

Cervical RADICULOPATHY

Electrodiagnosis

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OBJECTIVES

- WILL LEARN
 - 1) EDX of cervical radiculopathy
 - 2) Chronology of EDX ABNORMALITIES
 - 3) HOW TO ASSESS SEVERITY

Frequency of cervical radiculopathy

- C7 > C6 > C8 > C5
- This same in all large series

Importance of cervical paraspinals

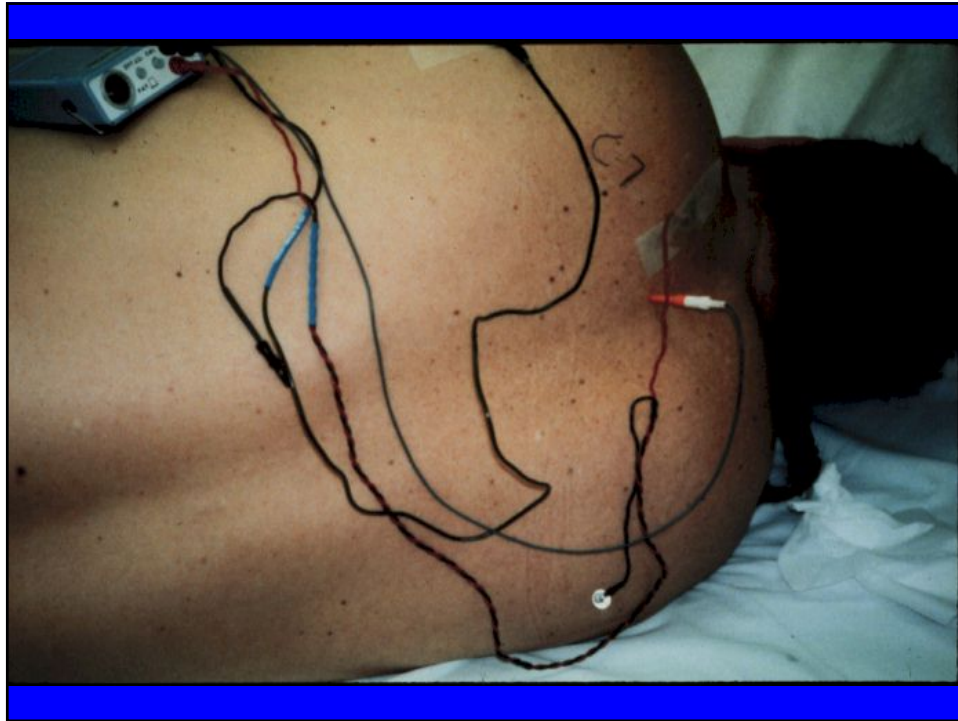
NOTA BENE!

It is difficult if not IMPOSSIBLE to diagnose cervical radiculopathy without EMG abnormalities in POSTERIOR PRIMARY NERVE DISTRIBUTION!

Position for EMG in cervical radiculopathy

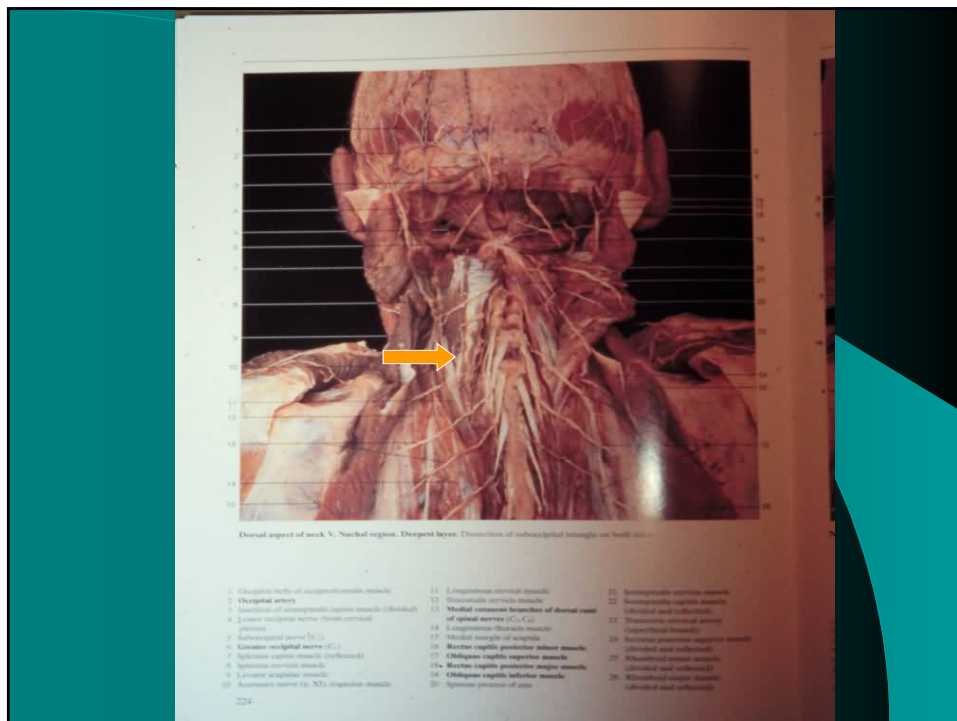
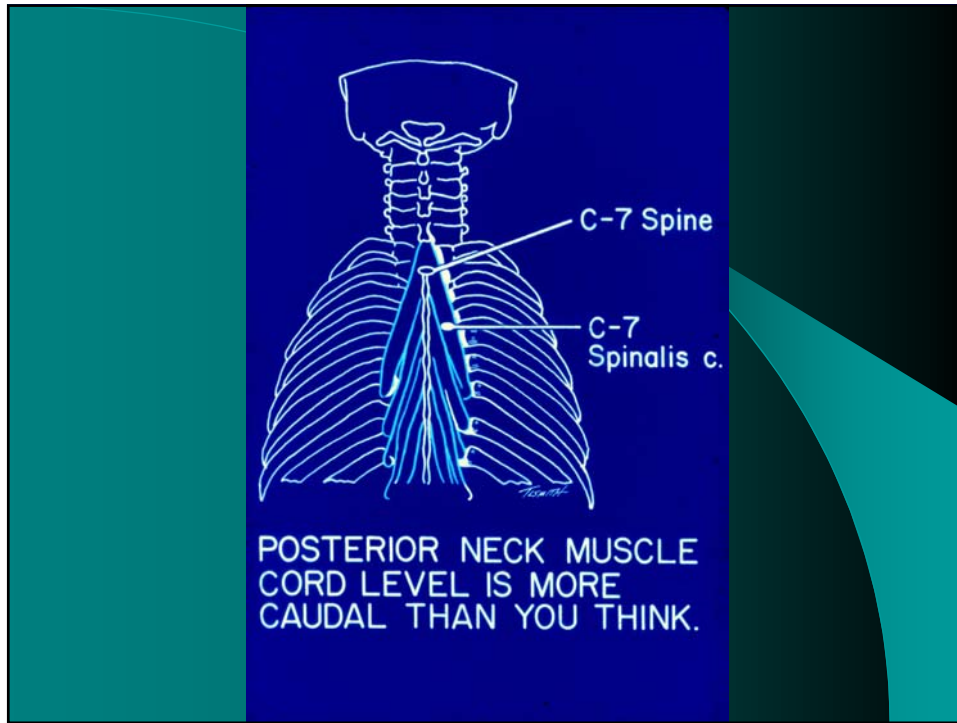
- Ideal – recumbent, prone, with pillows under chest to keep neck flexed
- Optional – side-lying with pillows holding head at right angle to body





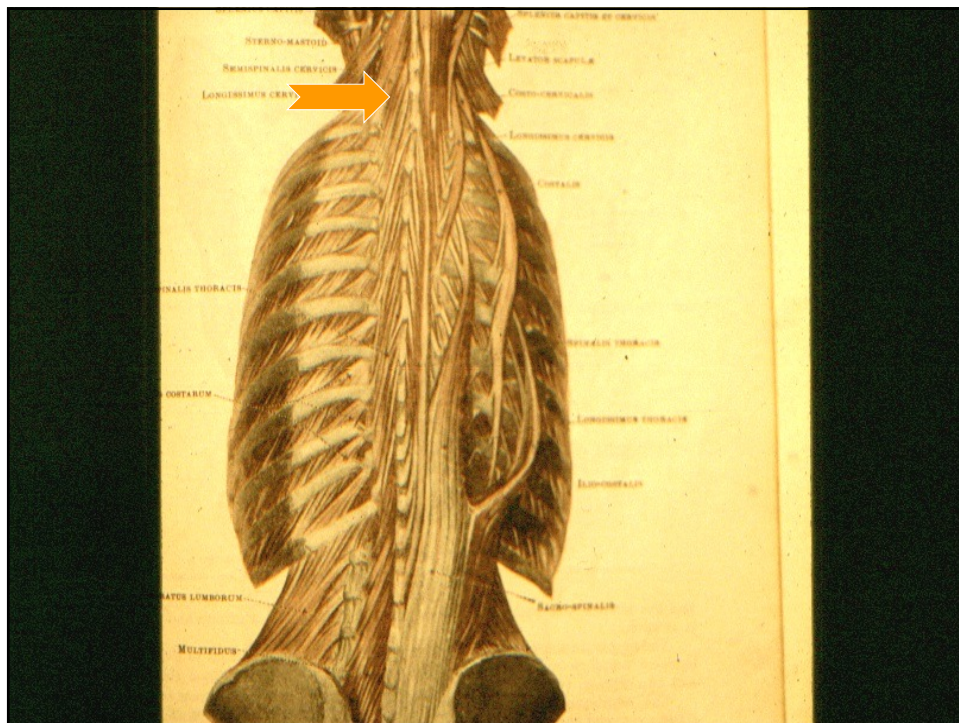
WHERE TO INVESTGATE

- POSTERIOR PRIMARY RAMI
- **MORE CAUDAL THAN YOU THINK!**
 - *C-6 is 1-2 CM CAUDAL TO TIP OF C-7 SPINOUS PROCESS*
 - *C-7 is at TOP OF MEDIAL SCAPULA*
 - *C-8 is at MID SCAPULA*



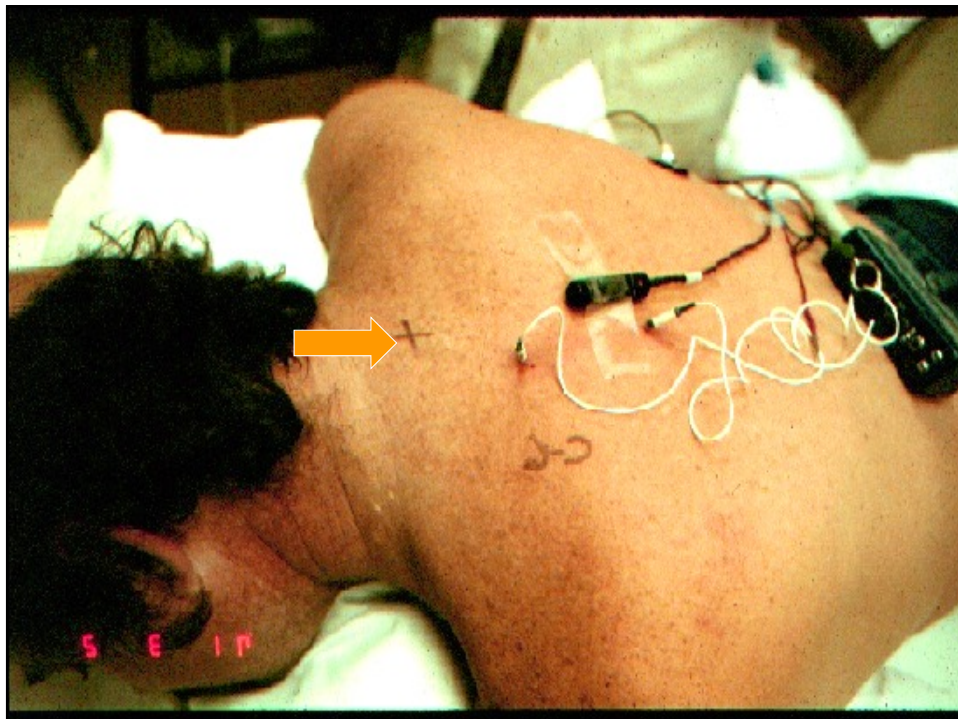
Note arrow at C-6 myotome

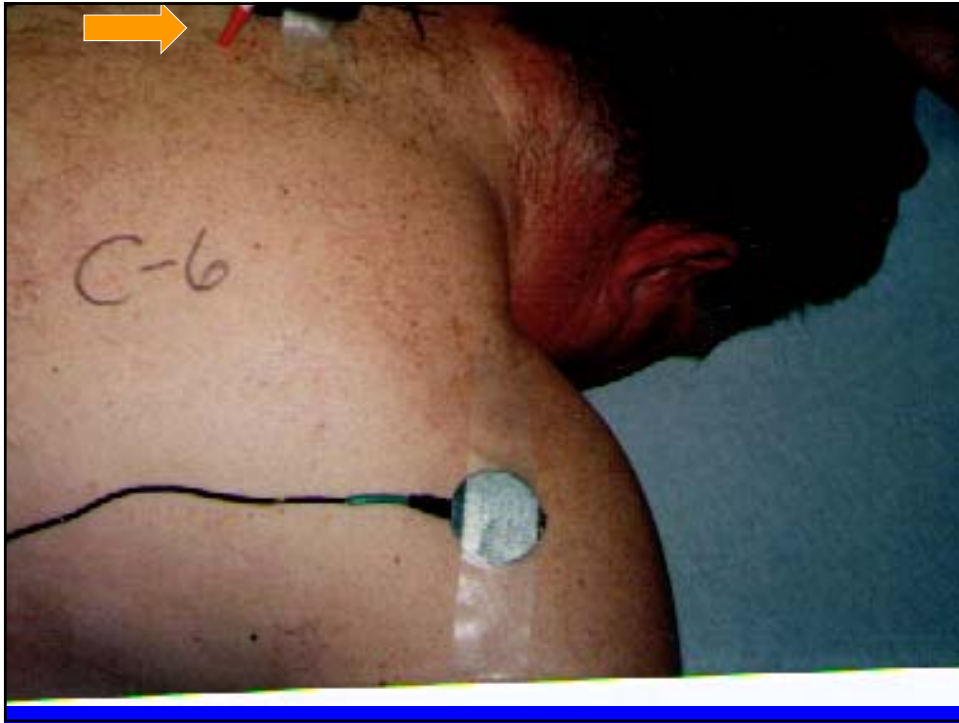
Also see course of muscles supplied
by posterior primary rami



Note that C6 myotome (posterior primary innervation) is below tip of C7(*arrow*) spinous process

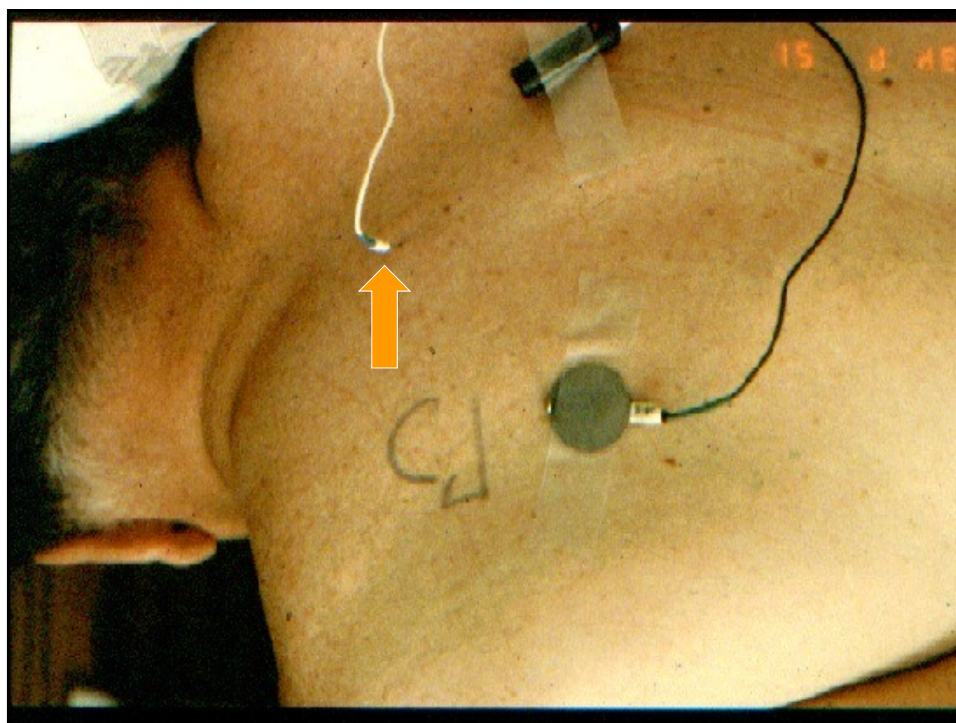
C7 myotome is 2 cm caudal and lateral to process

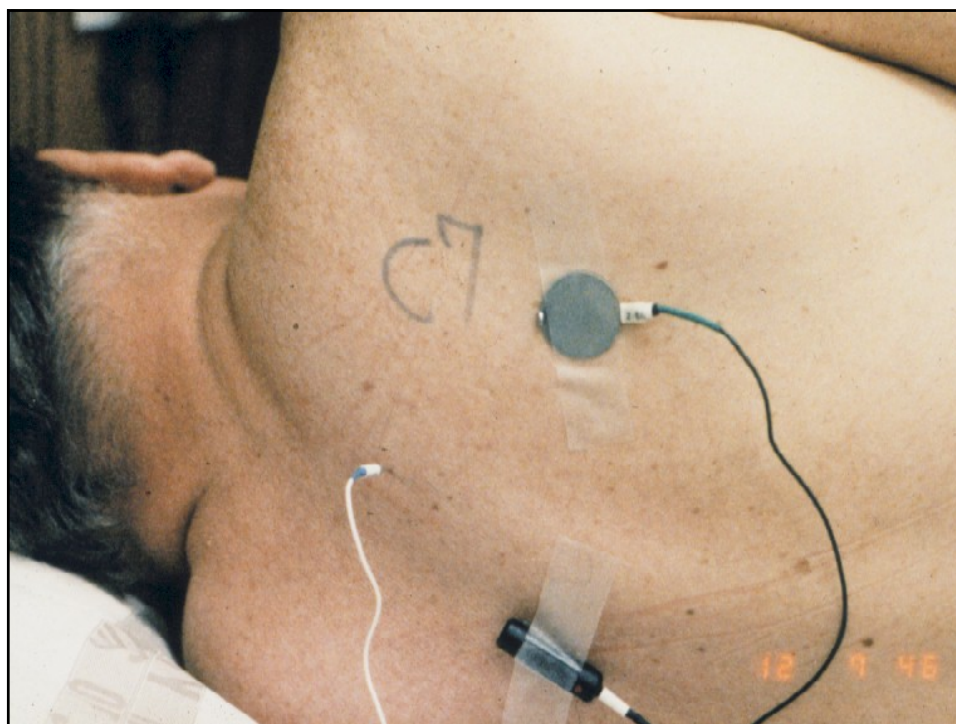




Note arrow points to myotome of
C-7

More caudal than one thinks





C8 myotome

This location is at the middle of the scapula!

CERVICAL RADICULOPATHY *CHRONOLOGY*

- 1ST WEEK – H reflex latency (C-7?) and
- reduced recruitment; “early polyphasic”
- 2d WEEK - positive waves in post neck muscles; also CMAP will reflect true weakness - compare with contralateral
- 3d WEEK – abnormal irritability in proximal limb muscles

Crane & Krusen - 1968

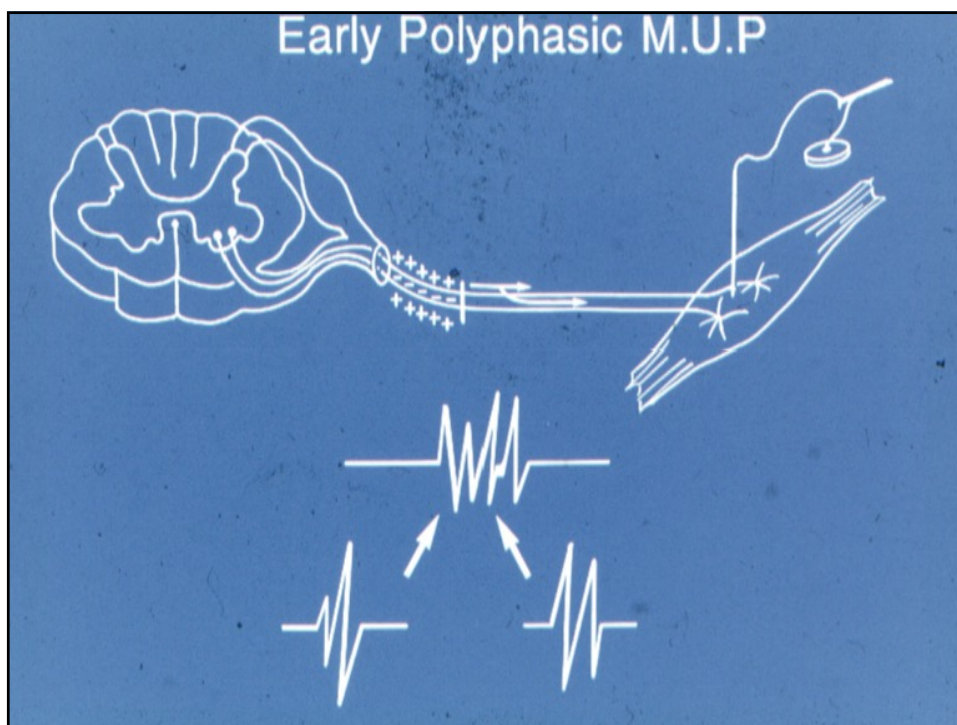
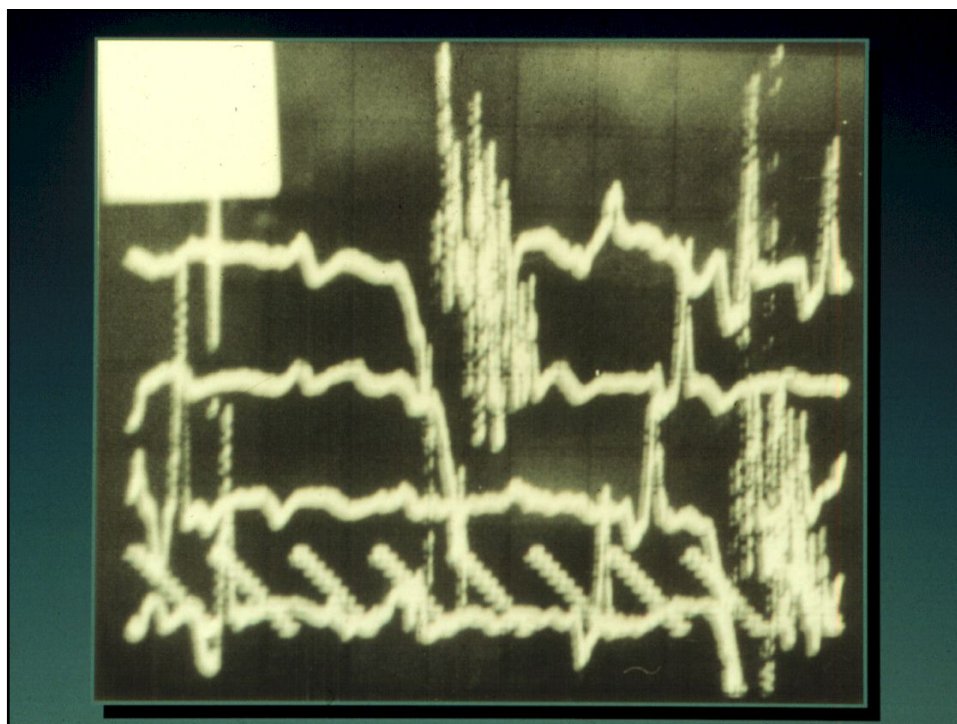
Reported polyphasic MUP's in cervical radiculopathy *before* fibrillations and positive waves

“Early polyphasic” in cervical radiculopathy

- Ephaptic activation of neighboring axons will result in an apparent polyphasic MUP
- Occur in 1st few days – before positive waves and fibrillations
- In 1970’s EMG’ers reported polyphasic MUP’s before fibs & positive waves

“Early polyphasic” MUP

- A football injury-
 - Tight end
 - ‘Stinger’ in Saturday game
 - EDX on Tuesday (4 days later)



“Early Polyphasic MUP”

- There is ephapsis at inflammed area of root
- The nerve impulse down axon activates (by this ephapsis) several adjacent axons
- These axons conduct at a slightly differing rate
- The recorded MUP's are synchronous but not simultaneous – thus – what appears to be – a *polyphasic MUP OR if separated – “group discharge”*

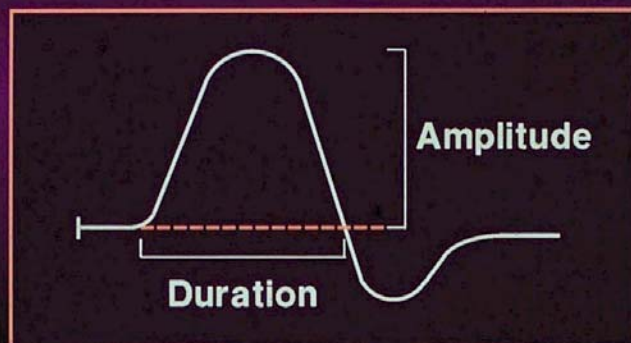


PROGNOSIS – CERVICAL RADICULOPATHY

- COMPARE CMAP TO CONTRALATERAL
- IF 50% OR GREATER – GOOD
- IF <50% not so good
- Collateral innervation will help

– *Normal side-to-side diff: <10%*

Negative Spike of Evoked Compound Muscle Action Potential



CMAP amplitude for prognosis

- Infraspinatus for C6
- Lateral head triceps br for C7
- Pronator quadratus for C8
- Abd dig min for T1

Value of CMAP of weak muscle

True weakness –

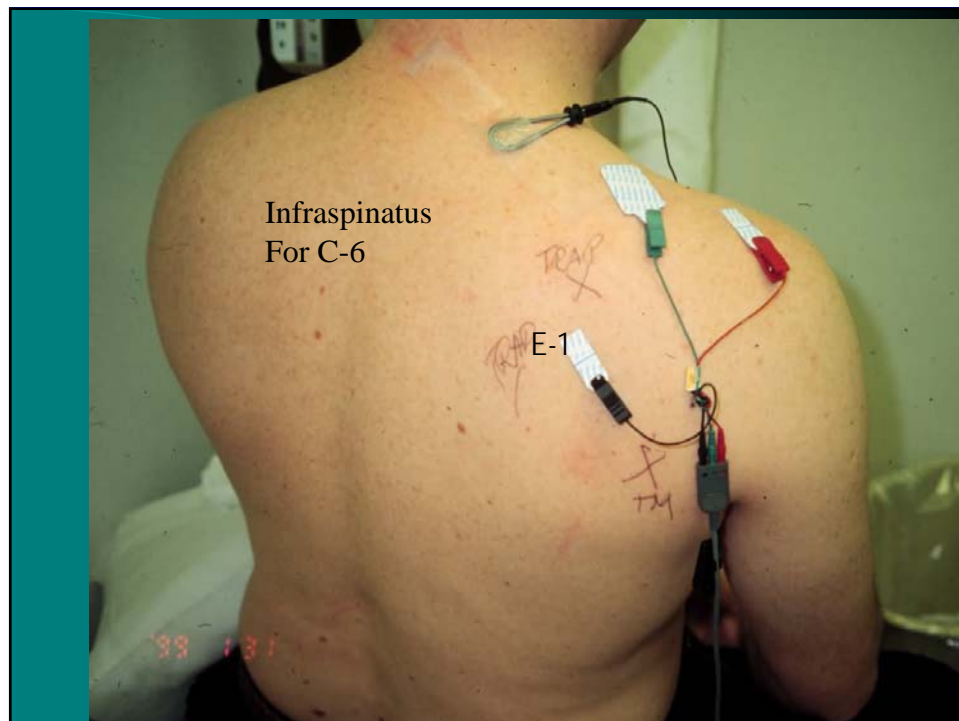
– Therefore, the operation – *no use*

Conduction block – ‘neurapraxia’

– Operation – *no need*

Record with *surface* electrodes

- If one records with needle electrode
 - *Only latency is recorded*
 - CMAP amplitude not available!
 - CMAP duration not available!
 - CMAP shape not available!



For C-8 NOTE THAT *E-1* is over
the DISTAL *DORSAL*
FOREARM (pronator quadratus)
E-2 is over ulnar head

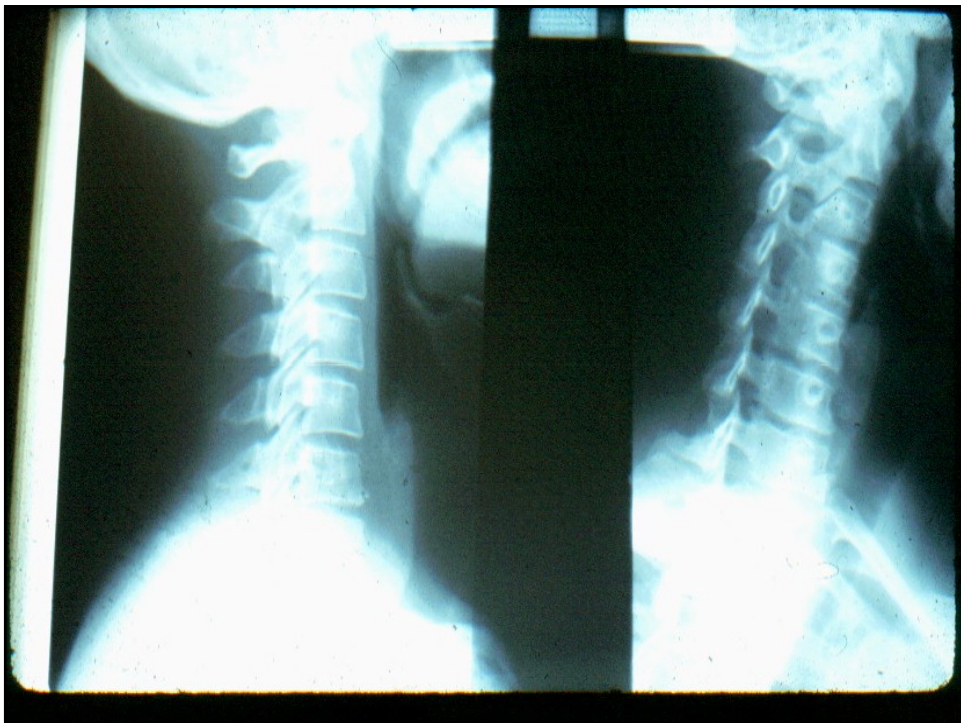
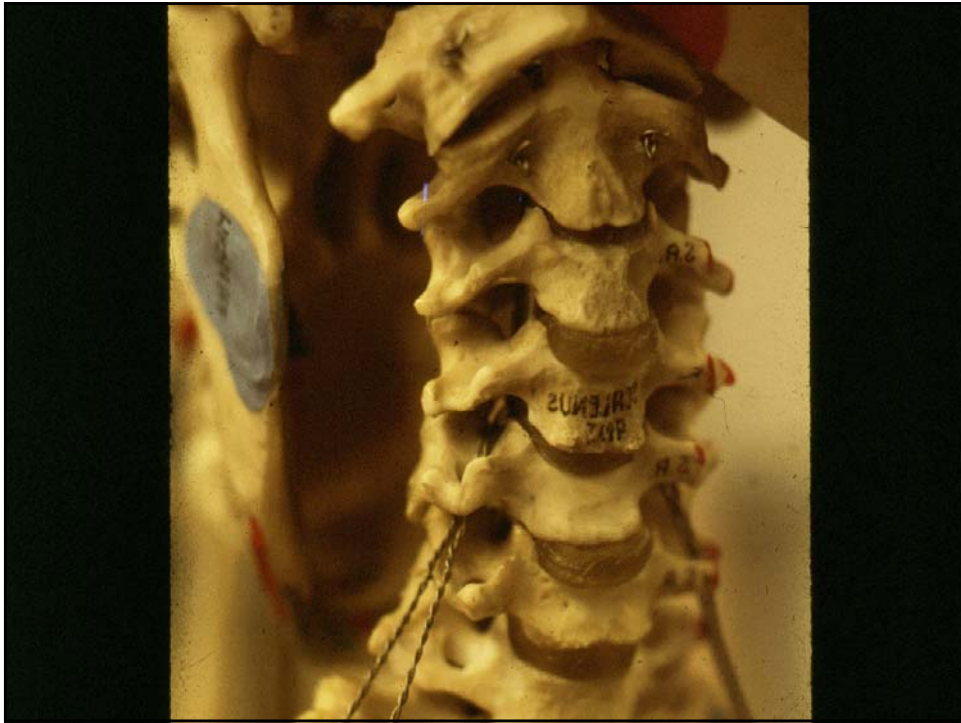


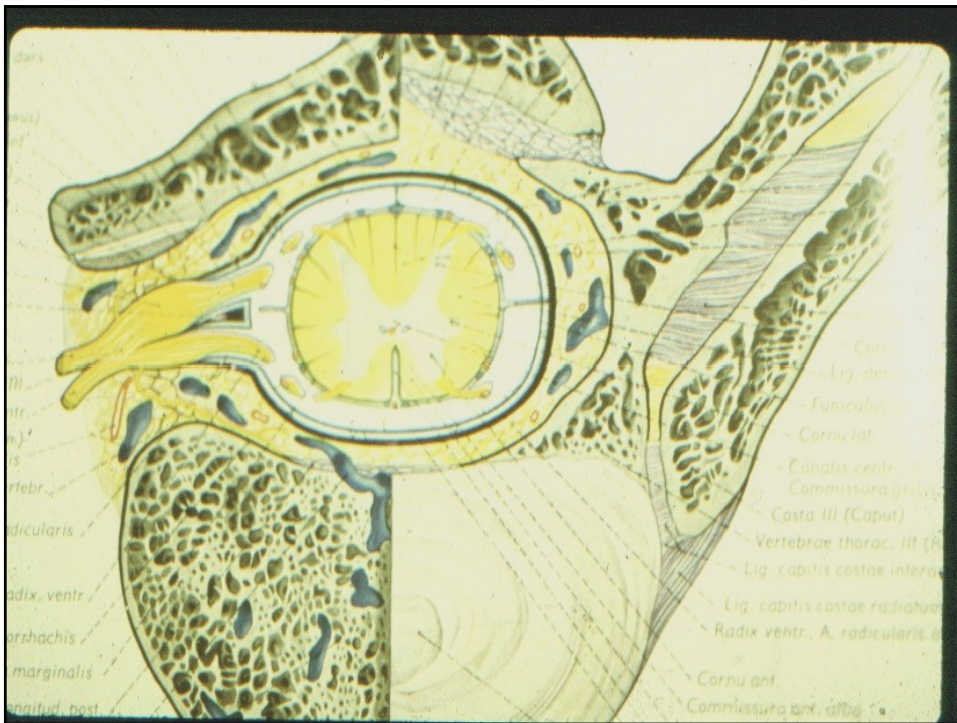
Bifocal as cause of cervical radiculopathy

- Middle age individual
 - Presbyopia
 - Degenerative disk disease (C5-6)
 - Computer with neck extended
 - “no-line or bifocal” results in more neck extension
 - ERGO – C-6 RADICULOPATHY

Joints of ‘Luschka’

Spurs form and result in radiculopathy



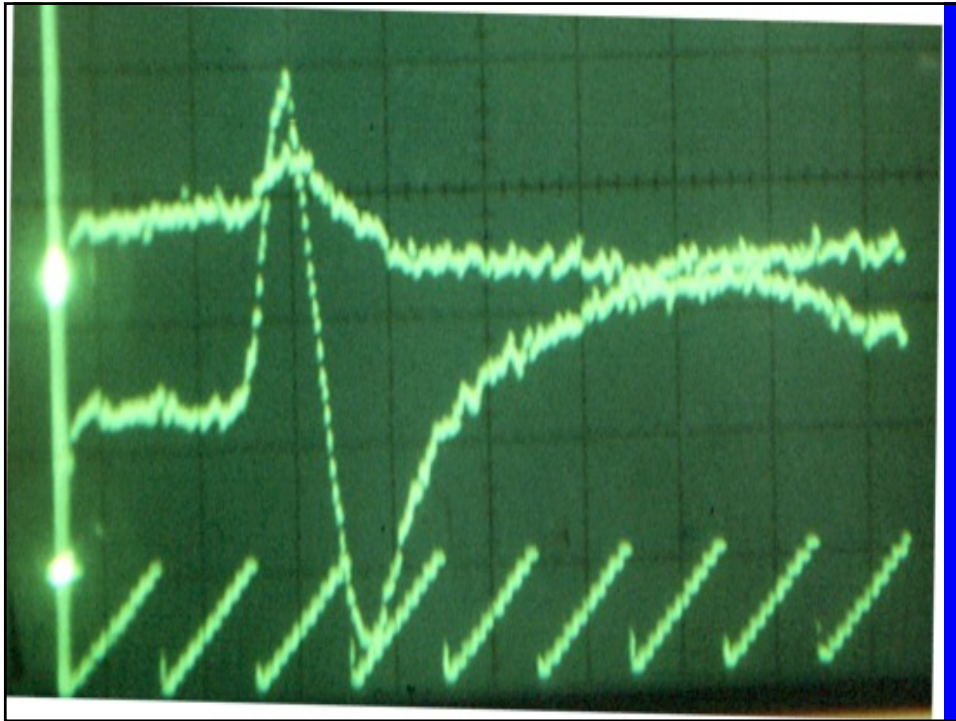


DX – C-6 RADICULOPATHY

- NUMBNESS & TINGLING THUMB
- MSR – biceps br -reduced
- WEAKNESS
 - SHOULDER EXTERNAL ROTATORS
 - WRIST EXTENSION
 - FOREARM PRONATION

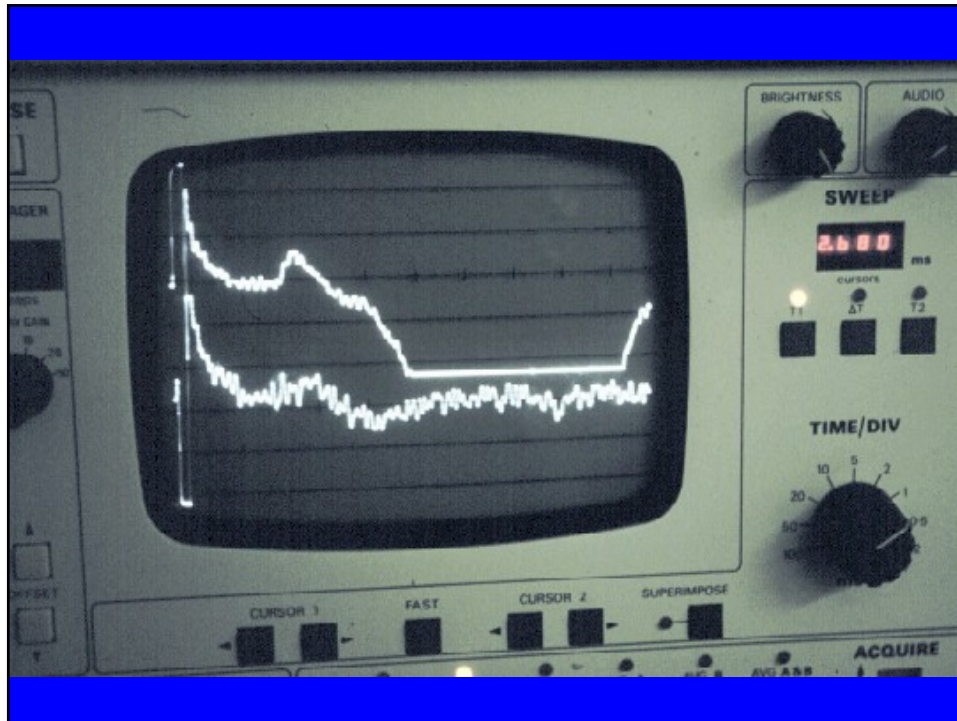
SNAP – DIGIT 1

Normal values – under 3.0 ms –
Median 35 uV; radial 15 uV



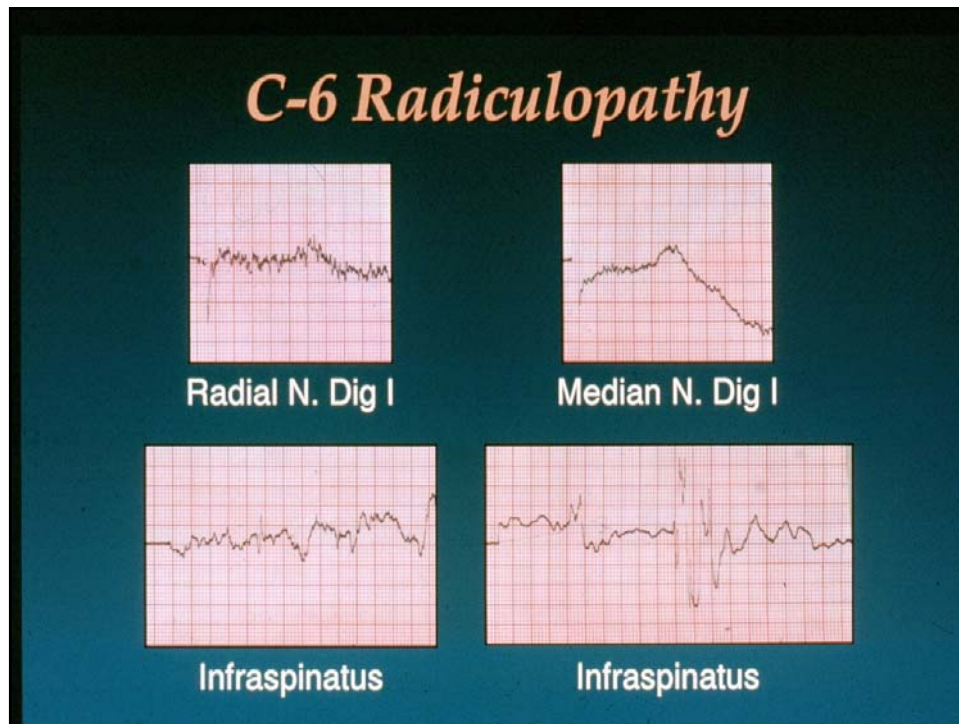
NUMB THUMB IN C-6 RADIC

- SNAP – DIG 1
 - MEDIAN – LATENCY NORMAL; AMPL IS REDUCED
 - RADIAL – LATENCY; AMPL IS REDUCED
 - “Pannozzo-Minard-Kadyan index” is sum of SNAP’s from median and radial nerves to dig 1. Less than 25 uV = probable C-6 radiculopathy
 - NB. *Compromise is at or distal to dorsal ganglion*



PANNOZZO-JOHNSON INDEX

***'NUMB THUMB HAS 'NORMAL
LATENCIES BUT **SUM OF SNAP**
amplitudes Radial and Median <25
uV***

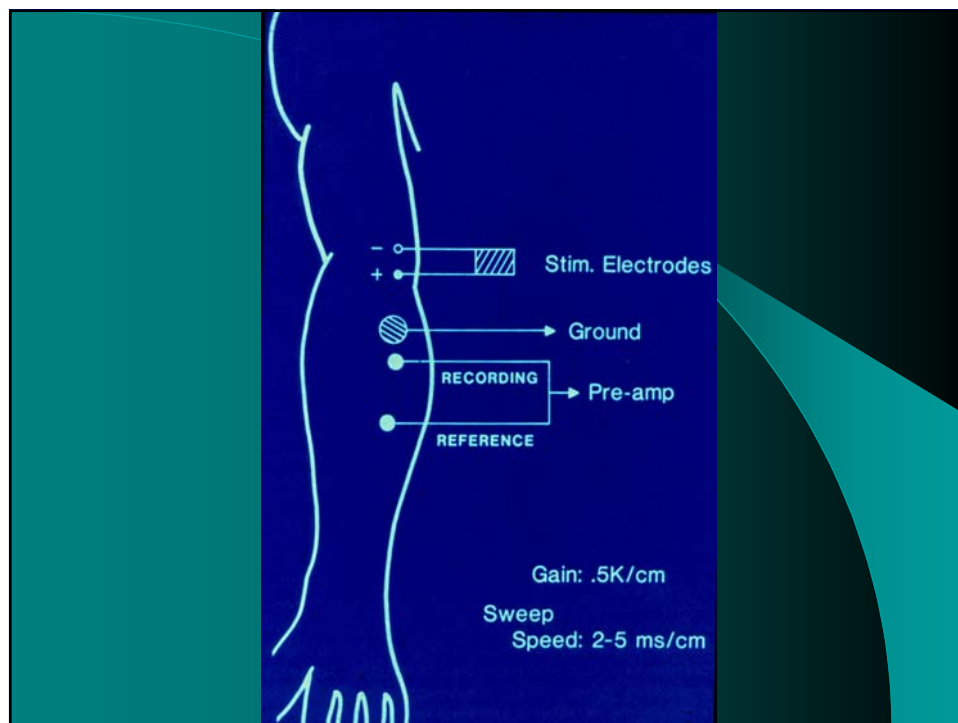


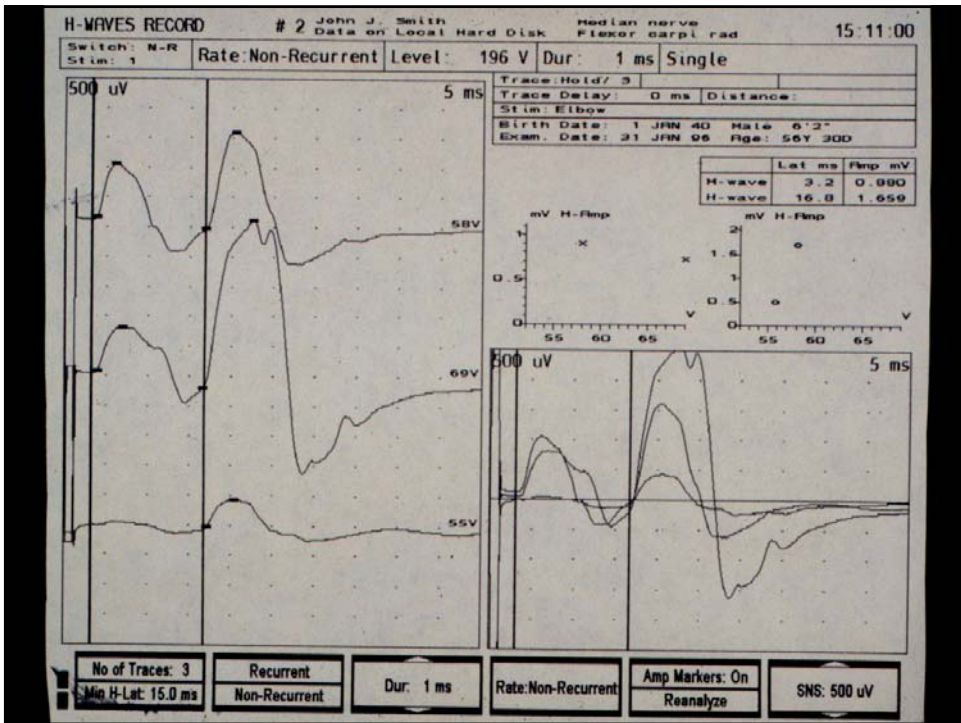
EDX VALUE OF SNAP

- DORSAL GANGLION IS USUALLY DISTAL TO HNP
- ERGO. NO CHANGE IN AMPLITUDE
- IF COMPROMISE TO ROOT is at, or DISTAL TO DORSAL GANGLION: SNAP AMPLITUDE WILL BE REDUCED

H RELEX IN FLEXOR CARPI RADIALIS

- E1 OVER FLEX C RAD
- E2 OVER TENDON
- STIMULATE MEDIAN NERVE WITH CATHODE PROXIMAL
- LOW INTENSITY – 1 MILLISEC DUR.





Cervical radiculopathy “the minimum # of muscles”

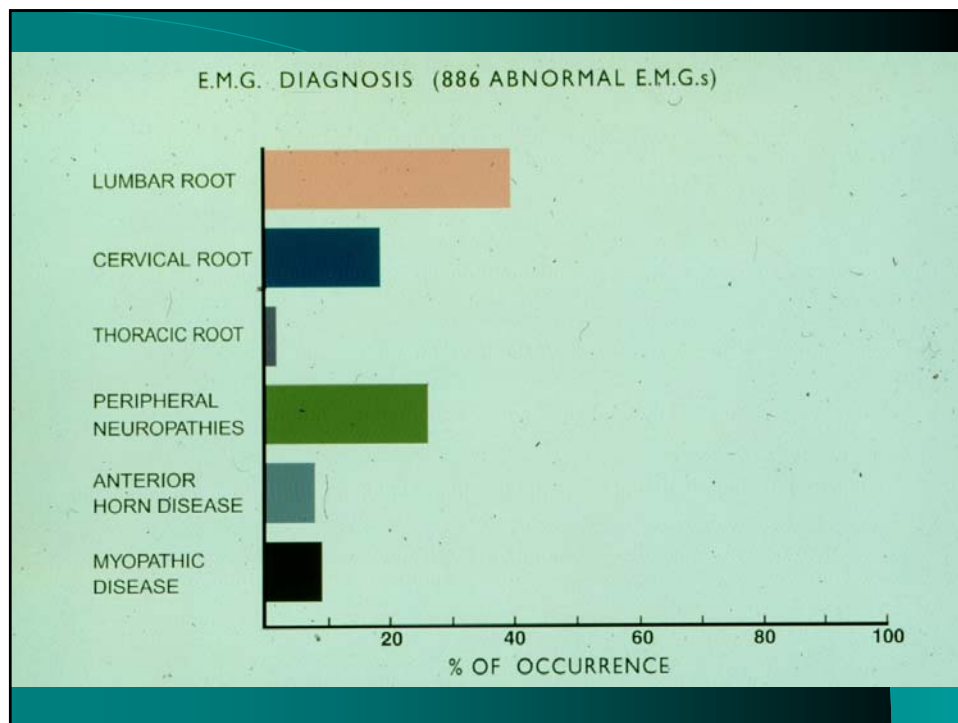
- Proximal muscle with suspected root
- Distal muscle with suspected root
- One proximal & distal to suspected root
- One from each of 2 different nerves
- *Of course, the posterior primary rami*

H REFLEX IN CERVICAL RADICULOPATHY

- WE BELIEVE IT SERVED BY C-7
- SIDE-TO-SIDE DIFFERENCE \neq $>$ 1 MS
- *NB. IF UNABLE TO GET H WAVE, surrogate is 10 F WAVES (MEAN 1.5 MS LONGER THAN H LATENCY)*

Earliest needle EMG findings are:

- Increased recruitment frequency (onset)
- “early polyphasic MUP’s” (first few days)
- 7 + days positive waves in post neck mus
- SNAP reduced in foraminal encroachment
- H reflex latency increased (C-7)



Structure vs Function

- MRI, CT and other Xrays show *structure!*
- EDX reveals *function*
 - They are complementary NOT substitutive

Cervical – BOTTOM LINE

- Location of posterior primary rami is more caudal than you think
- Use SNAP of digit I for location of compromise (C-6) pre & post ganglion

Stedman – 25th Ed.

extremitas (eks-trem'i-tas)

[L. fr. *extremus*, last, outermost] [NA].

Extremity; one of the ends of an elongated or pointed structure.

Incorrectly used to mean Limb.

See membrum.

references

- Magladery, J & McDougal, D:
Electrophysiological studies of nerve and reflex activity in normal man: Identification of certain reflexes in electromyogram and nerve conduction velocity of peripheral nerves. 1950. Johns Hopkins Hospital Bull.86:265.
- Johnson, E, Radecki, P & Paulson, G: Huntington Disease: early identification by H reflex testing. 1977. Arch PM&R. 58:162

references

- Braddom, R & Johnson, E: H reflex: review and classification with suggested clinical uses. 1974 Arch PM&R. 55:412
- Braddom, R & Johnson, E: Standardization of H reflex and diagnostic use in S-1 radiculopathy. 1974. Arch PM&R. 55:161
- McHugh, D et al: H reflex amplitude: Effect of leg muscle activity. 1997. Am J PM&R. 76:185

references

- Magladery, J & McDougal, D: Electrophysiological studies of nerve and reflex activity in normal man: Identification of certain reflexes in electromyogram and nerve conduction velocity of peripheral nerves. 1950. Johns Hopkins Hospital Bull.86:265.
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references

- Ishikawa, et al: Low frequency depression of H reflex in normal and spinal man.1966 Exp Neurol. 15:140
- Hohmann, T & Goodgold, J: Study of abnormal reflex in spasticity. 1961. 40:52
- Teasdall,R et al: Electrophysiologic studies of reflex activity in patients with lesions of CNS. 1952 Bull Johns Hopkins Hosp. 91:267

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