Neurologic Exam

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Elements of The Neuro Exam

- Cranial Nerves
- Motor – bulk, tone, strength
- Coordination – fine movements, balance
- Sensation – pain, touch, position sense, vibration
- Reflexes
- Gait

CN 1- Olfactory

- Check air movement thru ea nostril separately – push gently on outside of nostril, occluding it.

  Then ask patient to inhale/exhale thru other, assuring it's unobstructed.
- Screen for problems w/sense using coffee (or other substance w/strong odor)
- Ask patient to close eyes & identify the odor as you bring the substance close to the nostrils
- Odor normally detectable @ distance of ~10cm

CN 1- Olfactory: Sense of Smell

- Check **air movement** thru ea nostril separately.
- **Smell** not usually assessed (unless sx)
  - use coffee grounds or other w/distinctive odor
    (e.g. mint, wintergreen, etc)
  - check ea nostril independently
  - detect odor when presented @ 10cm.

Cranial Nerve 2 (Optic): Functional Assessment – Acuity

- Using hand held card (held @ 14 inches) or Snellen wall chart, assess each eye separately. Allow patient to wear glasses.
- Direct patient to read aloud line w/smallest lettering that they're able to see.

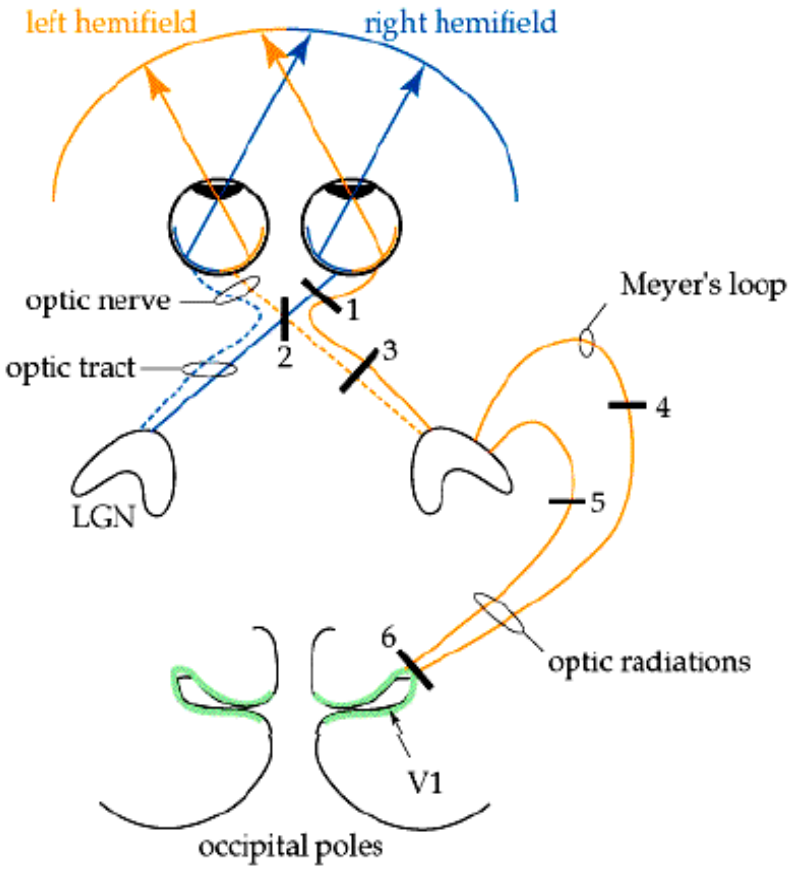
Hand Held Acuity Card

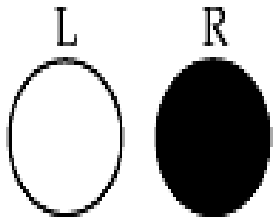
Functional Assessment – Acuity (cont)

- 20/20 =s patient can read at 20` with same accuracy as person with normal vision.
- 20/400 =s patient can read @ 20` what normal person can read from 400` (i.e. very poor acuity).
- If patient can't identify all items correctly, number missed is listed after a '-' sign (e.g. 20/80 -2, for 2 missed on 20/80 line).

Snellen Chart For Acuity Testing

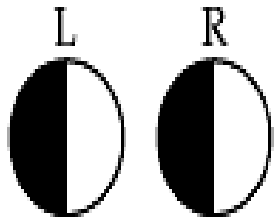
Cranial Nerve 2 (Optic): Functional Assessment - Visual Fields





loss of vision in R eye

Lesion #1



loss of vision in left hemifield

Lesion #3

Images from: Wash Univ. School of Medicine, Dept Neuroscience http://thalamus.wustl.edu/course/basvis.html

NEJM Interactive case – w/demo of visual field losses: http://www.nejm.org/doi/full/10.1056/NEJMimc1306176?query=featured_home

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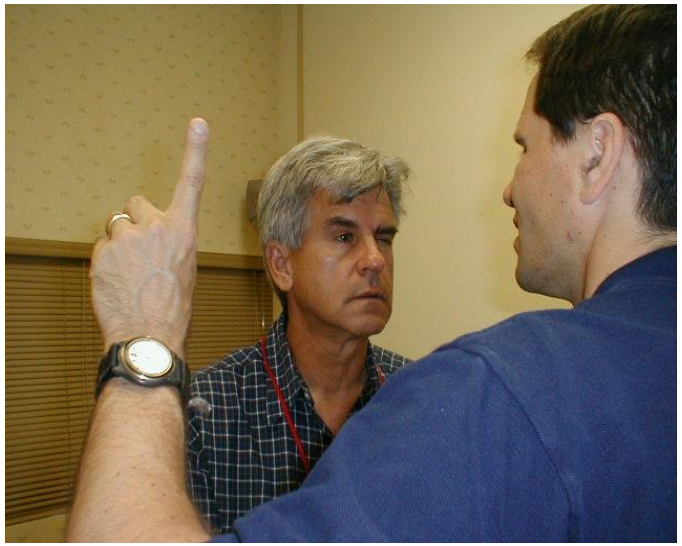
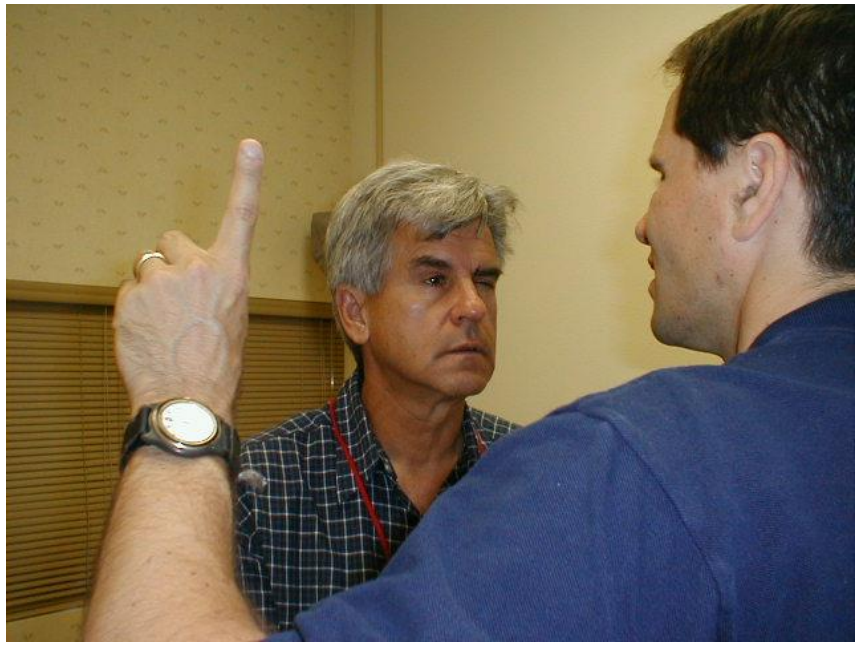
CN 2 - Checking Visual Fields By Confrontation

- Face patient, roughly 1-2 ft apart, noses @ same level.
- Close your R eye, while patient closes their L. Keep other eyes open & look directly @ one another.
- Move your L arm out & away, keeping it ~ equidistant from the 2 of you. A raised index finger should be just outside your field of vision.



CN 2 - Checking Visual Fields By Confrontation (cont)

- Wiggle finger & bring it in towards your noses. You should both be able to detect it @ same time.
- Repeat, moving finger in from each direction. Use other hand to check medial field (i.e. starting in front of the closed eye).
- Then repeat for other eye.



Pupillary Response (CNs 2 and 3)

- Pupils modulate amount of light entering eye (like shutter on camera)
- Dark conditions → dilate; Bright → constrict
- Pupils respond symmetrically to input from either eye
  - Direct response =s constriction in response to direct light
  - Consensual response =s constriction in response to light shined in opposite eye
- Light impulses travel away (sensory afferents) from pupil via CN 2
- Impulses that cause ciliary muscles to constrict are carried via parasympathetic (travel alongside CN3)
- Impulses that cause ciliary muscles to dilate carried via sympathetic chain

Pupillary Response Testing: Technique

- Make sure room is dark → pupils a little dilated, yet not so dark that cant observe response – can use your hand to provide “shade” over eyes
- Shine light in R eye:
  - R pupil → constricts
  - Again shine light in R eye, but this time watch L pupil (should also constrict)
- Shine light in L eye:
  - L pupil → constricts
  - Again shine light in L eye, but this time watch R pupil (should also constrict)

Describing Pupillary Response

- Normal recorded as: **PERRLA** (**P**upils **E**qual, **R**ound, **R**eactive to **L**ight and **A**ccommodation) – w/accommodation = to constriction occurring when eyes follow finger brought in towards them, directly in middle (i.e. when looking "cross eyed").
- Abnormal appearance of one pupil (anisocoria) and/or response to light occurs secondary to:
  - CN 2 impairment (afferents): pupil doesn't respond to light in affected eye
  - Disrupted sympathetics (1^{st}, 2^{nd}, or 3^{rd} order neurons): affected pupil appears constricted – will respond to light, though dilates slowly
  - Disrupted parasympathetics (often accompanies injury to CN3): affected pupil appears dilated, min response to light
  - Meds can affect both pupils: sympathomimetics (cocaine)→ dilate, narcotics (heroin)→ constrict.

CNs 3, 4 & 6:
Extra Ocular Movements

- Eye movement dependent on Cranial Nerves 3, 4, and 6 & muscles they innervate.
- Allows smooth, coordinated movement in all directions of both eyes simultaneously
- There's some overlap between actions of muscles/nerves

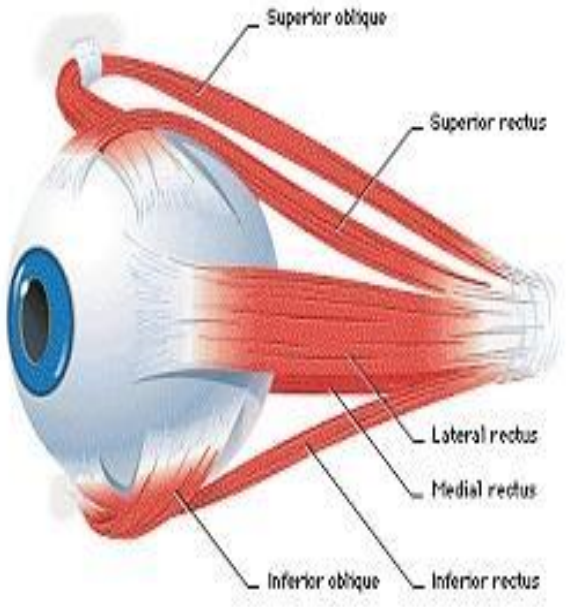


Image Courtesty of Leo D Bores, M.D. Occular Anatomy: http://www.e-sunbear.com/anatomy_01.html

Cranial Nerves (CNs) 3, 4 & 6
Extra Ocular Movements (cont.)

- CN 6 (Abducens)
  - Lateral rectus muscle → moves eye laterally
- CN 4 (Trochlear)
  - Superior oblique muscle → moves eye down (depression) when looking towards nose; also rotates internally.
- CN 3 (Oculomotor)
  - All other muscles of eye movement – also raises eye lid & mediates pupillary constriction.

CNs & Muscles That Control Extra Occular Movements

LR- Lateral Rectus

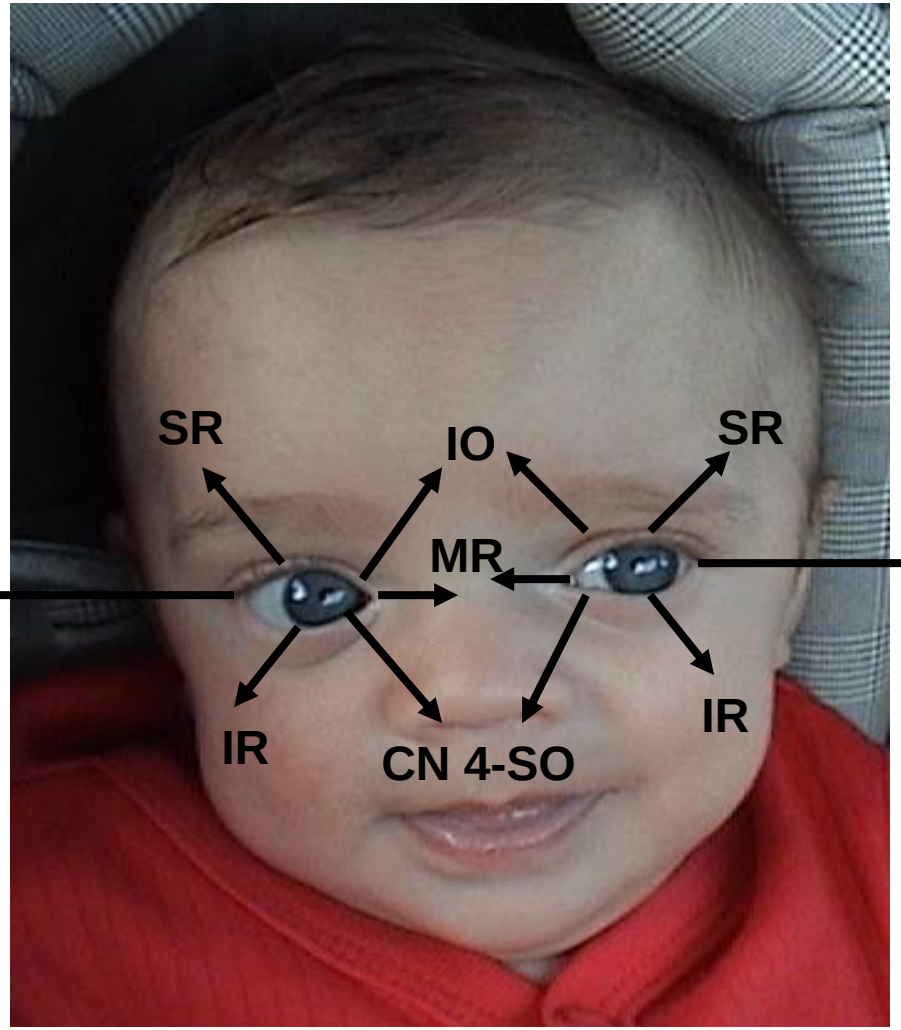
MR-Medial Rectus

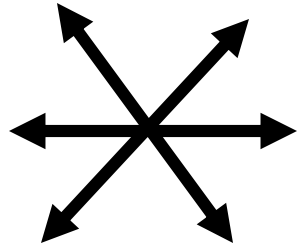
SR-Superior Rectus

IR-Inferior Rectus

SO-Superior Oblique

IO-Inferior Oblique





6 “Cardinal” Directions Movement

SO ‘4’, LR ‘6’, All The Rest ‘3’

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Technique For Testing Extra-Ocular Movements

- To Test:
  - Patient keeps head immobile, following your finger w/their eyes as you trace letter “H”
- Eyes should move in all directions, in coordinated, smooth, symmetric fashion.
- Hold the eyes in lateral gaze for a second to look for nystagmus

Function CN 5 - Trigeminal

- Sensation:
  - 3 regions of face: Ophthalmic, Maxillary & Mandibular
- Motor:
  - Temporalis & Masseter muscles

Function CN 5 – Trigeminal (cont.)

Motor

Temporalis (clench teeth)

Masseter (move jaw side-side)

Sensory

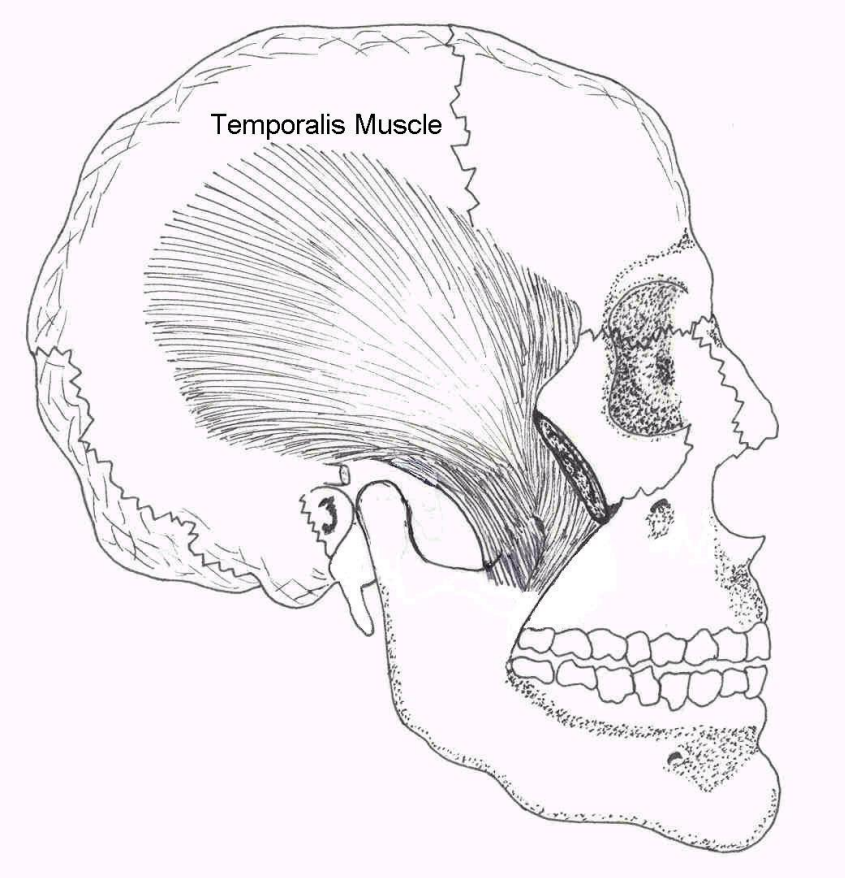
Ophthalmic(V1)

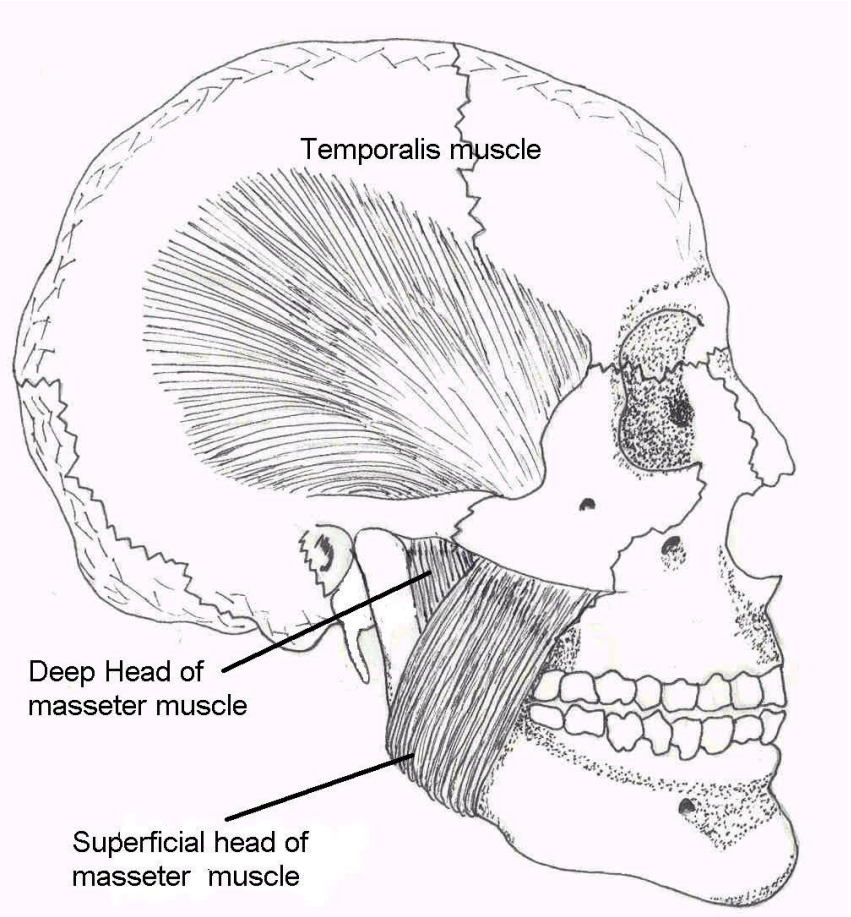
Maxillary (V2)

Mandibular (V3)

* Corneal Reflex: Blink when cornea touched - Sensory CN 5, Motor CN 7

Temporalis & Masseter Muscles





Courtesy Oregon Health Sciences University:
http://home.teleport.com/~bobh/

Testing CN 5 - Trigeminal

- Sensory:
  - Ask pt to close eyes
  - Touch ea of 3 areas (ophthalmic, maxillary, & mandibular) lightly, noting whether patient detects stimulus.
- Motor:
  - Palpate temporalis & mandibular areas as patient clenches & grinds teeth
- Corneal Reflex:
  - Tease out bit of cotton from q-tip - Sensory CN 5, Motor CN 7
  - Blink when touch cornea w/cotton wisp

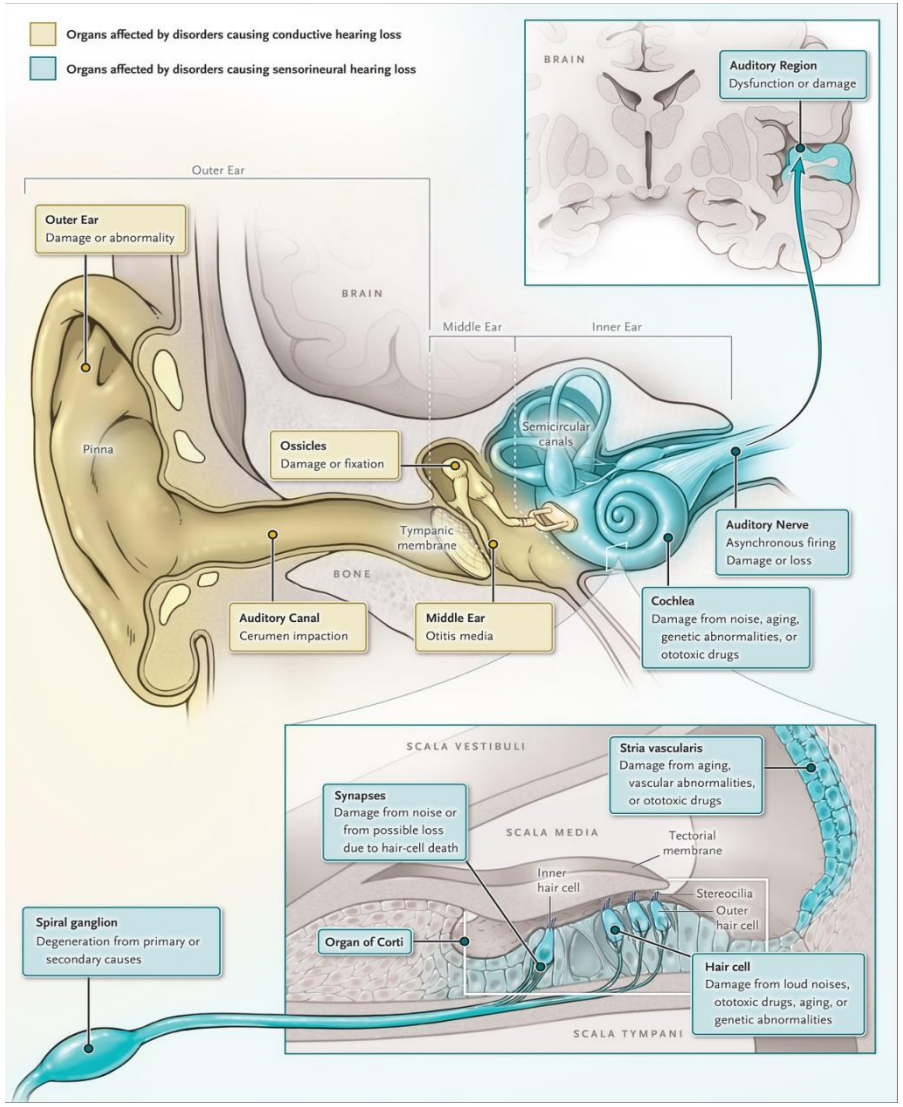
CN 7 (Facial) – Exam

- Observe facial symmetry
- Wrinkle Forehead
- Keep eyes closed against resistance
- Smile, puff out cheeks

Cute.. and symmetric!

The Ear – Functional Anatomy and Testing CN 8 (Acoustic)

- Crude hearing tests: rub fingers next to either ear; whisper & ask pt repeat words
- **If** hearing loss, determine: **<u>Conductive</u>** (external canal up to but not including cochlea & auditory branch CN 8) v **<u>Sensorineural</u>** (cochlea & auditory branch CN 8)



Cunningham L, et al. NEJM 2017;377:2465-2473.

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CN 8 - Defining Cause of Hearing Loss - Weber Test

- 512 Hz tuning fork - this (& not 128Hz) is well w/in range normal hearing & used for testing
  - Get turning fork vibrate→ striking ends against heel of hand **or**

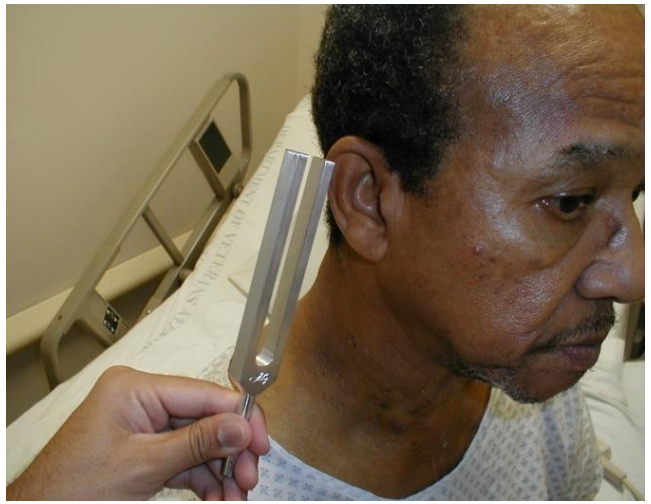
    Squeeze tips between thumb & 1st finger
- Place vibrating fork mid line skull
- Sound should be heard equally, R and L → bone conducts to both sides.

CN 8 - Weber Test (cont)

- If **conductive** hearing loss (e.g. obstructing wax in canal on L)→louder on L as less competing noise.
- If **sensorineural** on L→louder on R
- Finger in ear mimics conductive loss

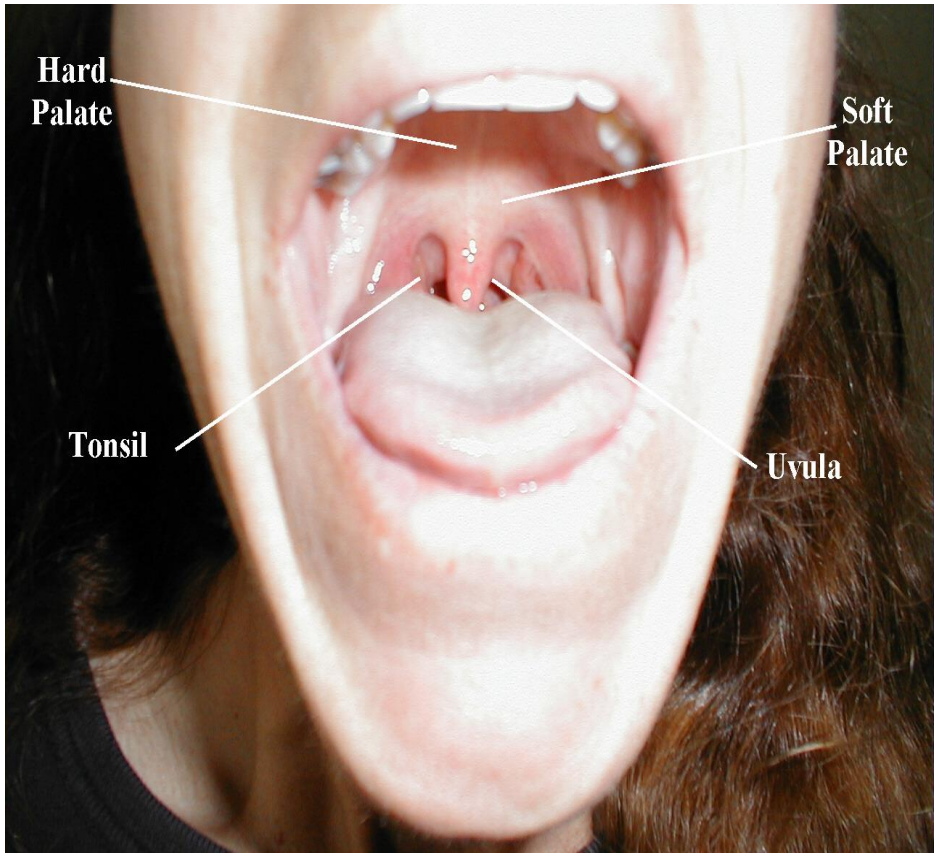
CN 8 - Defining Cause of Hearing Loss - Rinne Test

- Place vibrating 512 hz tuning fork on mastoid bone (behind ear).
- Patient states when can't hear sound.
- Place tines of fork next to ear→ should hear it again – as air conducts better then bone.
- If BC better then AC, suggests **conductive** hearing loss.
- If **sensorineural** loss, then AC still > BC



Note: Weber & Rinne difficult to perform in loud areas due to competing noise – repeat @ home in quiet room!

Oropharynx: Anatomy & Function CNs 9 (Glossopharyngeal), 10 (Vagus), 12 (Hypoglossal)



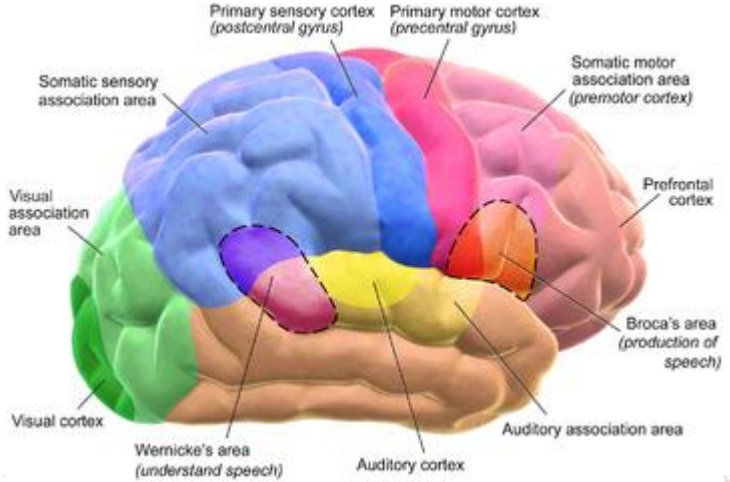
- **CN 9 &10** are tested together
- Check to see uvula is midline
- Stick out tongue, say "**Ahh**" – use tongue depressor if can't see
  - Normal response: palate/uvula rise
- **Gag Reflex** – provoked with tongue blade or q tip - CN 9 (afferent limb), 10 (efferent limb) – test this bilaterally
- **CN 12 Hypoglossal**
  - Stick out tongue – is it midline?
  - Have patient push tongue into their cheek while you resist from the outside

Neck Movement (CN 11 – Spinal Accessory)

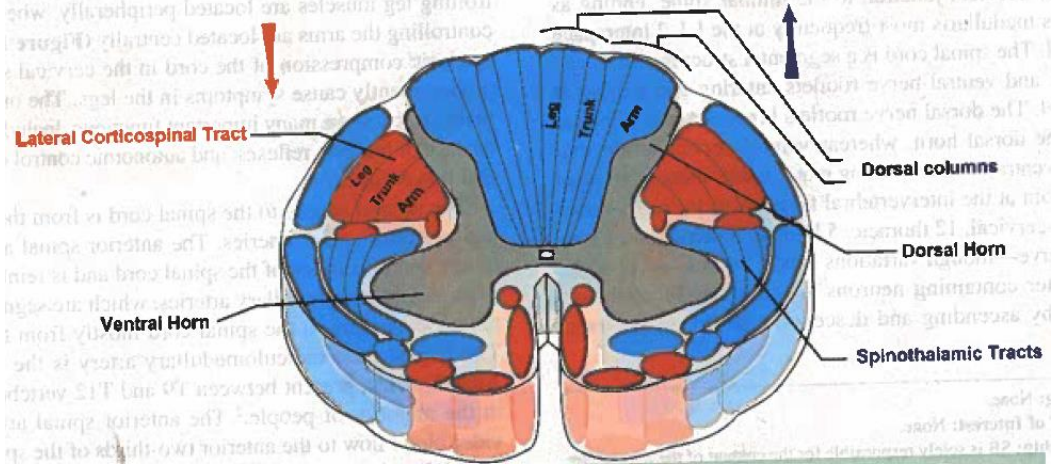
- **Turn head** to **L** into R hand→ function of **R Sternocleidomastoid** (SCM)
- **Turn head** to **R** into L hand (**L SCM**)
- **Shrug shoulders** into your hands

Core Anatomic And Functional Aspects of the Nervous System

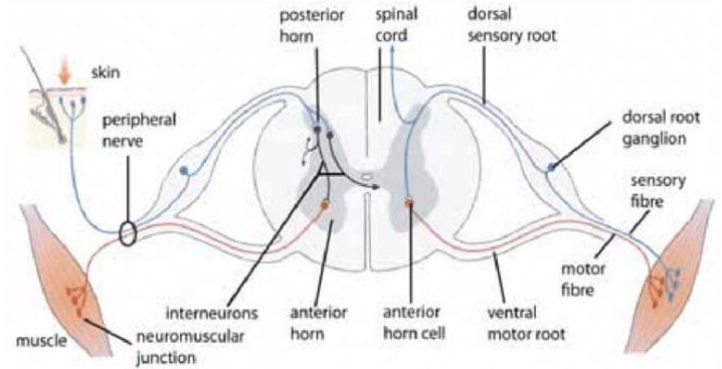
Brain



Spinal Cord



Peripheral Nervous System



Am J Med 2018; 131 (11): 1294

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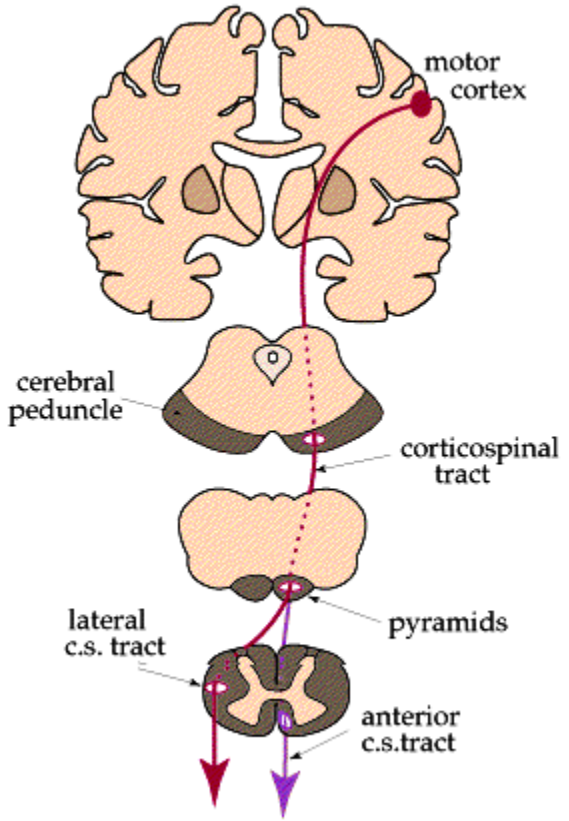
Motor/Strength Anatomy and Physiology

- Impulse starts brain
- Axon (upper motor neuron) crosses opposite side @ brain stem
- Travels down spinal cord

  → specific level Corticospinal (Pyramidal) Tracts
- Synapses w/2nd neuron (lower motor neuron)
- Leaves cord & travel to target muscle
- Muscle moves



Washington University (St Louis) School of Medicine - Dept Neuroanatomy http://thalamus.wustl.edu/course/basmot.html

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Muscles – Observation/Bulk and Palpation

- Make sure to **fully expose** the muscle that you're examining
- Note Bulk (amount of muscle mass): accounting for size patient, activity level, age – if decreased, ? Symmetric
- Palpation: feel the major muscle groups → provides insight about bulk, also ? any Inflammation, pain

L calf hypertrophy and R calf atrophy

L hand muscle wasting from de-nervation

Muscle Tone; Observe For Tremor

- Tone – move major joints (wrists, elbows, shoulders, hips,

  knees, feet) → range of motion
  - Normal → fluid
  - Increased w/UMN lesion (spasticity)
  - Decreased (flacid) w/LMN lesion
- Obvious tremor, unintended movements, fasciculations:
  - Loss of muscle innervation (rare!)
  - Video of fasciculations: http://meded.ucsd.edu/clinicalmed/fasciculations.html

Strength – Scoring System

Quantify with **0 → 5** Medical Research Council Scale (quasi-objective)

- **0/5** No movement
- **1/5** Barest flicker movement →not enough to move structure to which attached.
- **2/5** Voluntary movement not sufficient to overcome force of gravity. E.g. patient able to slide hand across table - but not lift it from surface.
- **3/5** Voluntary movement capable of overcoming gravity, not any applied resistance. E.g. patient raises hand off table, but not w/any additional resistance applied.
- **4/5** Voluntary movement capable of overcoming "some" resistance
- **5/5** Normal strength

+/– can be added to allow for more nuanced scoring of 4/5 strength (e.g., 4+ or 4-; **but not** 5-, 3+ or 3-, etc.)

Specific Muscle Group Testing

- Test the major muscle groups
  - Recognize that you will need to augment exam based on clinical picture/syndrome and may not test everything
  - Test one muscle group at a time and compare right to left
    - Should be similar accounting for handedness
- Start with shoulder - abduction & adduction
- Elbow - flexion & extension
- Wrist - extension & flexion
- Interossei of Hand – finger abduction & adduction
  - Usually first dorsal interosseous and abductor digiti minimi
  - Add others as clinically indicated
- Grip strength (okay for screening but unreliable)
  - Keep out of the pincer grasp!
- Also must account for age, sex, expected/appropriate strength

Muscle Group Testing (cont)

- Hip - flexion & extension
- Hip – abduction & adduction
- Knee – flexion & extension
- Ankle – plantar flexion & dorsiflexion

Pronator Drift: A test for subtle upper extremity weakness.

- Have patient stand, close their eyes & extend both hands, palm up.
- If R arm slightly weak, it will pronate & “drift” down ward – suggests UMN lesion

Coordination & Fine Motor Movement

- Coordinated movement depends significantly on cerebellar input - though also requires strength, crude motor function, joint movement, vision, sensation, etc.

<u>Several tests provide similar info:</u>

Specifics:

- Finger-to-nose:
  - Place your finger in space in front of patient
  - Have patient move their index finger between their nose & your finger tip
- Heel-to-shin:
  - Have patient run heel of 1 foot up & down opposite shin

Coordination (cont)

Specifics (cont):

- Rapid Alternating Hand Movement
  - Have patient alternately touch back & then front of 1 hand against palm of other
- Rapid Alternating Finger Movement
  - Have patient alternately touch tips of each finger against thumb of same hand
- Gait & Speech (tested elsewhere) often also abnormal in setting of cerebellar dysfunction

Normal movement is both **smooth** & **accurate**.

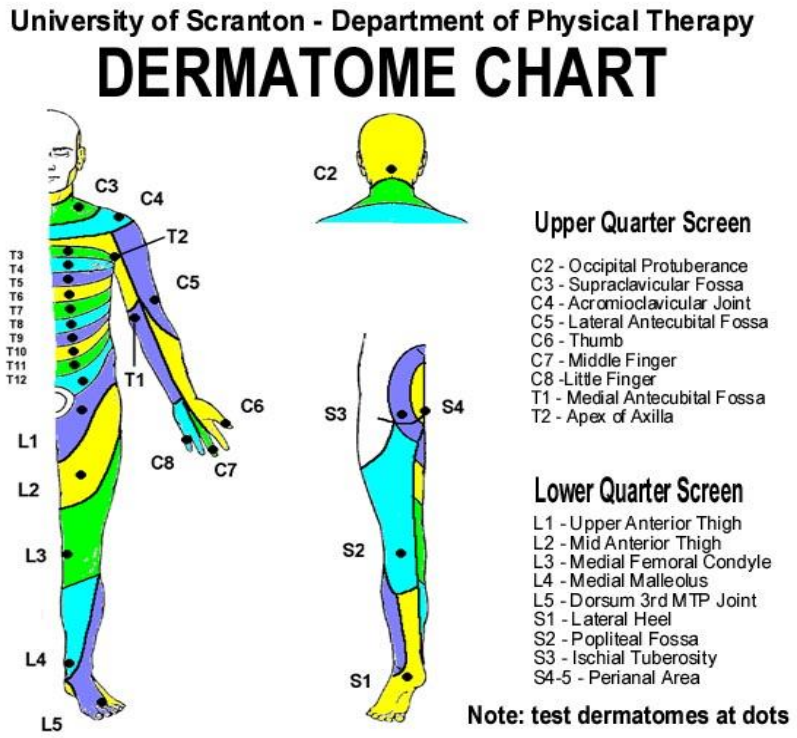
- If it is slow but regular and smooth, think weakness.

Sensory Testing
Anatomy & Physiology

- 2 main pathways: Spinothalamics & Dorsal columns.
- Spinothalamics
  - Pain, temperature, crude touch
  - Impulses enter from periphery→ cross to other side of cord within ~ 2 vertebral levels→ travel up that side to brain
- Dorsal Columns
  - Vibration, position, fine touch
  - Impulses from periphery enter cord → travel up that side → cross to opposite @ base of brain → then travel to their terminus

Nerves and Their Distributions

- Specific dermatomes not usually memorzied – reference chart helpful to pin down deficits
- Distributions (& spinal root contributions) for specific peripheral nerves→ looked up in appropriate setting
  - http://www.neuroguide.com/greatlessoccipital.html



http://academic.uofs.edu/department/pt/students/dermatom.htm

Spinothalamic Tracts: Pain, Temperature & Crude Touch

- Break Q-tip in half, creating sharp, pointy end
  - Or use a safety pin's sharp and blunt end
- Ask patient to close eyes→ unable to get visual clues.
- Start @ top of foot.
  - Orient patient by first touching w/sharp implement, then non-sharp object (e.g. the soft end of a q-tip) → clarifies for patient what you're defining as sharp & dull

Spinothalamics:
Pain, Temperature and Crude Touch (cont)

- Touch lateral aspect of foot w/either sharp or dull

  tool→ patient reports their response.
- Move medially across top of foot, noting their response to ea touch.
  - Remember to cross dermatomes
- Temperature tested by using a tuning fork (run under cold or warm water)
- Upper extremities can be checked in same fashion

Dorsal Columns: Proprioception

- Allows body to “know” where it is in space
- Important for balance, walking
- Ask patient to close eyes→ don’t receive any visual cues.
  - Grasp either side of great toe at the interphalangeal (IP) joint.
  - Place your other hand on the lateral and medial aspects of great toe distal to IP.
  - Orient patient as to up and down:
    - Flex the toe (pull it upwards) while telling patient what you’re doing.
    - Extend toe (pull it downwards) while informing them of which direction you’re moving it.

Dorsal Columns: Proprioception (cont)

- Alternately deflect toe up or down w/out telling patient in which direction

  you're moving it→ should be able to correctly identify movement & direction –Test both feet.
- Can be checked @ a more proximal joint (e.g. ankle) if abnormal.
- Upper extremities assessed in same fashion, deflecting finger up & down

For variations see:
http://www.neuroexam.com/neuroexam/content.php?p=40

Dorsal Columns: Vibratory Sensation

- Ask patient to close eyes →don't receive visual cues.
- Grasp **128 Hz** tuning fork by stem & strike forked ends against the floor→ vibrate.
  - Place stem on top of interphalangeal joint of great toe (you want to be on most distal joint for this exam)
  - Place fingers of your other hand on bottom-side of joint
  - Ask patient if they can feel vibration.
  - You should be able to feel same sensation w/fingers on bottom side of joint.

Dorsal Columns: Vibratory Sensation (cont.)

- Patient determines when vibration stops ➔ correlates w/when you can't feel it transmitted through joint
- Test both feet.
- Check more proximal joints (e.g. ankle) if sensation impaired.
- Upper extremities assessed similarly, w/fork placed on distal finger joint

Sensory Testing: Light Touch Spinothalamics and Dorsal Columns

- Tease out wisp of cotton or use q-tip
- Have patient close eyes
- Orient them to what sensation feels like
- Touch patient across distal extremity, asking them to identify which leg and area
- Can assess upper extremity in similar fashion

Special Sensory Testing (cont)

MONOFILAMENT TESTING

- Screening test for diabetic neuropathy
- Touch monofilament to 5-7 areas on bottom of foot.
- Normal =s Patient can detect filament when tip lightly applied to skin (i.e. before it bends).

Sensory Testing…

…Trying To **Prevent** This!

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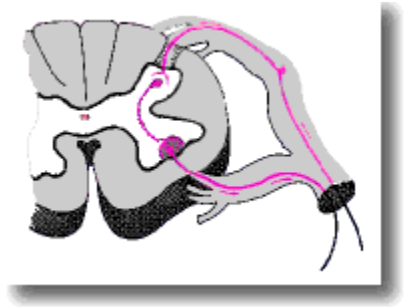
Reflex Testing
Anatomy and Physiology



Penn State Univ
http://www.hmc.psu.edu/sciweb/anat/anat4.htm

- Reflex arc made has afferent (sensory) & efferent (motor) limb
- Synapse in spinal cord, @ which point also input from upper motor neuron
- Disruption of any part of path alters reflexes: e.g.
  - UMN lesion → reflexes more brisk (hyperreflexia)
  - LMN or peripheral sensory lesions→ opposite effect (hyporeflexia)
- Reflexes graded 0-4+ scale: 0 = no reflex, 1+ = hyporeflexia, 2+ = normal, 3+ = hyperreflexia, 4+ = clonus (multiple movements after a single stimulus)

Reflex Basics

- Reflexes generally assessed in 5 places - 3 in the arm (biceps, triceps, brachioradialis); 2 in the leg (patellar & achilles)
- Basic Technique for assessing a reflex:
  - Clearly identify tendon of muscle to be tested
  - Position limb so muscle @ rest
  - Strike tendon briskly
  - Observe for muscle contraction & limb movement

Reflex Basics (cont)

- Array of hammers – all effective
- Reflex Trouble Shooting:
  - Make sure patient relaxed & that you're striking tendon directly
  - Hammer swings freely
  - Reinforcement (distraction) helps if you're having problems
    - When testing legs, ask patient to pull their hands apart as you strike tendon
    - When testing the upper extremities, ask them to clench teeth

Example of Hyper-Reflexia:
http://meded.ucsd.edu/clinicalmed/patellar_compare.htm

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Biceps (C 5, 6)

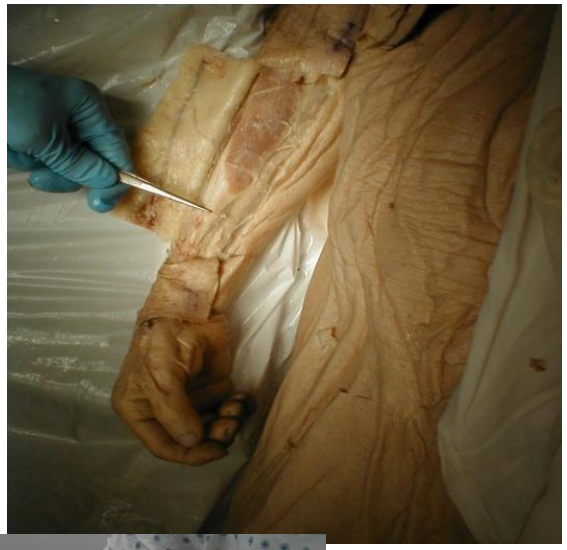
- Identify biceps tendon → have patient flex elbow against resistance while you palpate antecubital fossa
- Place arm so it's bent ~ 90 degrees
- Place one of your fingers on tendon and strike it briskly
- Muscle should contract & forearm flex

Triceps (C 7, 8)

- Identify triceps tendon → have patient extend elbow against resistance while you palpate above it
- Arm can hang down @ ninety degrees or have hands on hips
- Strike tendon directly or place finger on the tendon & strike it
- Triceps muscle contracts & arm extends.

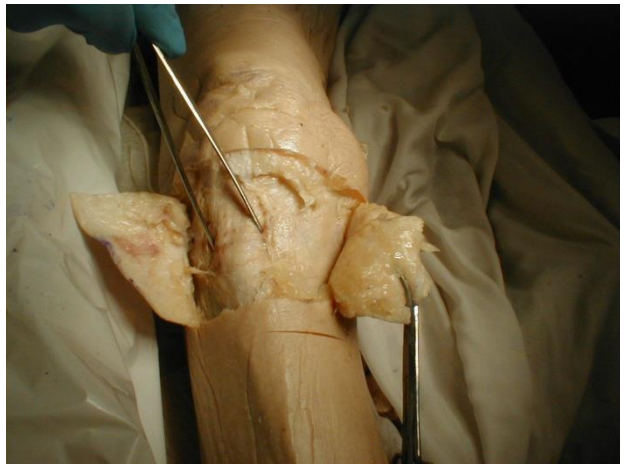
Brachioradialis (C5, 6)

- Tendon for brachioradialis is ~ 10 cm proximal to wrist – you cant see or feel it
- Place arm so resting on patient's thigh, bent @ elbow
- Strike firmly
- Muscle will contract & arm will flex @ elbow & supinate



Patellar (L3, 4)

- Patellar tendon extends below knee cap – it's thick & usually visible & palpable – if not, palpate while patient extends lower leg
- Strike firmly on tendon
- Muscle will contract & leg extend @ knee



Achilles (S1, S2)

- Achilles tendon →t hick structure connecting

  calf muscles → heel – if having trouble finding, palpate as patient pushes their foot into your other hand
- Hold foot @ 90 degrees
- Strike tendon firmly
- Muscle will contract & foot plantar-flex (move downward)

Babinski

- Gently stroke bottom of foot, starting laterally & near heel – moving up & across balls of feet (metatarsal heads)
  - If no response, increase your pressure
- Normal =s great toe moving downward
- If UMN lesion (or in newborns), great toe will extend & other toes fan out

http://meded.ucsd.edu/clinicalmed/babinski_compare.htm

UC San Diego School of Medicine

Gait and Romberg Testing

- Romberg: Test of balance & co-ordination→ input from multiple systems: proprioception, vestibular, cerebellum
  - Ask patient to stand still w/eyes closed
  - If @ risk for falling, be in position to catch ‘em (i.e. behind them) & get help
- Gait – pay attention to:
  - initiation of activity
  - arm, leg movement & position
  - speed & balance
  - have patient walk heel to toe
  - heel walking
  - toe walking

Example – Gait after stroke:

http://meded.ucsd.edu/clinicalmed/walking.htm

Summary of Skills

- ☐ Wash Hands
- ☐ Cranial Nerves:
  - ☐ CN1 (Olfactory) Smell
  - ☐ CN2, 3, 4, & 6: visual acuity, visual fields, extra occular movement, pupillary response to light
  - ☐ CN 5 (Trigeminal) Facial sensation; Muscles Mastication (clench jaw, chew);
    Corneal reflex (w/CN 7)
  - ☐ CN 7 (Facial) Facial expression
  - ☐ CN 8 (Auditory) Hearing
  - ☐ CN 9, 10 (Glosopharyngeal, Vagus) Raise palate (“ahh”), gag
  - ☐ CN 12 (Hypoglossal) Tongue
  - ☐ CN 11 (Spinal Accessory) Turn head against resistance, shrug shoulders

Continued on next slide →

Time Target: < 15 minutes

Summary of Skills (cont)

- ☐ Motor testing:
  - ☐ muscle bulk
  - ☐ tone
  - ☐ strength of major groups
- ☐ Sensory testing - in distal lower & upper extremities:
  - ☐ pain/crude touch
  - ☐ proprioception
  - ☐ vibration
- ☐ Reflexes
  - ☐ achilles
  - ☐ patellar
  - ☐ brachioradialis
  - ☐ biceps
  - ☐ triceps
- ☐ Coordination (finger → nose, heel → shin, etc.)
- ☐ Gait, Romberg
- ☐ Wash Hands

Time Target: < 15 minutes