Detailed Review of Cranial Nerves

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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.

Hmmm.. Coffee!
Functional Assessment – Acuity (Cranial Nerve 2 – Optic)

• Using hand held card (held @ 14 inches) or Snellen wall chart, assess ea eye separately. Allow patient to wear glasses.

• Direct patient to read aloud line w/smallest lettering that they’re able to see.
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).
Functional Assessment - Visual Fields (Cranial Nerve 2 - Optic)

Lesion #1
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:
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

- 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 (afferents) from pupil via CN 2 & back (efferents) to ciliary muscles that control dilatation via CN 3
Pupillary Response Testing Technique

• Make sure room is dark → pupils a little dilated, yet not so dark that can't 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)
Pupillary Response Testing Technique

• Swinging Flashlight Test
  – Looks for afferent pupil defect (CN II)
  – After observing each eye individually, move the flashlight between the left and right eye at a steady rate
  – See an example at Neuroexam.com:
Describing Pupillary Response

- Normal recorded as: **PERRLA (Pupils Equal, Round, Reactive to Light and Accommodation)** – w/accommodation = to constriction occurring when eyes follow finger brought in towards them, directly in middle (i.e. when looking “cross eyed”).

- Abnormal responses can be secondary to:
  - direct or indirect damage to either CN 2 or 3
    - Or parasympathetic injury to CN3 or damage to the sympathetic neurons
  - meds e.g. sympathomimetics (cocaine) → dilate, narcotics (heroin) → constrict.
Pupil Response Simulator

University of California, Davis School of Medicine – Designed by Dr. Rick Lasslo, M.D., M.S.

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.

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

• CN 6 (Abducens)
  – Lateral rectus muscle $\rightarrow$ moves eye laterally

• CN 4 (Trochlear)
  – Superior oblique muscle $\rightarrow$ 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

CN 6 - LR
CN 4 - SO
CN 6 - LR

SO '4', LR '6', All The Rest '3'

6 "Cardinal" Directions Movement
Technique For Testing Extra-Ocular Movements

• To Test:
  – Patient keeps head immobile, following your finger w/their eyes as you trace letter “H”
  – Alternatively, direct them to follow finger w/their eyes as you trace large rectangle

• Eyes should move in all directions, in coordinated, smooth, symmetric fashion.

• Hold the eyes in lateral gaze for a second to look for nystagmus
Extra Occular Eye Movement Simulator

University of California, Davis School of Medicine – Rick Lasslo, M.D., M.S.

http://cim.ucdavis.edu/eyes/version1/eyesim.htm
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-to-side)

Sensory

- Ophthalmic (V1)
- Maxillary (V2)
- Mandibular (V3)

* Corneal Reflex: Blink when cornea touched - Sensory CN 5, Motor CN 7
Temporalsis & Masseter Muscles

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
Function CN 7 – Facial Nerve
Facial Symmetry & Expression - Precise Pattern of Inervation

R UMN

R LMN - Forehead
R LMN - Face

L UMN

L LMN - Forehead
L LMN - Face

Thick arrow = UMN
Dashed arrow = LMN
CN 7 – Exam

- Observe facial symmetry
- Wrinkle Forehead
- Keep eyes closed against resistance
- Smile, puff out cheeks
- Rarely you may need to check taste to the anterior 2/3 of the tongue

Cute.. and symmetric!
Pathology: Peripheral CN 7 (Bell’s) Palsy

Patient can’t close L eye, wrinkle L forehead or raise L corner mouth → L CN 7 Peripheral (i.e. LMN) Dysfunction

Central (i.e. UMN) CN 7 dysfunction (e.g. stroke) - not shown: Can wrinkle forehead bilaterally; will demonstrate loss of lower facial movement on side opposite stroke.
Comparison of a patient with (A) a facial nerve (Bell’s Type - LMN) lesion and (B) a supra-nuclear (UMN) lesion w/forehead sparing


Note forehead and lower face are affected on the right, which is same side of the LMN lesion

Note forehead sparing on right side, opposite the UMN lesion
The Ear – Functional Anatomy & Testing (CN 8 – Acoustic)

• Crude tests hearing – rub fingers next to either ear; whisper & ask pt repeat words

• If sig hearing loss, determine Conductive (external canal up to but not including CN 8) v Sensorineural (CN 8)

CN 8 - Defining Cause of Hearing Loss - Weber Test

- 512 Hz tuning fork - this (not 128Hz) is well within 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 than bone.
- If BC better then AC, suggests conductive hearing loss.
- If sensorineural loss, then AC still > BC

Note: Weber & Rinne difficult to perform in Anatomy lab due to competing noise – repeat @ home in quiet room!
CN 8 Vestibular Division

- You will not routinely test; only w/patients who present w/new onset “dizziness”
- If the patient has vertigo you will need to perform a Dix-Hallpike maneuver
Oropharynx: Anatomy & Function CNs 9 (Glossopharyngeal), 10 (Vagus)

- **CN 9 & 10** are tested together
- Check to see uvula is midline
- Stick out tongue, say “Ahh” – use tongue depressor if can’t see
  - NI response: palate/uvula rise
  - We assume 9 is intact if the palate rises symmetrically thus we test 9 and 10 indirectly here
- **Gag Reflex** – provoked with tongue blade or q tip - CN 9 (afferent limb), 10 (efferent limb) – test this bilaterally
  - This directly tests 9 and 10
Hypoglossal CN 12

- **Tongue midline** when patient sticks it out → **CN 12**
  - check strength by directing patient push tip into inside of either cheek while you push from outside
  - Observe for atrophy or fasciculations
CN 9 & 12 Pathology

L CN 9 palsy: uvula pulled to R

L CN 12 palsy: tongue deviates L
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
Summary of Skills

- Wash Hands
- CN1 (Olfactory) Smell
- CN2 (Optic) Visual acuity; Visual fields
- CNs 2&3 (Optic, Occulomotor) Pupillary Response to light
- CNs 3, 4 & 6 (Occulomotor, Trochlear, Abduscens) Extra-Occular Movements
- 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

Time Target: < 15 minutes