

The Advanced Neurologic Exam Principles and Practice

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Objectives

- Students will perform a:
 - Detailed and comprehensive neurologic examination,
 - With optimized positioning and phrasing,
 - Based upon hypotheses from history and prior observations,
 - To build evidence for a finding or system to be reliably present/absent,
 - By interconnecting historical and examination components,
 - With an appreciation of sensitivity/specificity, subjectivity/objectivity,
 - While ensuring the big picture makes sense.

Transferability of Hypothesis Generation

- Clinical and scientific approach to:
 - Bedside Diagnosis in Medical and Surgical Specialties
 - Image Review and Interpretation
 - Operations and Procedures more Efficient with Fewer Complications
 - Histopathology Review and Interpretation
- Critical Thinking and Deductive Reasoning
 - Developing and Going through Your Process
 - Searching for Clues
 - Maintain an Open and Nimble Mind
 - Building a Case, Recognizing Pros/Cons, Typical/Atypical
 - Determining Best Approach to Proceed

Approach

- Take your time, there is no need to do a 5 minute neuro exam
- The history should include functional elements to preview the exam
- Bring your hypotheses to the exam, so you can scrutinize your findings

- Make a cheat sheet/scoring sheet
- After the history, pause:
 - Where do I localize their symptoms?
 - What diseases occur in those locations?
 - What am I expecting to find on exam?
 - UMN, LMN, motor, cerebellar, sensory, extrapyramidal, etc
- After each section of the exam, document and pause:
 - Does this make sense with regards to the big picture?
 - Am I confident in the findings I elicited? Do any need repeating?
 - Any additional maneuvers I should consider based upon localization and differential, or indeterminate/inconsistent findings?

Increasing Reliability

- Patient positioning
 - Sitting vs. lying, limb position
- Clinician positioning
 - Where to stand, where to put arms
- Technique
 - How to hold, how to swing, how fast to move
- Instructions
 - How to tell patient the maneuver
- Demeanor/Cooperation
 - Keeping the patient engaged with full effort
- Proactive evaluation
 - What do you expect to find?
- Confirmation
 - Is it reproducible, are there redundant techniques to confirm, does it fit a pattern, what else should I be looking for

Redundancy is Good

Signs of Corticospinal Tract Dysfunction

- Pronator drift
- Orbiting
- Slowed finger sequencing and foot tapping
- Reduced strength in UMN pattern
 - UE extensors, LE flexors
- Hyper-reflexia/asymmetry, + Babinski
- Increased spasticity
- Decreased stance time, increased tone, foot drop, leg instability
- Decreased hopping

Subjectivity and Objectivity – It Depends

Subjective

Pin Sensation

Clear instructions:
Do repeat trials
with sharp/dull or
sharp/reduced/dull

Mix

Vibration

Clear instructions:
Repeat Trials for
consistency starting
at different
thresholds

Objective

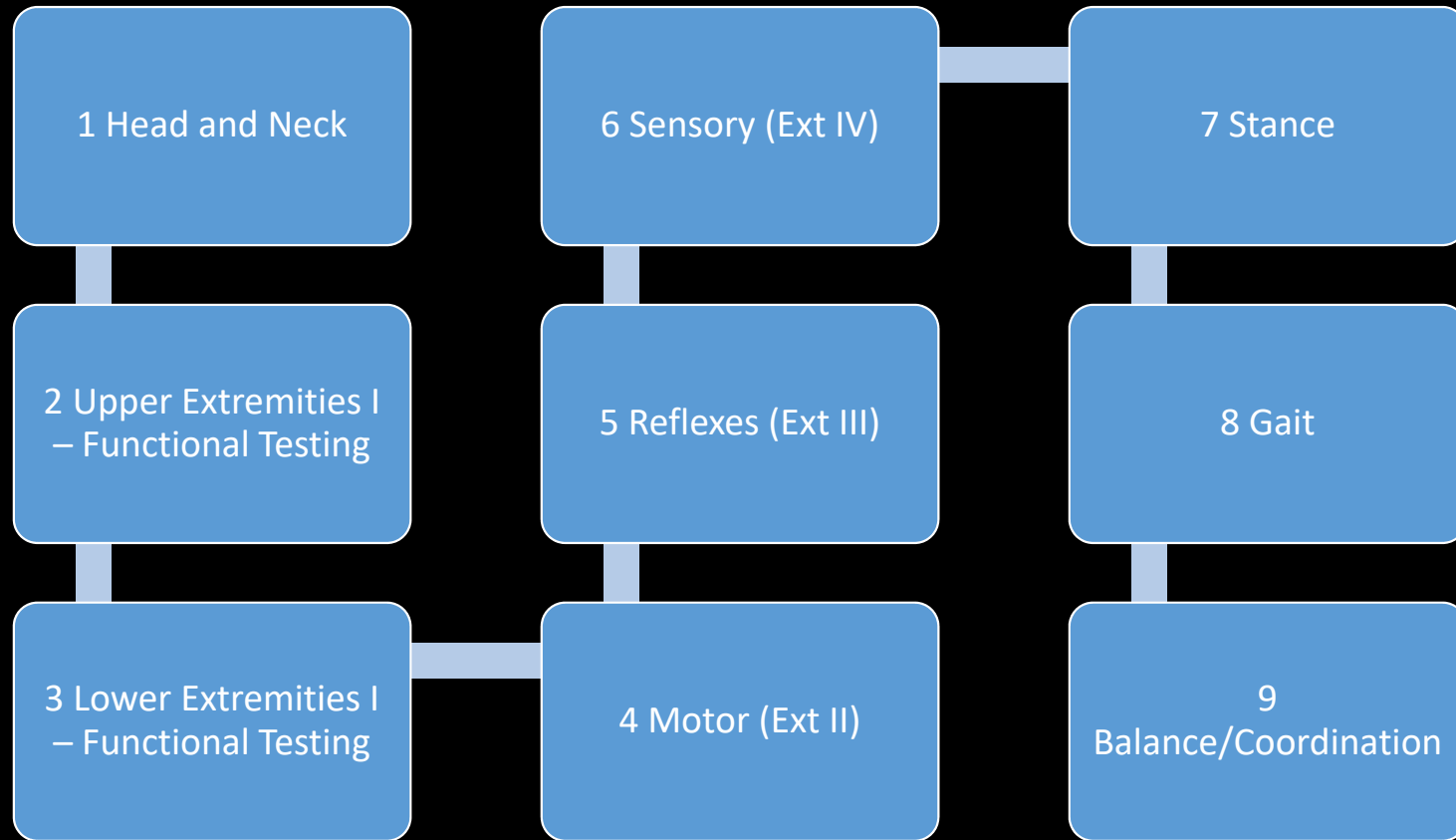
Reflexes

Three in a row,
more than one joint

Order

- Regional
- Start with high sensitivity, objective, uni-modality testing
- Follow-up with maneuvers that are more specific, more subjective, multi-modal testing
- Reliability = repeatability
- Validity = measuring what it is supposed to measure
 - Pain limiting motor testing

Regions



Phrasing

- Clear and simple
- Balancing providing explanation vs. making things confusing
- Instruct in patient's frame of reference
 - "Pull in", "Pull towards yourself"
- Include the outcomes of interest in the instructions
 - Rapid alternating movements: assess speed and rhythm
 - Slap your hand on your palm big, fast, and loud
- Give a visual
 - Demonstrate, point
- Encourage them to keep up effort and speed
 - Self selected speeds may help with compensation
- Give them praise, tell them when they got it right

1. Head and Neck

- II:
 - *Read near card at 14+ inches each eye.
 - Best corrected, glasses or pinhole, good lighting, push until 2 errors
 - Screen for scotoma (face or Amsler grid)†
 - *VFs to finger count or red object
 - *Fundi exam
 - *Pupils roundness and direct and consensual reactions
- III, IV, VI:
 - *Smooth pursuits in big “H” in arc
 - Saccades between central/lateral objects (15-20 degrees)†
 - Saccades between lateral objects (40-50 degrees)†
- V:
 - *Sensation to touch in 3 distributions
 - Corneal reflex†
- VII:
 - *Smile, raise eyebrows, eye closure
 - If unsure, activation asymmetry and facial strength†
 - Check neck flexors/extensors if suspect facial diplegia†
- VIII:
 - *Rub fingers, ask which side; or whisper addition problem
- IX:
 - Gag on both sides of palatte†
- X:
 - *Visualize palate elevating symmetrically
- XI:
 - *Shrug shoulders while palpating/visualizing trapezii
- XII:
 - *Wiggle tongue side-to-side, big and fast

*Required

†Additional

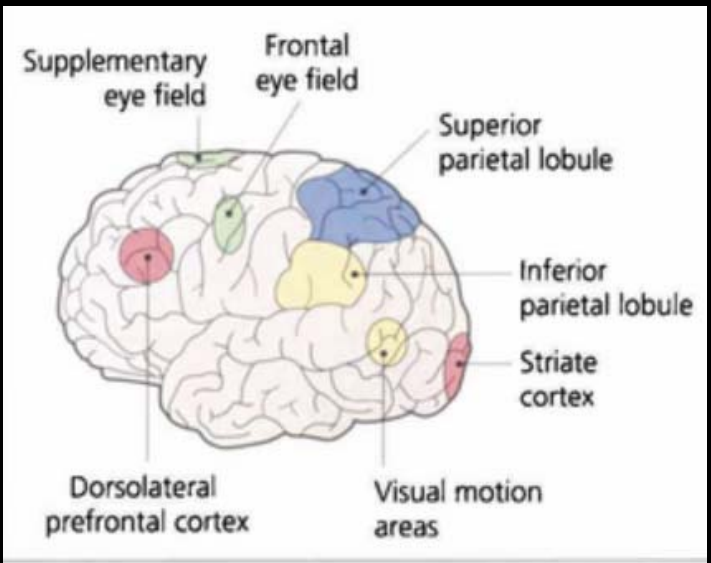
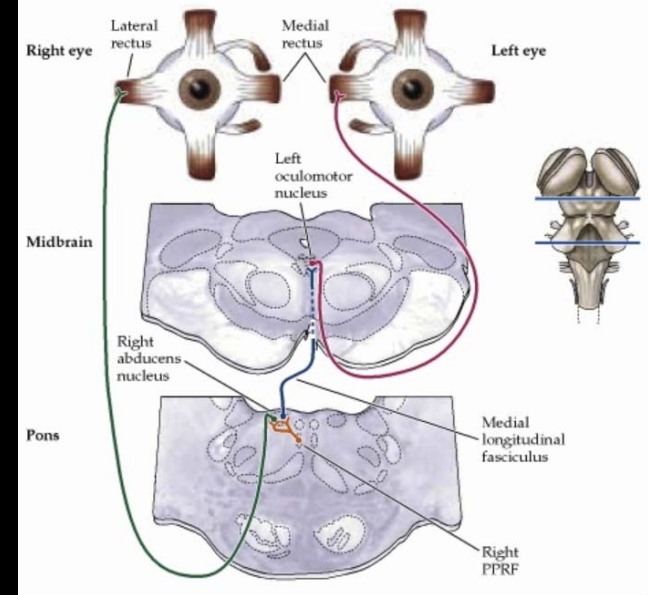
Redundancy: If there is an APD, what else do you expect to find?

- Decreased vision
- Red desaturation
- Scotoma
- Restricted fields
- Altered fundusoscopic exam

- What is causing the APD
 - Inflammatory: MS, NMO, MOG, sarcoid, vasculitis
 - Infectious: Crypto, TB, cat scratch disease, syphilis, Lyme
 - Ischemic: NAION, GCA
 - Cancer: Lymphoma, compressive, paraneoplastic
 - Metabolic: Thyroid, B12, Copper
 - Hereditary: Mitochondrial, SCA
 - Toxic: Amiodarone, ethambutol

Primary vs. Supranuclear/Higher Order

- Higher Order testing requires Primary System to be Intact
- Saccades
 - Prefrontal eye fields (planning)
 - Frontal eye fields (voluntary activation)
 - Basal ganglia (initiation)
 - PPRF (neuron generator)
 - CNVI, MLF, CNIII (primary nuclei)
 - Parietal eye fields (spatial representation)
 - Superior colliculi (amplitude and direction)
 - Cerebellum (accuracy and consistency)



2&3. Upper and Lower Extremities I

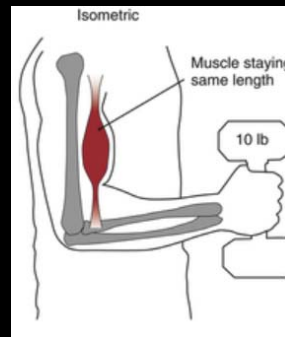
- Corticospinal (strength and finesse)
 - *Pronator drift
 - Finger-nose proprioceptive test
 - Orbiting†
 - ***Finger sequencing (big and fast and clean)**
 - Very sensitive and often lateralizing
 - ***Toe tapping (from heel - big and fast and loud)**
 - Very sensitive and often lateralizing
 - *Spasticity
 - *Bulk
- Extrapyrimal (initiation, speed, amplitude, inhibition)
 - *Evaluation of facial expressivity, eye blinking, voice volume
 - Hand opening/closing, pronation/supination†
 - Rigidity†
 - *Tremors
 - *General observations during history and exam
 - Rest, posture†
 - Assess extra movements (asterixis, myoclonus, spasms, dystonia) †
- Cerebellar (precision or motor conservation, temporalspatial accuracy)
 - *Finger-to-nose
 - Dysmetria (an inaccurate trajectory)
 - Intention tremor (oscillation that worsens upon approaching target)
 - Dysdiadokokinesia (inability to coordinate rapid alternating movements involving bilateral or synchronous muscle groups)
 - Heel-knee-shin†
 - Lap slap (synchronous bilateral slapping movements)†
 - Finger tracking (inaccuracy of finger tracking)†
 - Rebound (failure for antagonist muscles to stabilize displaced limb)†

4. Motor

- Isometric contraction
- Side-to-side
- Individual more reliable than bilateral
- Assess force for the muscle to be overpowered/lengthen
- Gain mechanical advantage on big muscles
- Rate peak force, note activation/effort
- Sustaining effort is variable
- UPPER: Delt, bicep, tricep, finger extensors, finger abductors, opponens
- LOWER: Iliopsoas, quad, hamstring, tibialis anterior, plantar extensors
- OPTIONAL: Abductor pollicis brevis, gluts, others in case of specific nerve injuries

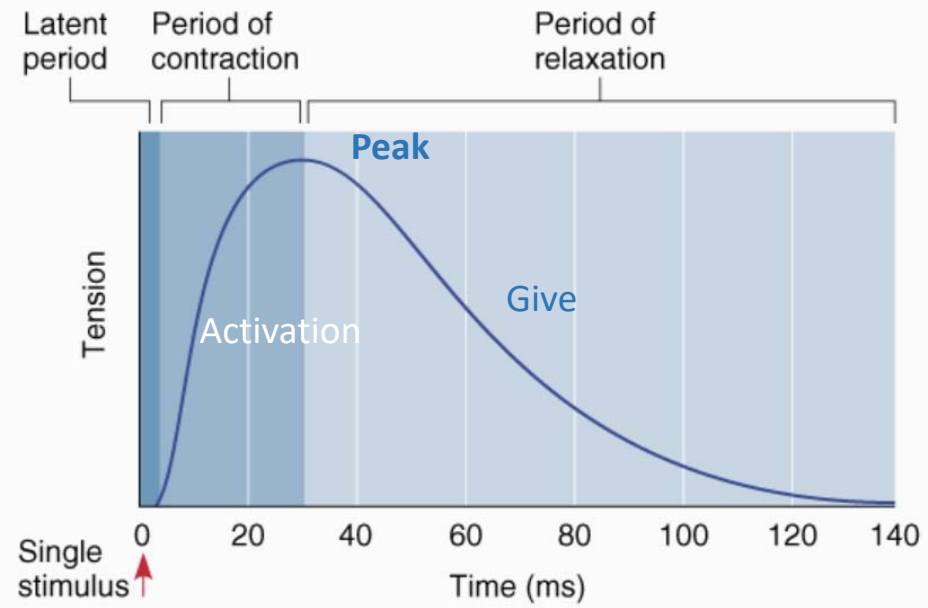
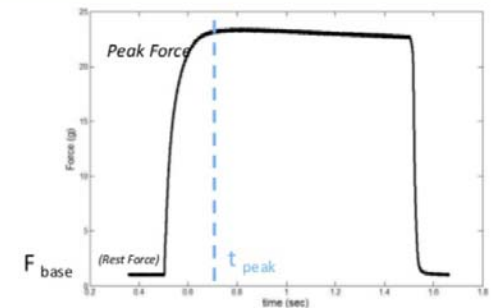
Judging effort

- Elicit maximal/peak tension
- Encourage not to let muscle give
- Assess activation/time slope
- Ramp up counter force similar to activation speed to reflexively encourage full activation
- Start with better side



Isometric Maximal Tetanus

A maximum tetanus is the result of maximal summation: no further increase in force output despite increased frequency of activation.



(a)

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Muscle Testing Scale

- 5: Normal
- 5-: Very difficult to overpower but some asymmetry
- 4+: High resistance; or asymmetric
- 4: Moderate resistance
- 4-: Minimal resistance; or asymmetric
- 3+: Antigravity, good range of motion, no resistance; asymmetric
- 3: Antigravity, moderate range of motion
- 3-: Antigravity, limited range of motion; asymmetric
- 2: Movement with gravity removed (horizontal plane)
- 1: Muscle contraction but no limb movement
- 0: No muscle contraction

When Patients are not Consistent

- Encourage when possible
 - “Please give me everything you’ve got so we can make our best assessment”
- Always start with the good or better side
 - “Let’s start on the good side so I know you understand the instructions”
- Traditional methods for proving non-organic are not perfect
 - If one side is strong, check bilateral to see if good side is now weak
 - Check flexion and extension repeatedly in rapid succession
 - Vary activation counter-force
- OK to put simple qualifiers in note
 - Motor strength limited due to pain, ?APD
 - Don’t put commentary/interpretation in exam section
- Document discretely
 - Motor exam “tremulous”, “shaky”, “decreased activation”, “guarded”... but at least 4/5 strength...

Reliability of Deep Tendon Reflexes

- 20 Patients scored by 3 neurologists
- 160 Total Reflexes:
 - 26% complete agreement
 - 46% had disagreement in 1/3 raters by 1 point
 - 28% had disagreement in 1/3 raters by 2+ points
- 80 reflex pairs, regarding symmetry
 - 55% complete agreement
 - 30% had disagreement in 1/3 raters by 1 point
 - 15% had disagreement in 1/3 raters by 2+ points
- Operator dependent

<i>Description</i>	<i>Score</i>
Absent	-4
Just elicitable	-3
Low response	-2
Moderately low	-1
Normal	0
Brisk	+1
Very brisk	+2
Exhaustible clonus	+3
Continuous clonus	+4

5. Reflexes

- Sitting up
- Side to side
- Keep limbs at rest and similar position
- Swing hammer with wrist and fingers, let it fall naturally
- Strike “through the joint”
- Keep it simple
- Rarely have to tell them to “relax”
- **Three in a row** for consistency
- Look at muscle contraction, not limb movement
 - Speed, amplitude, duration, number of contractions, recruitment, spread
- 0: none
- Tr: maybe, not consistent
- 1: Hypoactive
- 2: Normal
- 2+: Normal but brisk
- 3: Hyperactive
- 4: Non-sustained clonus or several contractions
- 5: Sustained clonus or multiple contractions

6. Sensory

- **Safety pin**
 - Poke or scratch
 - 1 per second
 - Steady the patient limb for safety
 - Arms/hands and feet/legs distal to proximal, side-to-side
 - Lower back
- **Scale**
 - Can compare to normal area by percent, or cents to a dollar
 - Mild: Sharp but reduced
 - Moderate: Impaired ability to discriminate sharp/dull
 - Severe: No ability to discriminate sharp/dull
 - Absent/Anesthesia: Unable to feel pin
- **Vibration**
 - Distal joint, can go higher if absent
 - Start in hands before feet
 - “What do you feel?”
 - “Tell me the moment you can no longer feel the vibration”
 - Can ask “Can you still feel it...how about now...”
 - Can do more than one trial for consistency
- **Scale**
 - Fingers are 5-10 seconds better than feet
 - Minimal: You can feel for 5-10 seconds longer
 - Mild: 10-15 seconds longer
 - Moderate 15-20 seconds longer
 - Severe: 20+ seconds longer
 - Absent
- **Proprioception**
 - “Tell me up or down as soon as you feel your finger move.”
 - Start in hands before feet, demonstrate same direction twice
 - Isolate the distal phalynx, hold on either side
 - 3-5 degrees for hands
 - 5-10 degrees for feet
- **Scale**
 - Mild (1-2 errors or requires slightly larger movements)
 - Moderate (misses many movements, requires full movement)
 - Severe (Unable to feel movement at that joint)

Reliability and Validity of Babinski Testing

Table Interobserver reliability and validity of the Babinski sign and foot tapping

	Overall	Neurologists	Non-neurologists
Babinski testing			
No. of evaluations	199	99	100
Kappa	0.30	0.28	0.36
Validity, %	56	58	54
Sensitivity, %	35	36	34
Specificity, %	77	80	74
Foot tapping			
No. of evaluations	198	98	100
Kappa	0.73	0.73	0.72
Validity, %	85	82	88
Sensitivity, %	86	86	86
Specificity, %	84	78	90

Plantar Reflex

- Let patient know you are going to scratch the bottom of their foot to check a reflex
- Ensure entire leg is relaxed
 - Hand holding heel
 - Lying in bed
- Keep foot at approx 90 degree position
- Use tines of tuning fork
 - One tine on foot undersurface to 5th toe, then across towards big toe (Babinski)
 - One tine on lateral foot (Chaddock maneuver)
- Don't do too fast (5-6 seconds)
- Start gentle, increase pressure
 - Originally described as noxious and painful, but not always necessary



7. Stance

- Stand with feet touching together (front and back), eyes open
 - Normal: Some movement at toes, occasional movement at ankles
 - Minimal: Relying more on ankle movement
 - Mild: More ankles plus knees/hips; sways but does not fall
 - Moderate: Unsteady after a moment
 - Severe: Unable to do without falling
- Close your eyes
 - Normal: Some movement at toes, some movement at ankles
 - Minimal: A lot of ankle movements, occasional movement at knees/hips
 - Mild: Relying more on knees/hips; sways but does not fall
 - Moderate: Unsteady after a moment
 - Severe: Unable to do without falling

General Scales - Sample

- 0: Normal
- 1: Subtle
 - May not be obvious
 - May not be consistent
 - May be normal for some
 - Patient may not be aware
- 2: Mild
 - Clearly apparent
 - Consistently present
 - May have mild difficulties that are not limiting
 - Often have corroborating findings
 - Patient sometimes aware of difference/problem
- 3: Moderate
 - Affecting some function
 - Easy to see
 - Patients often have a clinical correlate that is limiting
- 4: Severe
 - Affect most or all function
 - Very limited or non-functional
 - Patients always aware (“My useless arm”)
- Use “+” for asymmetry
 - I sometimes use + if a little worse than descriptors
 - I sometimes use range (2-3) if a lot worse but not quite at top number
 - Descriptors: “Labored”, “effortful” if not full effort

8. Gait

- Walk 25 feet up/down hallway several passes
- Initiation
- Posture
 - Trunk, upper body
- Arm swing
- Symmetry
 - Hips
- Tone
 - Hips, knee flex/ext
- Stride length
 - Shuffling, shortened
- Base of support
- Stance time (listen)
- Staggering
- Toe clearance/foot scuffing
- Steps to turn
- Comfort (antalgic, cautious, etc)

Balance/Coordination

- Walk on heels a couple steps, now walk on on toes
 - Strength test
 - Can do assisted if necessary (notate)
- Walk a straight line, heel-to-toe, 8 steps
 - Keep up speed
 - Look down at feet
 - Don't over cross you feet
 - Touch the toes to the heel
- Hop 10 times on either foot without touching wall unless you have to

Exam Conclusions

- Take your Time, Convince Yourself that Something is Present/Absent
- Before you Begin, Pause and Consider Hypotheses and Expected Findings
- After Each Section, Pause and Consider Consistency, Reliability, and Confidence in Findings
- At the End, Consider Big Picture: Does Everything Make Sense and Fit with their Story and Function?