Detailed Review of Cranial Nerves

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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.
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

Images from: Wash Univ. School of Medicine, Dept Neuroscience
http://thalmus.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 of the 4 quadrants.
- 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 $\rightarrow$ dilate; Bright $\rightarrow$ constrict
• Pupils respond symmetrically to input from either eye
  • Direct response $=$ constriction in response to direct light
  • Consensual response $=$ 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 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)
Describing Pupillary Response

• Normal recorded as: **PERRLA (Pupils Equal, Round, Reactive to Light and Accomodation)**
  • accommodation = constriction occurring when eyes follow finger towards nose (looking “cross eyed”).
Abnormal Appearing Pupils

• Asymmetric pupils (anisocoria) secondary to:
  • Parasympathetic nervous system dysfunction \(\rightarrow\) e.g. tumor compressing CN3 \(\rightarrow\) pupil dilated (also ptosis, eye down/out)
  • Sympathetic nervous system dysfunction (e.g. Horner’s Syndrome) \(\rightarrow\) pupil smaller at baseline (also ptosis)
  • Prior surgery, trauma to pupils, other

• Systemic Meds affect both pupils
  • sympathomimetics (cocaine) \(\rightarrow\) dilate
  • narcotics (heroin) \(\rightarrow\) constrict

• Local meds (e.g. eye drops) can affect just one pupil
Pupillary Response Testing: Relative Afferent Pupillary Defect (RAPD)

- **Swinging Flashlight Test**
  - Looks for afferent pupil defect (CN II)
  - Baseline appear normal
  - Move flashlight between left & right eye at steady rate
  - With right afferent defect, pupil appears to dilate when swing light repeatedly from left (normal afferents) → right (abnormal afferents)

- RAPD indicates process affecting Optic nerve (e.g. optic neuritis, stroke, Temporal arteritis)

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 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

SO ‘4’, LR ‘6’, All The Rest ‘3’
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-to-side)

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

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

V1 (ophthalmic branch) Zoster

V2 (maxillary branch) Zoster
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
Function CN 7 – Facial Nerve
Facial Symmetry & Expression - Precise Pattern of Inervation

- R UMN
- L UMN
- R LMN - Forehead
- L LMN - Forehead
- R LMN - Face
- L LMN - Face

Thick arrow = s UMN
Dashed arrow = s LMN
CN 7 (Facial) – Exam

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

Cute.. and symmetric!
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
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.
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: **Conductive** (external canal up to but not including cochlea & auditory branch CN 8) v **Sensorineural** (cochlea & auditory branch CN 8)

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.
• 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 than 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!
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

• You can see an example of it here: http://www.neuroexam.com/neuroexam/content.php?p=23
Oropharynx: Anatomy & Function CN 9 (Glossopharyngeal) and CN 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
  - Normal response: palate/uvula rise
- **Gag Reflex** — provoked with tongue blade or q tip - CN 9 (afferent limb), 10 (efferent limb) — test this bilaterally (noxious — so discuss rationale with patient prior to performing)
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, 3, 4, & 6: visual acuity, visual fields, extra ocular 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
☐ Wash Hands

Time Target: < 15 minutes