

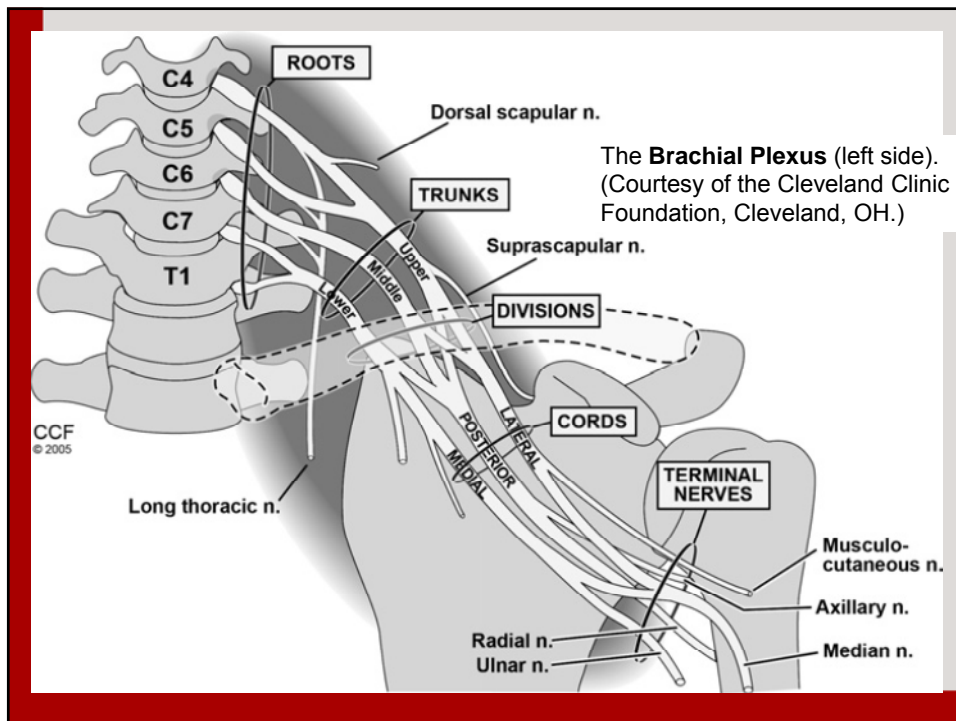


EMG Exam for Brachial Plexus Injuries, etc.

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Wexner
Medical
Center



Case 1

32 yo F Left Shoulder Pain

- Non-helmeted passenger on small MC hit by SUV at intersection
- Mod TBI
- Sensation-slight decr lateral forearm
- Strength
 - Elb Flex 3+ (brachioradialis prominent)
 - Sh Abd 4
 - Sh Ext Rot 4
 - El ext, Wr ext, hand = 5

Case 1

32 yo F Left Shoulder Pain



9 d post-injury

Differential Diagnosis

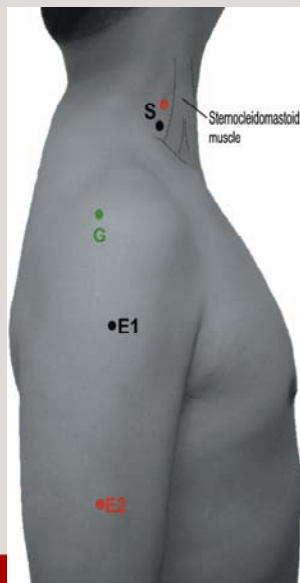
- Brain, motor pathways
- Brachial Plexus
- Axillary and/or musculocutaneous nerve
- Cervical radiculopathy (C5, C6)
- Painful shoulder/arm, “giving way”

Case 1

32 yo F Left Shoulder Pain

- Motor-NCS (6 wk post-injury)
- L Musc-Cut (Biceps) No Response
- L Axillary (Delt) 2.5 ms 0.15 mV

Axillary Nerve

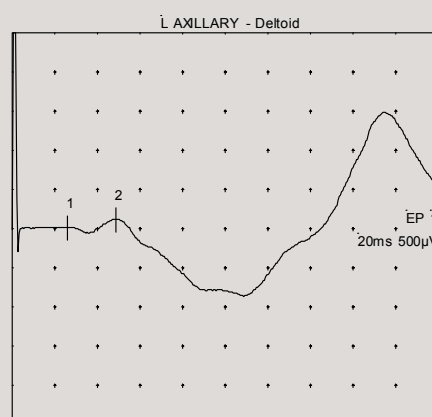


E1	Midway between acromion and deltoid tubercle	
E2	At deltoid tubercle	
G	Between the stimulating point and active electrode	
S	Cathode	Supraclavicular fossa
	Anode	Superomedially

Normal values (9) (n = 62)

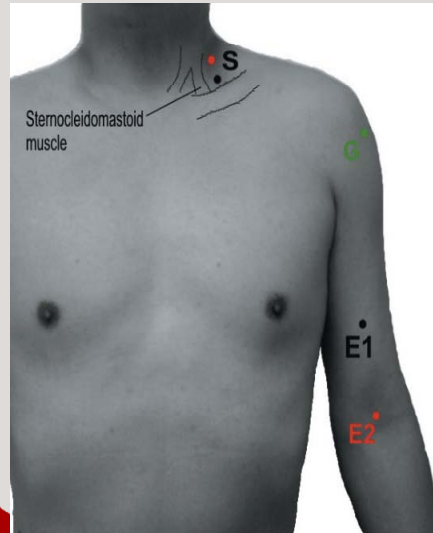
	Mean \pm SD	Normal limit
Onset latency	3.9 \pm 0.5 ms	\leq 5.0 ms

Axillary Nerve



- Deltoid response
- Amp=0.15 mV
- Duration ?

Musculocutaneous Nerve Motor



Electrode placement

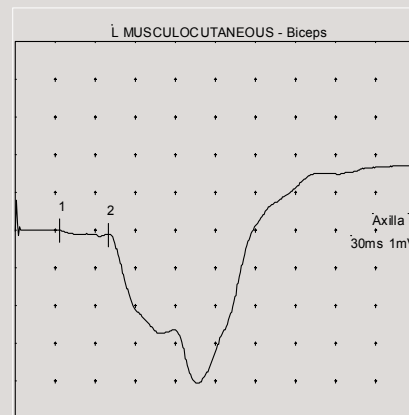
E1	Midpoint of the biceps brachii muscle belly	
E2	Distal biceps tendon	
G	Over the acromion	
S	Cathode	Supraclavicular fossa
	Anode	Superomedially

Normal values, (9) (n=62)

	Mean \pm SD	Normal limit
Onset latency	4.5 \pm 0.6 ms	\leq 5.7 ms

Musculocutaneous Nerve Motor Non-Response

- Increase gain
- Increase stimulus
- “Have to try to get a response!”
- Eventually see triceps response



Case 1

32 yo F Left Shoulder Pain

EMG Summary Table									
	Spontaneous					MUAP			Recruitment
	IA	Fib	PSW	Fasc	H.F.	Amp	Dur.	PPP	Pattern
L. CERV PSP (U)	N	None	None	None	None				
L. CERV PSP (M)	N	None	None	None	None				
L. CERV PSP (L)	N	None	None	None	None				
L. DELTOID	N	None	2+	None	None	N	N	N	2+ dec
L. BICEPS	N	3+	3+	None	None	N	N	Present	Discrete
L. TRICEPS	N	None	None	None	None	N	N	N	N
L. EXT CARPI R LONG	N	None	None	None	None	N	N	N	N
L. BRACHIORADIALIS	N	None	None	None	None	N	N	N	Dec- Mild
L. FIRST D INTEROSS	N	None	None	None	None	N	N	N	N

Case 1

32 yo F Left Shoulder Pain

- Exam limited by patient cooperation, brain-injury related disinhibition and pre-existing personality
- Have not resolved the C5,C6 radicle possibility, but she had no neck pain and a acute CT scan of C-spine was OK

Case 1

32 yo F Left Shoulder Pain

Repeat exam 14 weeks post injury

Strength elbow flexion 4-4+, Sh Abd 5-

(Cognition seemed intact during the exam's interaction)

M-NCS

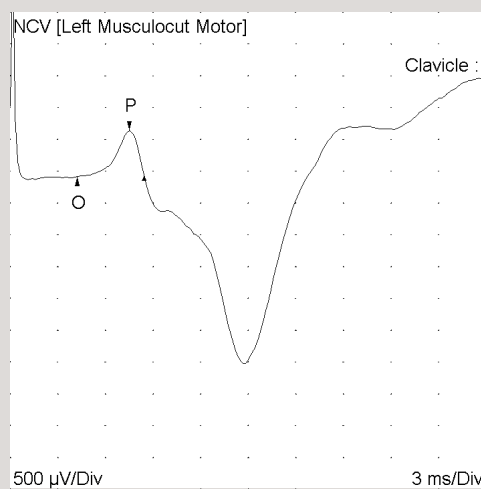
L Mus-Cut (Biceps) 4.2 ms 0.7 mV

Side	Muscle	Nerve	Root	Fibs	Psw	MUP Amp	Dur	Poly	Recrt	Comment
Left	Biceps	Musculocut	C5-6	1+	1+	Incr	Incr	2+	1+ decr	
Left	Brachialis	Musculocut	C5-6	1+	1+	Incr	Incr	2+	1+ decr	
Left	BrRad	Radial	C5-6	Nml	Nml	Nml	Nml	0	Min decr	

Case 1

32 yo F Left Shoulder Pain

- 14 wk post injury
- L Biceps Br
- CMAP
- Strength now
Elb Flx= 4/5



Case 1

32 yo F Left Shoulder Pain

- S-NCS
- L Lat antebrachial 1.4 ms 6 μ V
- Suggests possible neurapraxia
- Others tested were normal
- Poor exam tolerance and behavior (TBI) limited exam

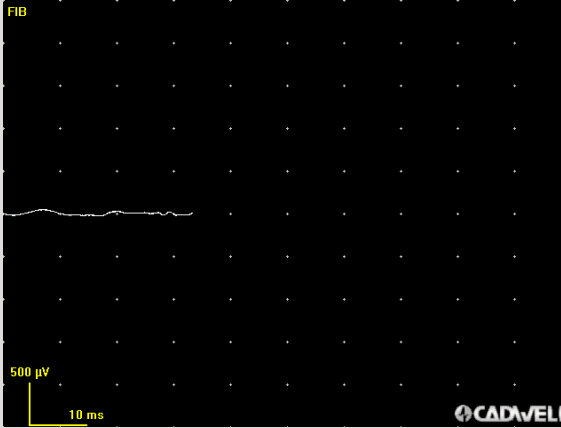
Musculocutaneous Nerve Sensory

- **Normal values (26) (10-cm distance) (n 213)**
- Peak latency ≤ 2.6 ms
- Onset to peak Amplitude ≥ 3 μ V



Case 1 32 yo F Left Shoulder Pain

- 14 wk post injury
- L Biceps Br
- Monopolar 25mm



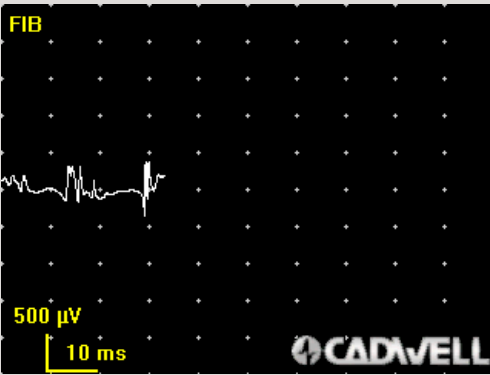
500 μ V
10 ms
CADVELL

Video = PolyMUPBrPIInjHI

Detailed description: This slide shows an EMG trace on a black grid. The trace is a flat white line, indicating no electrical activity. The grid has a vertical scale of 500 μ V and a horizontal scale of 10 ms. The text 'FIB' is in the top left, and 'CADVELL' is in the bottom right.

Case 1 32 yo F Left Shoulder Pain

14 wk post injury
L Biceps Br
Monopolar 25mm



500 μ V
10 ms
CADVELL

Video = RecrBicBrPIInj

Detailed description: This slide shows an EMG trace on a black grid. The trace shows a burst of electrical activity with several distinct peaks. The grid has a vertical scale of 500 μ V and a horizontal scale of 10 ms. The text 'FIB' is in the top left, and 'CADVELL' is in the bottom right.

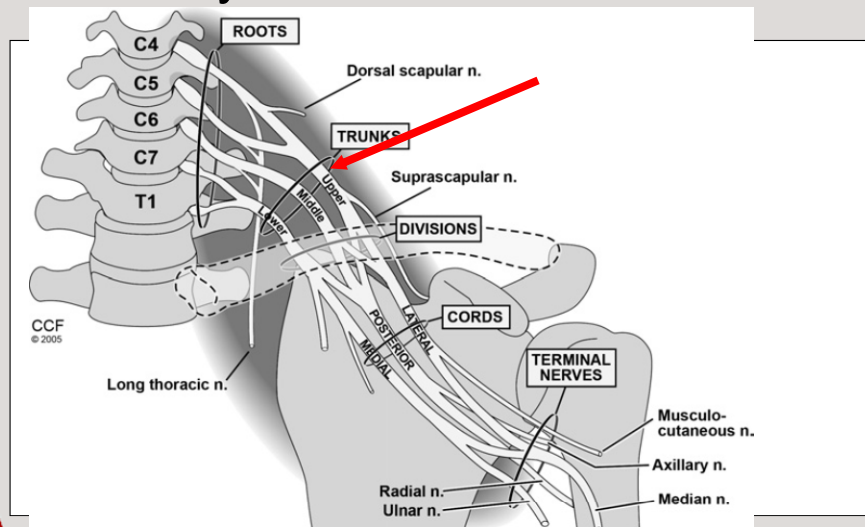
Case 1

32 yo F Left Shoulder Pain

- Traumatic left supraclavicular brachial plexus injury
- Upper trunk injury with severe axon loss
- 1st exam demonstrates sparing of some MUPs and that neurotmesis has not occurred

Case 1

32 yo F Left Shoulder Pain



The brachial plexus (left side). (Cleveland Clinic Foundation, Cleveland, OH.)

Case 2

58 yo M Right shoulder Pain

- 5 mon h/o Rt hand weakness, paresthesia small finger
- No h/o trauma
- Spurling sign +/- (pain with motion)
- Weakness of hand grasp, pinch and intrinsic
- Normal shoulder and elbow strength
- Normal reflexes

Differential Diagnosis

- C8 Radiculopathy
- Neck pain, osteoarthritis (DJD)
- Brachial Plexopathy
 - Idiopathic plexitis
 - Tumor, eg, Pancoast
- Ulnar neuropathy

Case 2

58 yo M Right shoulder Pain

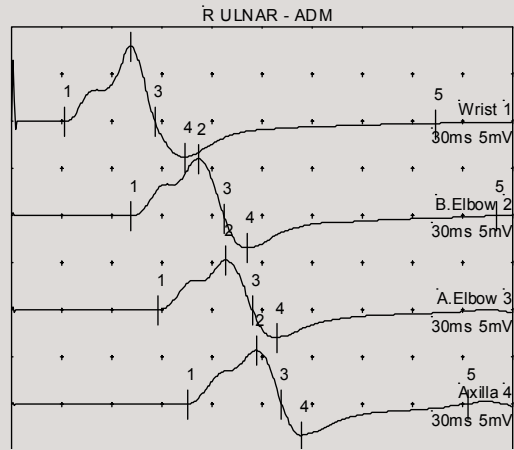
• S-NCS	Lat (ms)	Amp (μ V)
• R Median (D1)	2.6	24
• R Ulnar	2.1	3*
• R DUC	NR	
• R Med AB cut	2.0	20
• L Med AB cut	1.8	10

Case 2

58 yo M Right shoulder Pain

• M-NCS	Lat	Amp	NCV	F lat
• R Median APB wr	3.5	14.5		30.9
• Elb		14.3	52.2	
• R Ulnar ADM wr	3.1	8.0		32.5
• BE		6.1	50.0	
• AE		5.3	50.0	
• R Ulnar FDI wr	3.8	9.7		
• BE		8.8	50.0	
• AE		8.4	55.6	

Case 2 58 yo M Right shoulder Pain



Case 2 58 yo M Right shoulder Pain

EMG Summary Table									
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	IA	Fib	PSW	Fasc	H.F.	Amp	Dur.	PPP	Pattern
R. CERV PSP (U)	N	None	None	None	None	N	N	N	N
R. CERV PSP (M)	N	None	None	None	None	N	N	N	N
R. CERV PSP (L)	N	1+	1+/CRD	None	1+				
R. Abd Poll Br	N	0	0	None	None	Incr			Decr
R. DELTOID	N	None	None	None	None	N	N	N	N
R. BICEPS	N	None	None	None	None	N	N	N	N
R. TRICEPS	N	None	None	None	None	N	N	N	N
R. Ext Digtorum	N	1+	1+	None	None	1+	1+	1+	Reduced
R. PRON TERES	N	None	None	None	None	N	N	N	N
R. FLEX POLL LONG	N	1+	1+	None	None	1+	1+	1+	Reduced
R. FLEX CARPI ULN	N	1+	1+	None	None	1+	1+	1+	Reduced
R. FIRST D INTEROSS	N	1+	1+	None	None	1+	1+	1+	Reduced
R. ABD DIG MIN (UL)	N	1+	1+	None	None	1+	1+	1+	Reduced
R. EXT CARPI R LONG	N	None	None	None	None	N	N	N	N
L. CERV PSP (L)	N	None	None	None	None	N	N	N	N

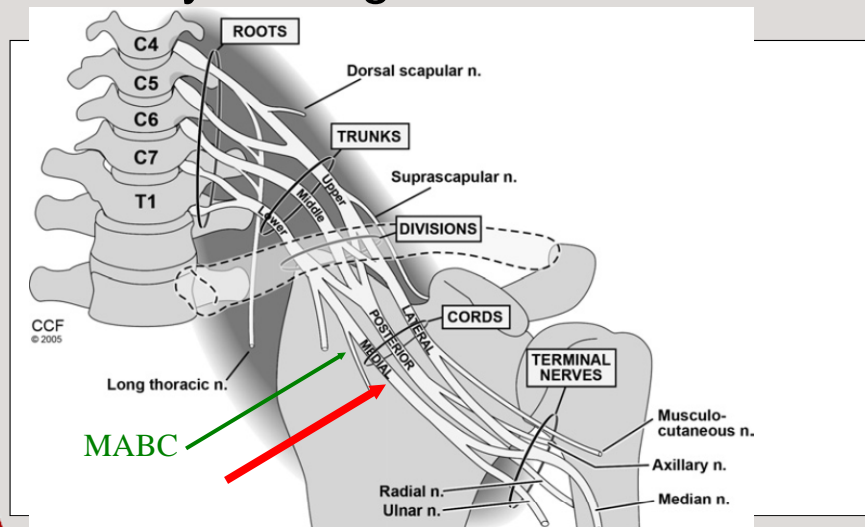
Case 2

58 yo M Right shoulder Pain

- EDX Rt Medial cord including its median motor fibers, but not med antebrachial
- Imp: Infra-clavicular brachial plexus injury
- Dx Ca Right lung upper lobe

Case 2

58 yo M Right shoulder Pain



The brachial plexus (left side). (Cleveland Clinic Foundation, Cleveland, OH.)

Case 2

58 yo M Right shoulder Pain



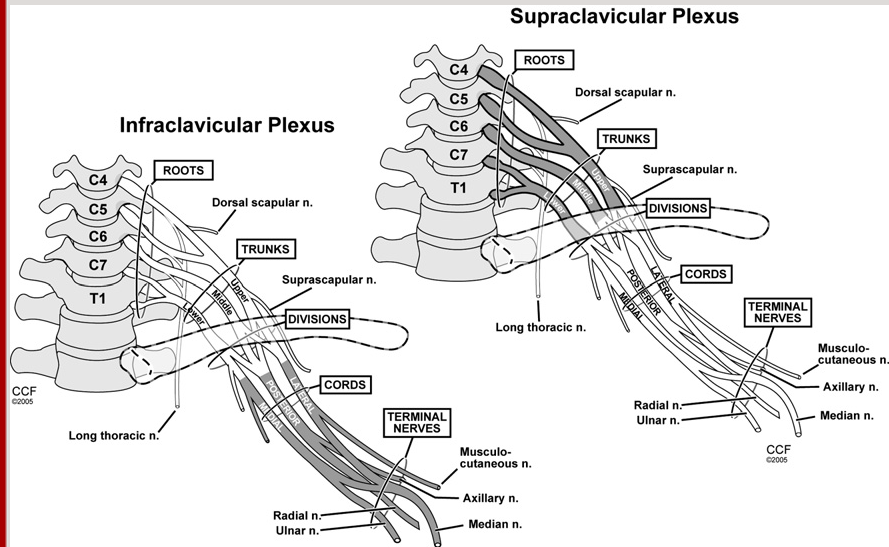
PET scan, Routine CXR & MR unremarkable

Case 2

58 yo M Right shoulder Pain

- When sensory amplitude reduction is the prominent finding, suspect brachial plexus pathology and root injury as less likely.
- Temporal dispersion of the ulnar motor response, and mild delay of ulnar F wave are also consistent.
- Don't fixate on finding PSW in paraspinals -this is common and does not exclude additional pathology.

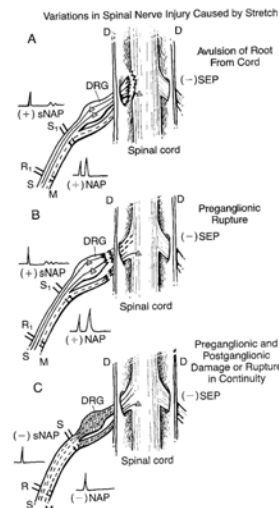
5 Roots, 3 Trunks, 3 Cords, & 5 Nerves



Wilbourn A: The two major divisions of the brachial plexus: supraclavicular and infraclavicular. (Cleveland Clinic Foundation, Cleveland OH.) Muscle Nerve 2007

Location According to Sensory Nerve Response (SNAP)

- *Normal response in insensate area is bad news.*
- *Absent response suggests plexus injury.*
- *Partial response with partial strength is good news.*



Brachial Plexus Trauma Paradox

- Supraclavicular injuries tend to be more severe and have worse outcomes.
- Upper trunk injuries recover better than lower trunk because distance to muscle is shorter for re-innervation, among other reasons

Prognosis According to Motor Nerve Response (CMAP)

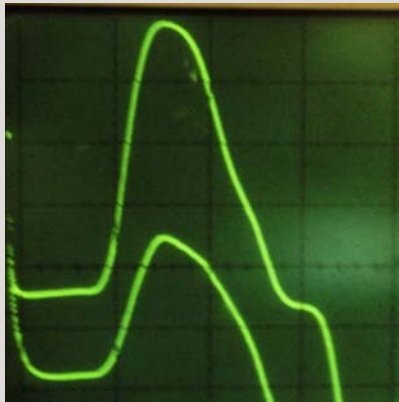
- *At 10 to 15 days post-injury, Compare with contralateral nerve (or reference value)*
- *If loss is <50%, Prognosis is Excellent*
- *If loss is 50-80%, Prognosis is fair to good (more than 20% of axons survive)*
- *If loss is >90%, Prognosis is poor*



Exercise in Rehab After Nerve Injury

- 1. Maintain motion/flexibility
- 2. Avoid strenuous progressive resistive exercises (no 10RM-DeLorme exercise)
 - No exercise to fatigue
 - Avoid eccentric exercise
 - Adapt to reduce frequency of eccentric work in ADLs

The KEY word About axon loss



- **AMPLITUDE**
- **AMPLITUDE**
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- **AMPLITUDE**
- **AMPLITUDE**

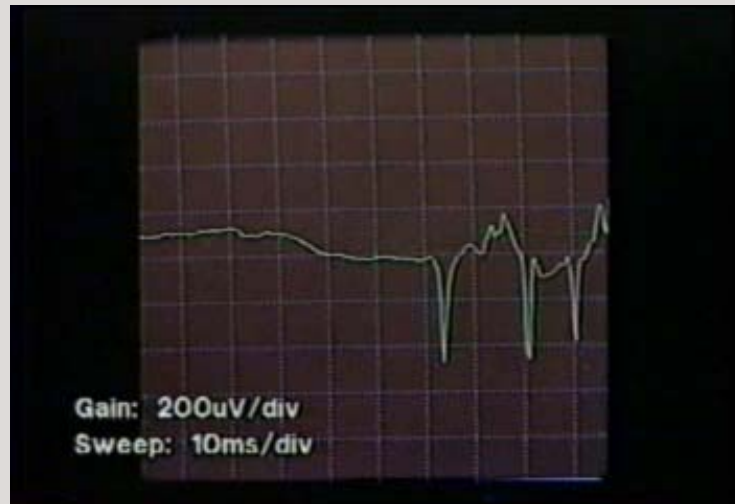
Brachial Plexopathy

- Sensory NCS is a key component of assessment
 - Med ABC, Ulnar, Median (3), Radial, Lat ABC
- Motor NCS are less sensitive, but amplitudes give more info about prognosis for motor recovery

Myokymia

- Frequently associated with radiation induced (post-radiation) plexopathy.
- Severe neuropathic pain often accompanies this entity.
- No effective treatment has been identified.

Myokymia



Video = myokymia2

Brachial Plexus References

- Ferrante MA. Brachial Plexopathies:... Muscle Nerve 2004; 30:568
- Jaeckle KA. Neurologic manifestations of neoplastic ...Sem Neurol 2004; 24:385
- Mullins GM, et al. Non-traumatic brachial plexop ... Clin Neurol Neurosurg 2007; 109:661
- Pease. Johnson's Practical EMG. 2007.
- Wilbourn AJ. Plexopathies. Neurol Clin 2007; 25:139