAP

Sensory conduction studies

- SNAP (sensory nerve action potential)
  - is a summation of all individual sensory fiber potentials
- Onset Latency
  - represent nerve conduction time
- Peak Latency
- Amplitude
  - Low amplitude indicted definite disorder of peripheral nerve
- Duration
  - help to I identify a potential as a nerve rather than a muscle potential as in CAMP

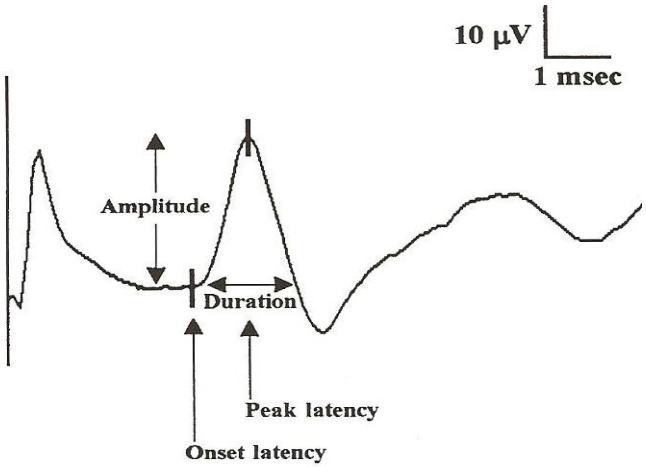


FIGURE 3–5
Sensory nerve action potential (SNAP). The SNAP

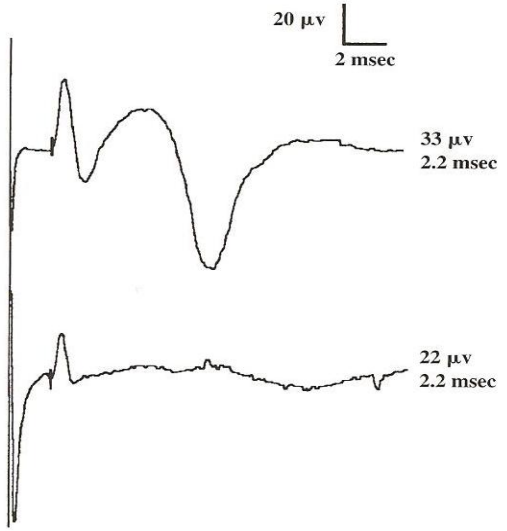


FIGURE 3–8
Antidromic and orthodromic sensory studies. Median

Mixed conduction studies

- Represents the summation of all the individual sensory and motor fiber action potentials
- Biphasic or Triphasic

faster than motor and sensory studies because include Ia fibers

- Ia fibers are earliest affected by demyelinating lesions, such as in entrapment neuropathies

Neuropathic lesions

- **Axonal loss**
  - Seen after physical disruption of the nerve, toxic, metabolic or genetic disorders
  - Decrease amplitude
  - Normal conduction velocity
  - Normal distal latency
  - In acute nerve transection the amplitude will be normal with distal stimulation but reduced with proximal stimulation

    (pseudo-conduction block)
- **Demyelination**
  - Entrapment and Compressive Neuropathies
  - Slowing of conduction velocity
  - Prolongation of distal latency

Neuropathic lesions

- **Conduction Block**
  - Seen in demyelinating lesions
  - Reduced amplitudes with proximal stimulation and normal with distal stimulation
  - Drop in either CMAP amplitude or area of more than 20%
  - Any increase in CMAP duration of more than 15%
- **Myopathy**
  - Normal sensory conduction studies
  - CMAP mostly normal of distal muscles
  - CMAP amplitudes may be low if the distal muscles are affected
- **Neuromuscular junction disorders**
  - Normal sensory conduction studies
  - Normal CMAP in postsynaptic disorders (e.g. Myasthenia gravis)
  - CMAP amplitude low in presynaptic disorders (botulism)

Mononeruopathies

- **Carpal tunnel syndrome**

- Clinical

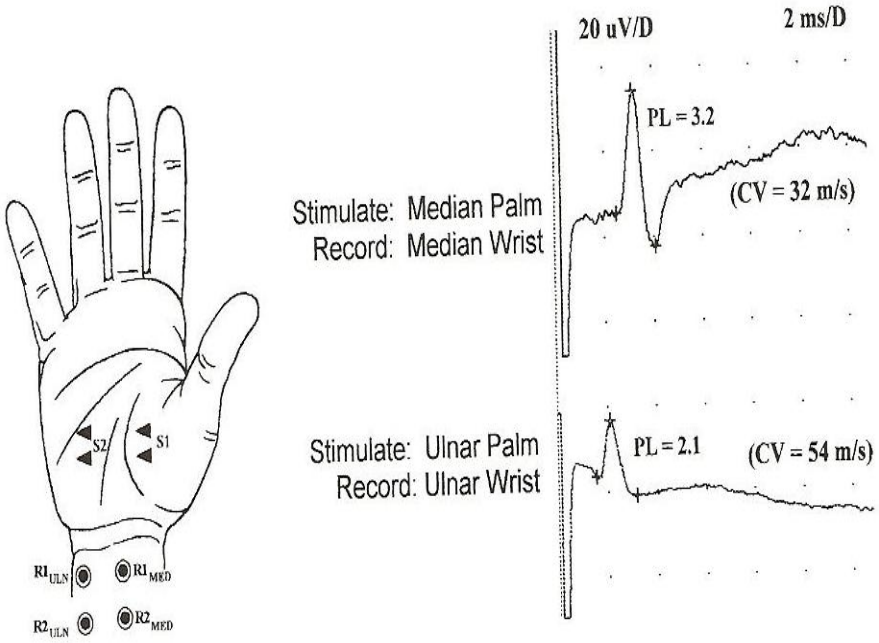
(nocturnal parasthesia, pain, sensory symptoms of 1,2,3 and half of the 4 digit), weakness/wasting of thenar eminence and phalen's manoeuvre reproduces the symptoms

- Nerve conduction studies

. Median vs ulnar comparison studies

. Median vs ulnar Digit 4 sensory Latencies

. Median 2nd lumbrical vs ulnar interossei distal motor latencies



PALMAR MIXED COMPARISON STUDY

Mononeruopathies

- **Proximal median neuropathy**
  - Proximal entrapment by the ligament of Struthers
  . Rare
  . Pain, parasthesia of innervated digits, weakness of PT& other median innervated muscles

  - Pronator syndrome
  . More common
  . Tinel's sign over the site of entrapment
  . Pain, parasthesia, mild weakness of median – innervated muscles

  - Anterior interosseous nerve syndrome
  . Innervate FPL, FDP, PQ
  . Unable to flex distal phalanx of innervated fingers
  . Weakness of pronation (weakness of PQ)

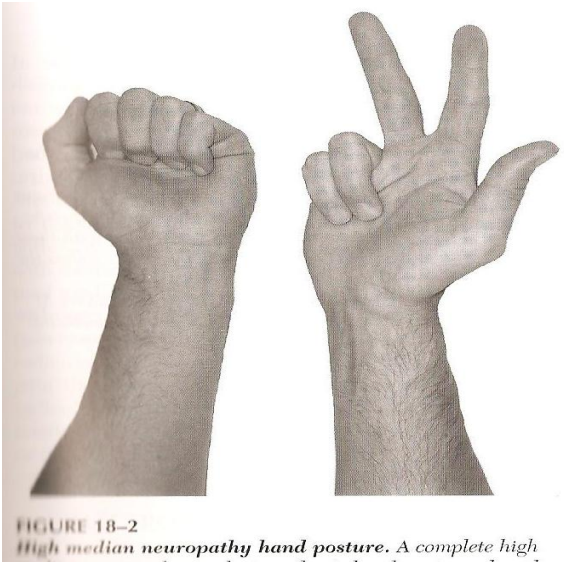


FIGURE 18–2
High median neuropathy hand posture. *A complete high*

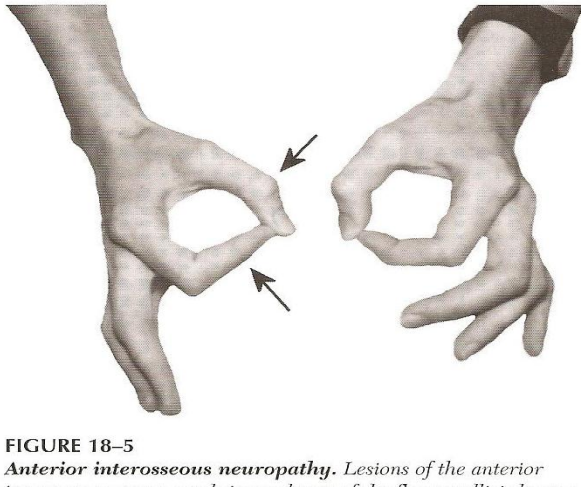


FIGURE 18–5
Anterior interosseous neuropathy. *Lesions of the anterior*

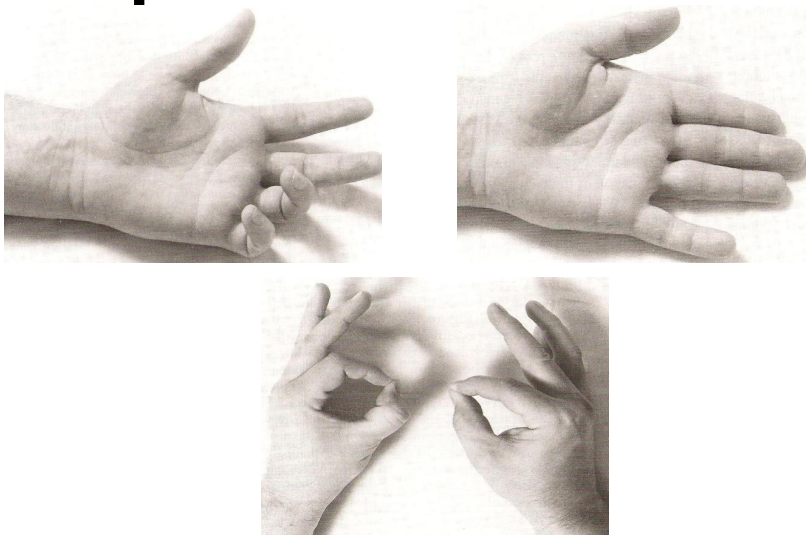
"OK" Sign

Mononeruopathies

- **Ulnar neuropathy at the Elbow**

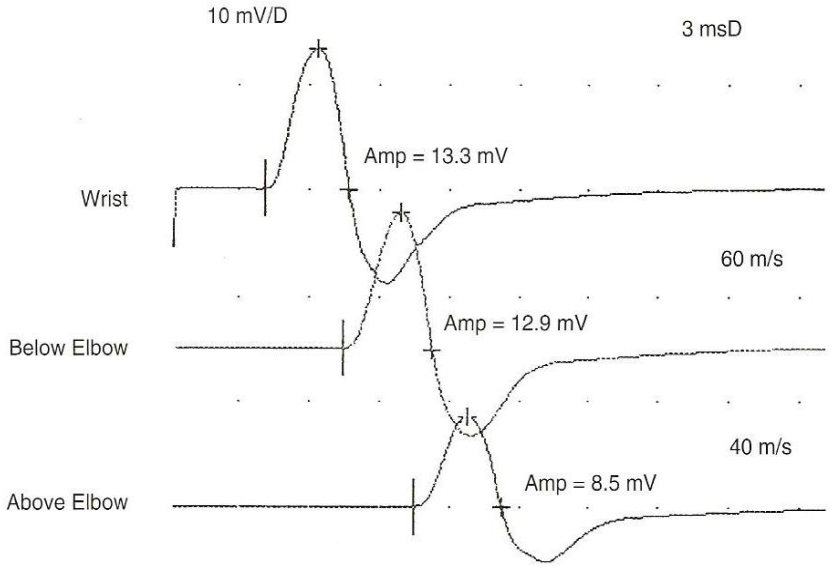
  - Clinical,

  Pain, sensory disturbance,
  Benediction posture, Wartenberg's sign,
  fromaent's sign



- Nerve conduction studies

. CMAP normal at wrist
. CMAP normal below the elbow
. Decrease amplitude
. Focal slowing Above elbow (40m/s)



Mononeruopathies

- **Ulnar neuropathy at the Wrist**

- Clinical

pain less weakness & atrophy of ulnar intrinsic hand muscles, both hypothenar & thenar wasting, in advanced cases may find (Benediction posture, Wartenberg's sign, fromaent's sign)

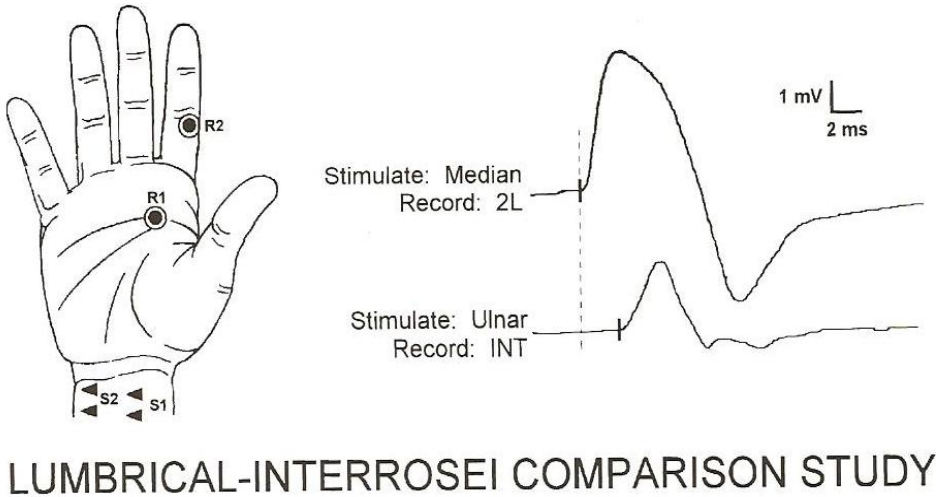
± sensory disturbances

- Nerve conduction studies

Lumbrical – interrosei comparison study

. Prolonged latency

. Low amplitude



LUMBRICAL-INTERROSEI COMPARISON STUDY

Mononeruopathies

- **Radial neuropathy**

  - Clinical

  . most common site at spiral groove (Saturday night palsy) but can be in axilla or post. Inerosseous neuropathy or superficial radial sensory neuropathy

  . wristdrop, fingerdrop, weakness of supination and elbow flexion, sensory disturbances

- **Nerve conduction studies**

  . Compared the contralateral arm

  . Marked drop in amplitude and area across the spiral groove (conduction block)

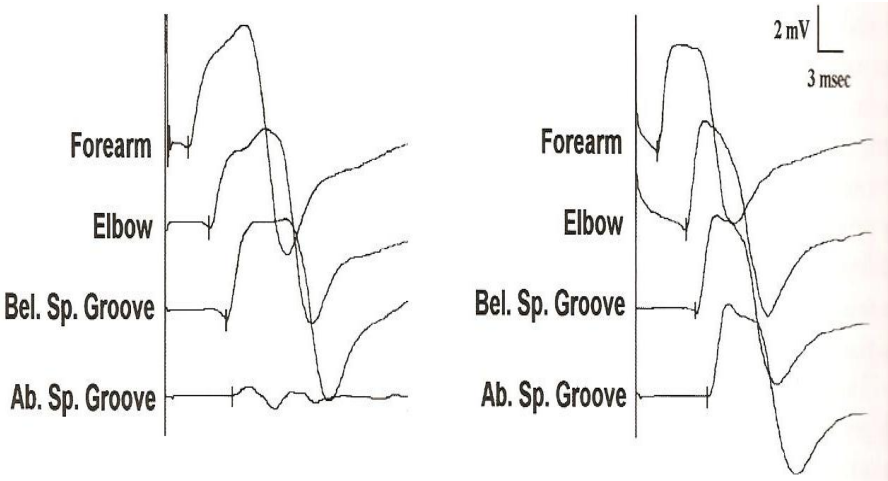


FIGURE 21–8
*Radial motor studies for radial neuropathy at the spiral groove. **Left:** Symptomatic arm. **Right:** Contralateral asymptomatic*

Mononeruopathies

Peroneal neuropathy

- Clinical

. At fibular neck

. Foot and toe drop

. Weakness of foot eversion

. Steppage gait

. Sensory disturbances

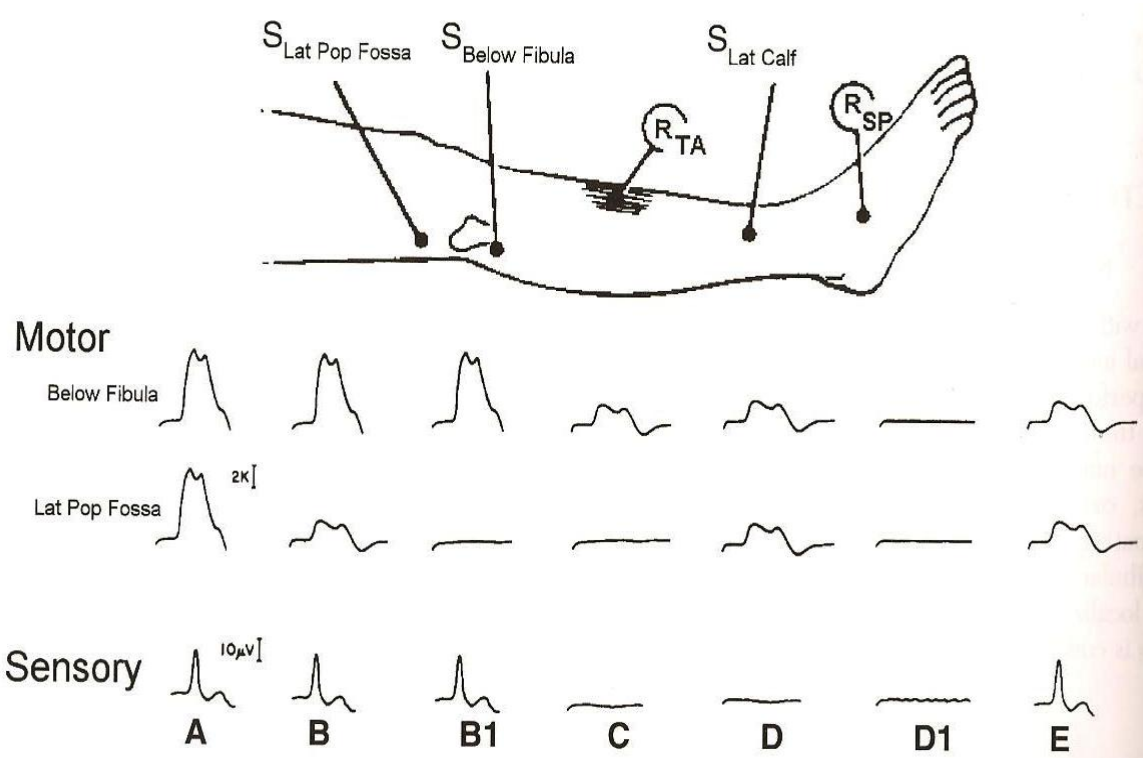
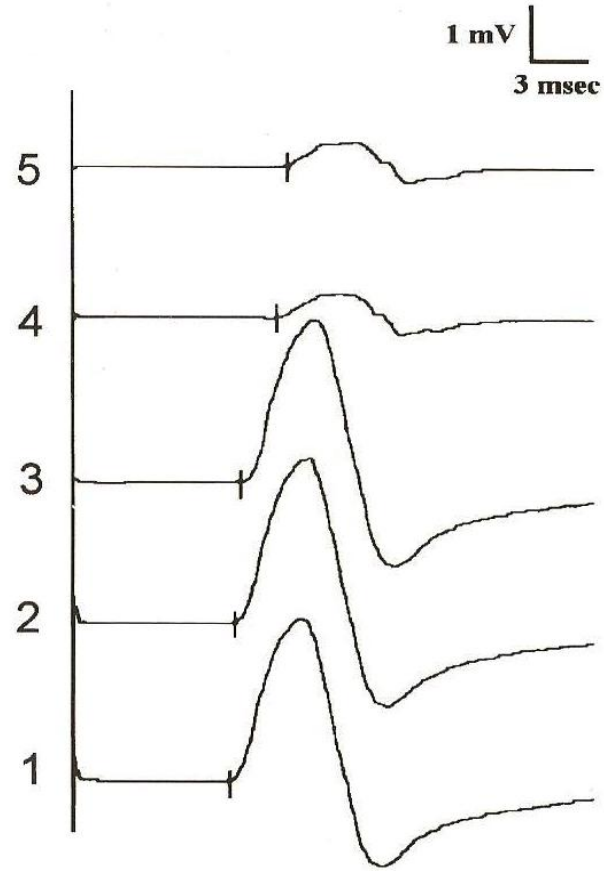


FIGURE 22–6

Nerve conduction patterns in peroneal neuropathy. *In each panel, the waveforms at the* ***top*** *are peroneal motor waveforms, stimulating below fibular head and recording the tibialis anterior; the waveforms in the* ***middle*** *are peroneal motor waveforms, stimulating the lateral popliteal fossa and recording tibialis anterior (TA); the waveforms at the* ***bottom*** *are superficial peroneal (SP) sensory waveforms, stimulating the lateral calf and recording the lateral ankle.* ***A:*** *Normal.* ***B:*** *Partial conduction block.* ***B1:*** *Complete conduction block.* ***C:*** *Complete conduction block with axonal loss.* ***D:*** *Partial axonal loss.* ***D1:*** *Complete axonal loss.* ***E:*** *Partial axonal loss lesion of deep peroneal nerve. (Note: This last pattern can also be seen in L5 radiculopathy or anterior horn cell disorders.) (Adapted from Katirji MB, Wilbourn AJ. Common peroneal mononeuropathy: a clinical and electrophysiologic study of 116 lesions. Neurology 1988;38:1723. Reprinted with permission from Little, Brown.)*

Mononeruopathies



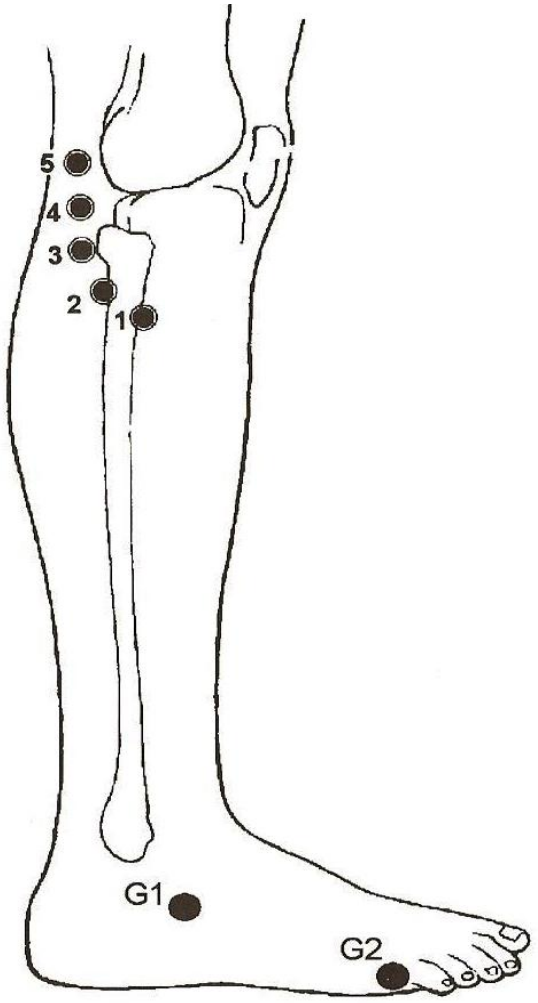


FIGURE 22–7
Conduction block across the fibular neck. *The common peroneal nerve is stimulated, and the extensor digitorum brevis is recorded.* ***From bottom to top:*** *Stimulating below the fibular neck and proceeding proximally in 1-cm increments.*

Mononeruopathies

- **Femoral neuropathy**

  - Clinical

  . Buckling of the knee (quadriceps)

  . Dragging of the leg (iliopsoas)

  . Sensory disturbances (medial & anterior thigh and medial calf)

  . Depressed or absent quadriceps reflex

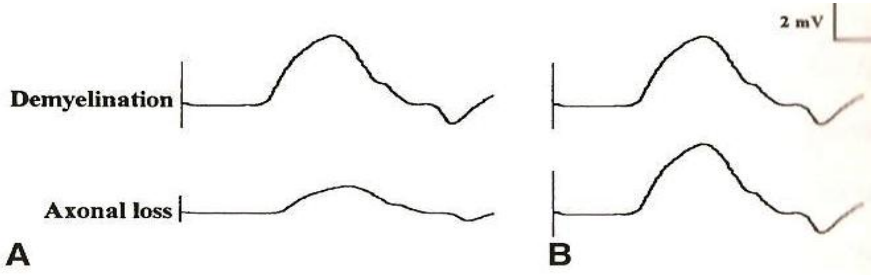
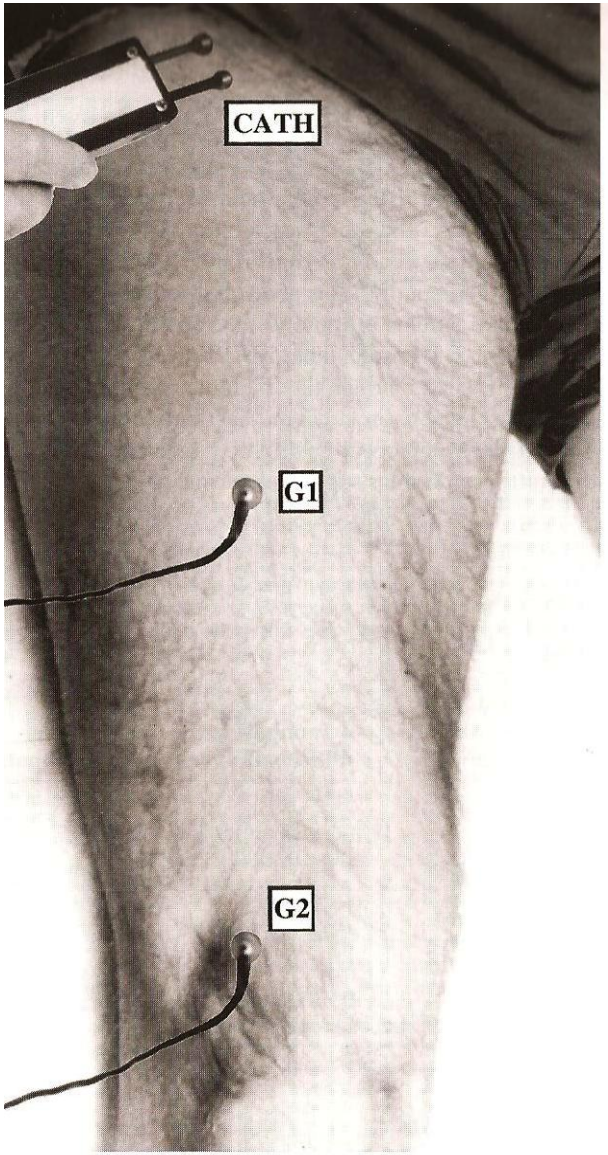
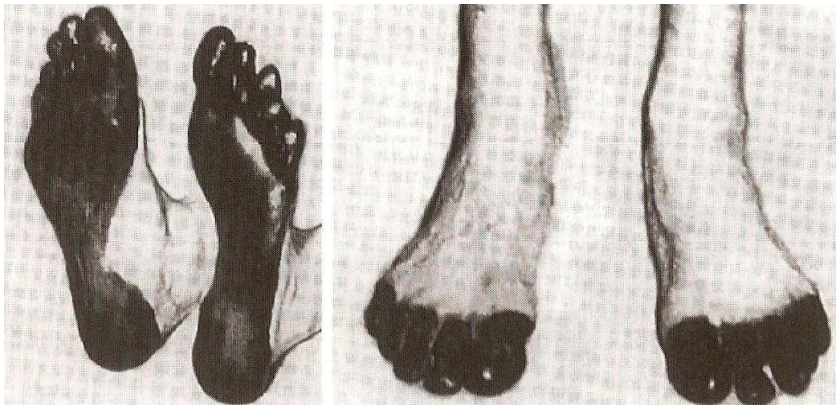


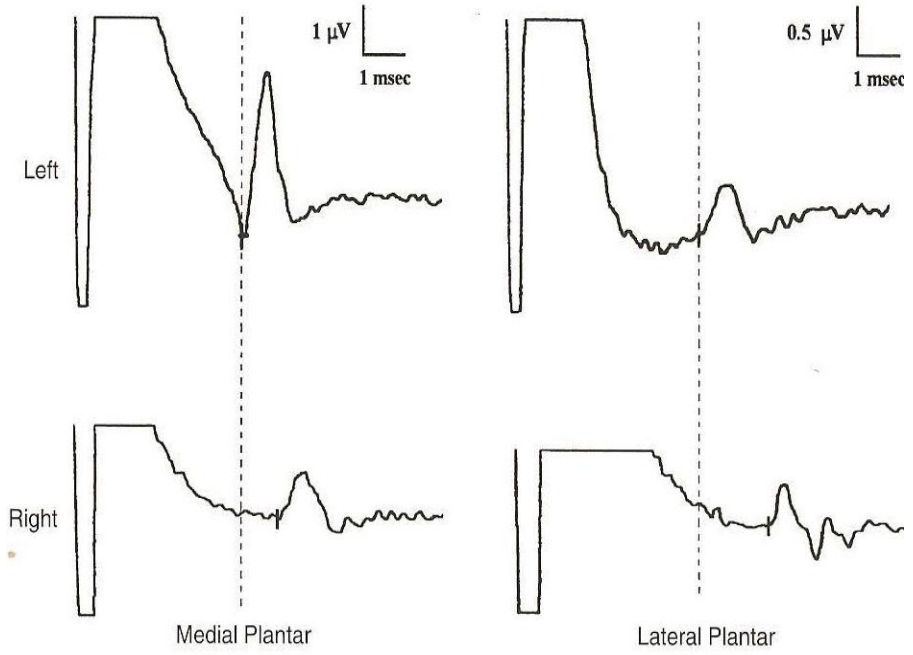
FIGURE 23–4
Femoral motor studies. *For lesions older than 1 week, the amplitude of the femoral compound muscle action potential (CMAP) on the symptomatic side* ***(A)*** *compared with that on the contralateral asymptomatic side* ***(B)*** *reflects the number of intact axons. In a purely demyelinating lesion, the femoral CMAP will be normal if the nerve is stimulated distal to the lesion. In axonal loss lesions, the CMAP amplitude will decrease in proportion to the amount of axonal loss. Prognosis and recovery time depend on the amount of axonal loss.*



Mononeruopathies

- **Tarsal Tunnel Syndrome (TTS)**
  - **- Clinical**
    - . Perimalleolar pain
    - . Ankle & sole pain
    - . Parasthesia & sensory loss involving the sole of the foot
    - . Intrinsic muscle atrophy (not specific / L5-S1 Radiculopathy)
    - . Tinel's sign (non specific)





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