Case 4

You are the physiatrist in the Plexopathy clinic today. You have 4 patients to see.

Patient 1

Mr A. is a healthy 52yo male. He comes to your clinic because he has trouble with his left hand. He has difficulty defining it but says it feels "strange" and doesn't "react like usual". **Just with this information, what would be your differential diagnosis?**

> Potential answers: Stroke (brain), Myelopathy (SCI), Anterior cell horn/motor neuronopathy, Radiculopathy (C6-C7-C8-T1), Brachial plexus injury ((upper)middle-inferior trunks, anterior divisions, medial-lateral cords), Peripheral nerve injury (median proximal or wrist, ulnar elbow or wrist)

REFERENCE : Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic-Ultrasound Correlations, Preston and Shapiro 4th edition

After taking the history and completing the physical examination, your principal diagnosis is ***carpal tunnel syndrome.***

What studies do you plan to perform in the Neurophysiologic/Electromyography lab?

> Potential answers: SNCS (radial 1, median 1-2-3-4, ulnar 4-5), MNCS (median thenar, ulnar ADM-FDI, comparison second lumbrical-interosseous latency), Needle EMG?
>
> Live add-on question: Do you know/use the Robinson index (Median-ulnar mixed nerve mid-palmar difference, median-radial antidromic thumb difference and median-ulnar antidromic ring finger difference)? Benefits: add reliability, improved sensitivity, high specificity, accurate prognostic value

REFERENCE : Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic-Ultrasound Correlations, Preston and Shapiro 4th edition

You are training a new technologist in the clinic. Explain how you grade the severity of Carpal Tunnel Syndrome.

> Potential answers: normal-mild-moderate-severe OR normal-very mild-mild-moderate-severe-very severe-extremely severe.
>
> Padua vs Bland vs others: sensory velocity only, motor latency, sensory/motor amplitude/axonal loss
>
> Stick with your lab's values!

REFERENCE : Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic-Ultrasound Correlations, Preston and Shapiro 4th edition

What is your care plan for a *moderate* Carpal Tunnel Syndrome?

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Potential answers: Ergonomics, avoid activities that worsen the symptoms, nighttime wrist splint, steroid injection (Cochrane), surgery.

REFERENCE : Ashworth NL, Bland JD P, Chapman KM, Tardif G, Albarqouni L, Nagendran A. Local corticosteroid injection versus placebo for carpal tunnel syndrome. Cochrane Database of Systematic Reviews 2023, Issue 2. Art. No.: CD015148. DOI: 10.1002/14651858.CD015148.

What would be your differential diagnosis if you have a normal Median sensory nerve action potential (SNAP) with an absent thenar compound muscle action potential (CMAP)?

Potential answers: Trapeziometocarpal joint Osteoarthritis, Radiculopathy, Motor neuron diseases

REFERENCE : Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic-Ultrasound Correlations, Preston and Shapiro 4th edition

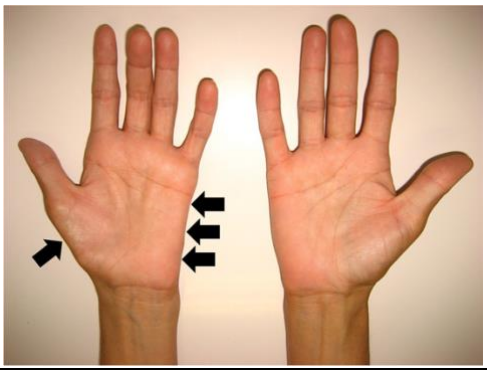
What would be your main diagnosis if the first dorsal interosseous (FDI) and the thenar were wasted, but the abductor digiti minimi (ADM) was preserved?

Potential answers: Amyotrophic Lateral Sclerosis (ALS) – split hand

Live add-on question: what would you look for, especially at the needle EMG, in Amyotrophic Lateral Sclerosis (ALS)? Fasciculations, Neurogenic changes (denervation, large polyphasic prolonged motor unit action potential - MUAP)

REFERENCE : Benny R, Shetty K. The split hand sign. Ann Indian Acad Neurol. 2012 Jul;15(3):175-6. doi: 10.4103/0972-2327.99700. PMID: 22919187; PMCID: PMC3424792.

On the other hand, what would be your main diagnosis if the thenar eminence and abductor digiti mini (ADM) were affected much more than the first dorsal interosseous (FD); also called Gilliatt-Sumner hand)?



Potential answers: Thoracic Outlet Syndrome (TOS)

REFERENCE : Goeteyn, Jens et al. “Thoracic outlet decompression surgery for Gilliatt-Sumner hand as a presentation of neurogenic thoracic outlet syndrome.” Journal of vascular surgery vol. 75,6 (2022): 1985-1992. doi:10.1016/j.jvs.2022.01.133

Disorders	Sensory NCS	Motor NCS	Muscles involved by EMG
Motor neuron disease e.g. ALS	Normal[38]	Median CMAP: low amplitude Ulnar CMAP: low amplitude[38]	EMG signs of LMN dysfunction in at least 2 of the 4 CNS regions: bulbar, cervical, thoracic, or lumbosacral spinal segments[38]
C8/T1 radiculopathy	Normal[39]	Median CMAP: normal or low amplitude Ulnar CMAP: normal or low amplitude[39]	All or some of C8/T1 supplied muscles (APB, FDI, ADM, FPL, EIP, and paraspinals)[40]
Thoracic outlet syndrome (lower trunk)	Median SNAP: normal Ulnar and medial antebrachial SNAP: low amplitude[41]	Median CMAP: low amplitude Ulnar CMAP: less severe involvement than median CMAP[42]	All or some of C8/T1 supplied muscles (T1 worse than C8), sparing paraspinals[41]
Medial cord lesion	Median SNAP: normal Ulnar and medial antebrachial SNAPs: low amplitude[41]	Median CMAP: low amplitude Ulnar CMAP: low amplitude[41]	C8/T1 muscles; spares fibers traveling through posterior cord (e.g., EIP) and Paraspinals[41]
C5 radiculopathy	Normal[39]	Median CMAP: normal Ulnar CMAP: normal[39]	C5 muscles: supraspinatus, infraspinatus, deltoid, brachioradialis, biceps, and C5 paraspinals[40]
C6 radiculopathy	Normal[39]	Median CMAP: normal Ulnar CMAP: normal[39]	C6 muscles: as in C5 + PT, FCR, triceps, anconeus, EDC and C6 paraspinals[40]
C7 radiculopathy	Normal[39]	Median CMAP: normal Ulnar CMAP: normal[39]	C7 muscles: triceps, anconeus, PT, FCR, EDC, and C7 paraspinals[40]
Upper trunk	Median-D1& 2 SNAP: low amplitude Radial SNAP: low amplitude Lateral antebrachial: low amplitude Ulnar SNAP: normal[41]	Median CMAP: normal Ulnar CMAP: normal[41]	All or some of C5/6 muscles (listed above) sparing paraspinals, serratus anterior and rhomboids[41]
Lateral cord	Median-D1, 2 & 3 SNAP: low amplitude Lateral antebrachial: low amplitude Ulnar SNAP: normal[41] Radial SNAP: normal[41]	Median CMAP: normal Ulnar CMAP: normal[41]	Biceps, brachialis, PT, and FCR[41]
Median nerve at or proximal to the elbow	Median SNAP: decreased Ulnar SNAP normal[43]	Median CMAP: low amplitude Ulnar CMAP: normal[43]	APB, FPL, FDP-D2 & 3, FDS, PQ, FCR and PT[43]
AIN neuropathy	Normal	Normal	FPL, FDP-D2 & 3, PQ[43]
Length dependent axonal polyneuropathy	Sural SNAPs are affected earlier and more severely than upper limb SNAPs[44]	Lower limb CMAPs are affected earlier and more severely than upper limb CMAPs[44]	Denervation is worse in distal compared to proximal muscles, and in lower more than upper limbs[44]

ADM - abductor digiti minimi, AIN - anterior interosseous nerve, ALS - amyotrophic lateral sclerosis, APB - abductor pollicis brevis, CMAP - compound muscle action potential, EDC - extensor digitorum communis, EIP - extensor indicis proprius, EMG - electromyography, FCR - flexor carpi radialis,

FDI - first dorsal interosseous, FDP D2 & 3 - flexor digitorum profundus digits 2 and 3, FDS - flexor digitorum superficialis, FPL - flexor pollicis longus, LMN - lower motor neuron, NCS - nerve conduction study, PQ - pronator quadratus, PT - pronator teres, SNAP - sensory nerve action potential

Case 4

Patient 2

Ms. C is referred to your clinic for a suspected C7 radiculopathy. What muscles would you test in the needle EMG?

Potential answers: C7(serratus anterior, latissimus dorsi, triceps, supinator, pronator teres, brachialis, Anconeus, FCR, FCU, ECRB, EDC, ECU, FDS, FDP, FPL, APL, EPB, EI), include multiple nerves (MSC, Median, Radial, Ulnar), and other roots (C6-C8).

REFERENCE : Aids to the examination of the peripheral nervous system 5th edition

Patient 3

Mr. D is coming to your clinic because he has had weakness in his left arm for the last few months. He has a history of lung cancer treated with radiotherapy. You are trying to remember the differences between recurrence of neoplasia and radiation plexopathy.

Fill out the table below.

	Neoplastic	**Radiation**
Associated conditions		
Common presentation		
Progression		
Electrodiagnostic findings (and how you would test this?)		

Potential answers:

Neoplastic : Pancoast, breast cancer, lymphoma, metastasis, severe pain, horner, rapid, lower trunk, medial antebrachial cutaneous

Radiation : chest radiation, high radiation dose, paresthesia and weakness, months to years, upper/middle trunk (but study showed PT>APB>FPL), myokymic discharges

REFERENCE : Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic-Ultrasound Correlations, Preston and Shapiro 4th edition

Case 4

Patient 4

Baby B is a 1-month old, accompanied by her parents. They have noticed that her right arm is not moving like her left arm. You suspect a neonatal brachial plexus palsy.

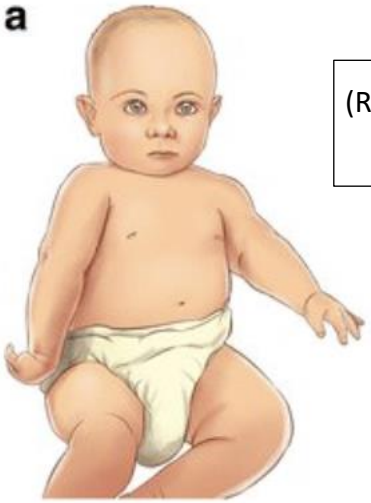
What questions would you ask on history to determine the cause?

Potential answers: shoulder dystocia, humeral fracture, clavicular fracture, maternal diabetes, forceps-vacuum assisted delivery, prolonged labour, episiotomy, fetal or birth asphyxia, macrosomia, large for gestational age infants, floppy infants

REFERENCE : REFERENCE : Bahm J et al. Obstetric brachial plexus palsy: treatment strategy, long-term results, and prognosis. Dtsch Arztebl Int. 2009 Feb;106(6):83-90. doi: 10.3238/arztebl.2009.0083. Epub 2009 Feb 6. PMID: 19562016; PMCID: PMC2695299.

Looking at the following different pictures, what is the localization of the lesion (and give the name if there is one)?

a



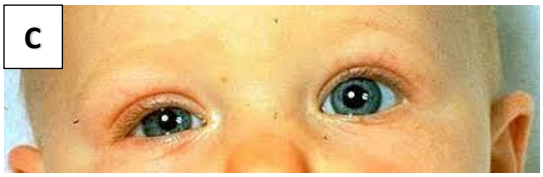
(Right upper trunk or C5-C6 nerve roots – Erb)

b

(Left lower trunk or C8-T1 nerve roots – Klumpke)

Case 4

C



(Right root avulsion C7-T1 – Horner)

REFERENCE : Bahm J et al. Obstetric brachial plexus palsy: treatment strategy, long-term results, and prognosis. Dtsch Arztebl Int. 2009 Feb;106(6):83-90. doi: 10.3238/arztebl.2009.0083. Epub 2009 Feb 6. PMID: 19562016; PMCID: PMC2695299.

What are the important elements to look for in the Neurophysiologic/Electromyography (EMG) lab for the prognosis (electrodiagnostic + clinical)?

Potential answers:

Not clear, very variable according to the literature.

Preserved SNAP with severe palsy is bad prognosis (pre ganglionic->nerve root avulsion).

Horner syndrome is associated with bad prognosis.

Diaphragmatic paralysis is associated with bad prognosis.

Extensive lesion is associated with bad prognosis.

Isolated upper trunk is good prognosis

Biceps MUAP at 1mo is good prognosis.

Any movements at 2 months is good prognosis.

No MUAP in biceps at 3 months indicates the need for surgical exploration.

MMT at 3 months is well correlated with recovery.

Cookie test success at 9 mo is good prognosis, failure indicates need for surgical exploration.

Live add-on question: What criteria would suggest referring, when and to whom? When are you going to follow up?

Surgery must be done before 12mo.

Multidisciplinary clinics, Occupational Therapy, Physiotherapy, closed follow-up.

REFERENCE : Bahm J et al. Obstetric brachial plexus palsy: treatment strategy, long-term results, and prognosis. Dtsch Arztebl Int. 2009 Feb;106(6):83-90. doi: 10.3238/arztebl.2009.0083. Epub 2009 Feb 6. PMID: 19562016; PMCID: PMC2695299.

Case 4

During the appointment, you sense tension between the parents.

After receiving the follow-up date, while the father is in the bathroom, the mother comes back to ask for another date and says she doesn't want the father to know it. How will you respond?

https://www.cmpa-acpm.ca/en/advice-publications/browse-articles/2016/family-disputes-and-the-physician-staying-focused-on-safe-care

https://www.justice.gc.ca/eng/fl-df/parent/mp-fdp/p5.html