

# 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.



Hand Held Acuity Card

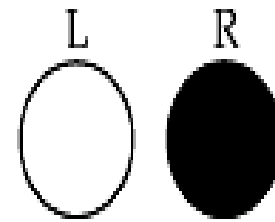
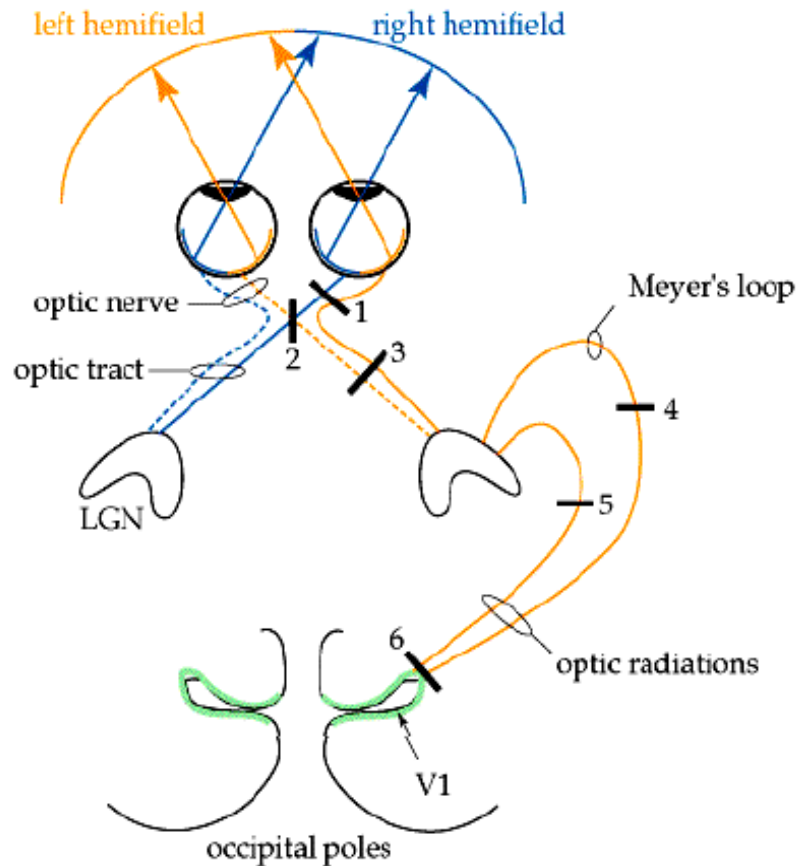
# Functional Assessment – Acuity (cont)

- 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).



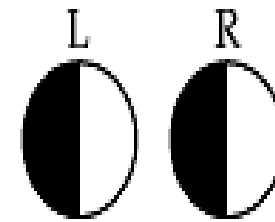
Snellen Chart For Acuity Testing

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



loss of vision  
in R eye

**Lesion #1**



loss of vision in  
left hemifield

**Lesion #3**

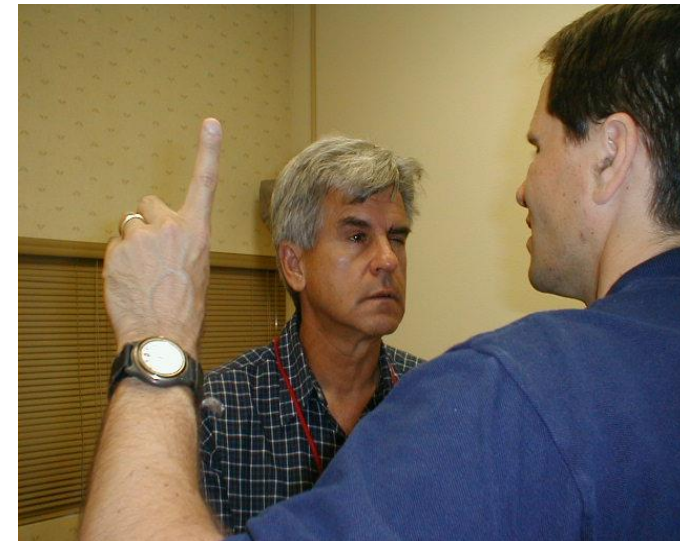
Images from: Wash Univ. School of Medicine, Dept Neuroscience  
<http://thalamus.wustl.edu/course/basvis.html>

NEJM Interactive case – w/demo of visual field losses:

[http://www.nejm.org/doi/full/10.1056/NEJMimc1306176?query=featured\\_home](http://www.nejm.org/doi/full/10.1056/NEJMimc1306176?query=featured_home)

# 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 → 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

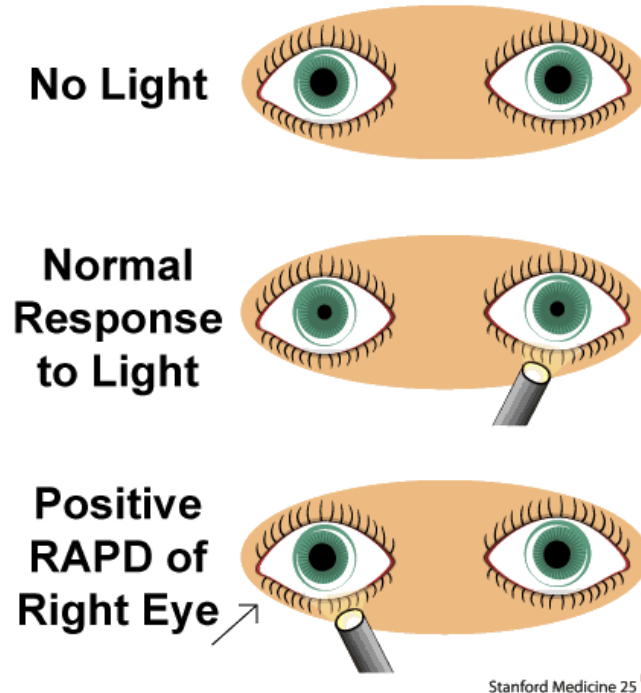
- Normal recorded as: **PERRLA** (**P**upils **E**qual, **R**ound, **R**eactive to **L**ight and **A**ccommodation)
  - accommodation = constriction occurring when eyes follow finger towards nose (looking “cross eyed”).

# Abnormal Appearing Pupils

- Asymmetric pupils (anisocoria) secondary to:
  - Parasympathetic nervous system dysfunction → e.g. tumor compressing CN3 → pupil dilated (also ptosis, eye down/out)
  - Sympathetic nervous system dysfunction (e.g. Horner's Syndrome) → pupil smaller at baseline (also ptosis)
  - Prior surgery, trauma to pupils, other
- Systemic Meds affect both pupils
  - sympathomimetics (cocaine) → dilate
  - narcotics (heroin) → 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

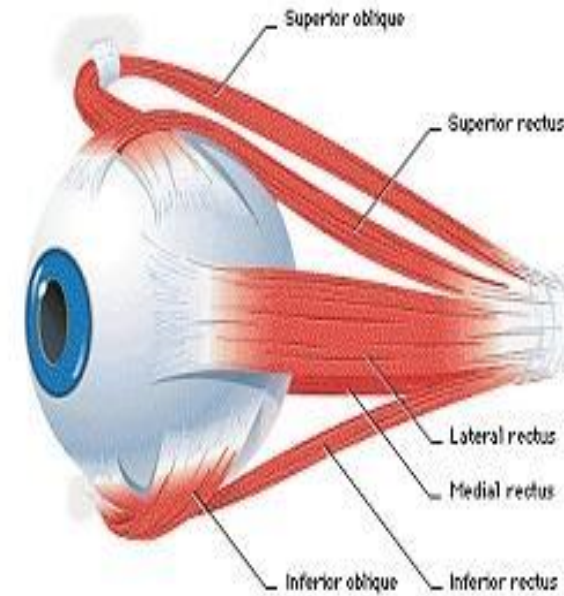


Image Courtesy of Leo D Bores,  
M.D. Occular Anatomy: [http://www.e-sunbear.com/anatomy\\_01.html](http://www.e-sunbear.com/anatomy_01.html)

# 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 Ocular Movements

**LR**- Lateral Rectus

**MR**-Medial Rectus

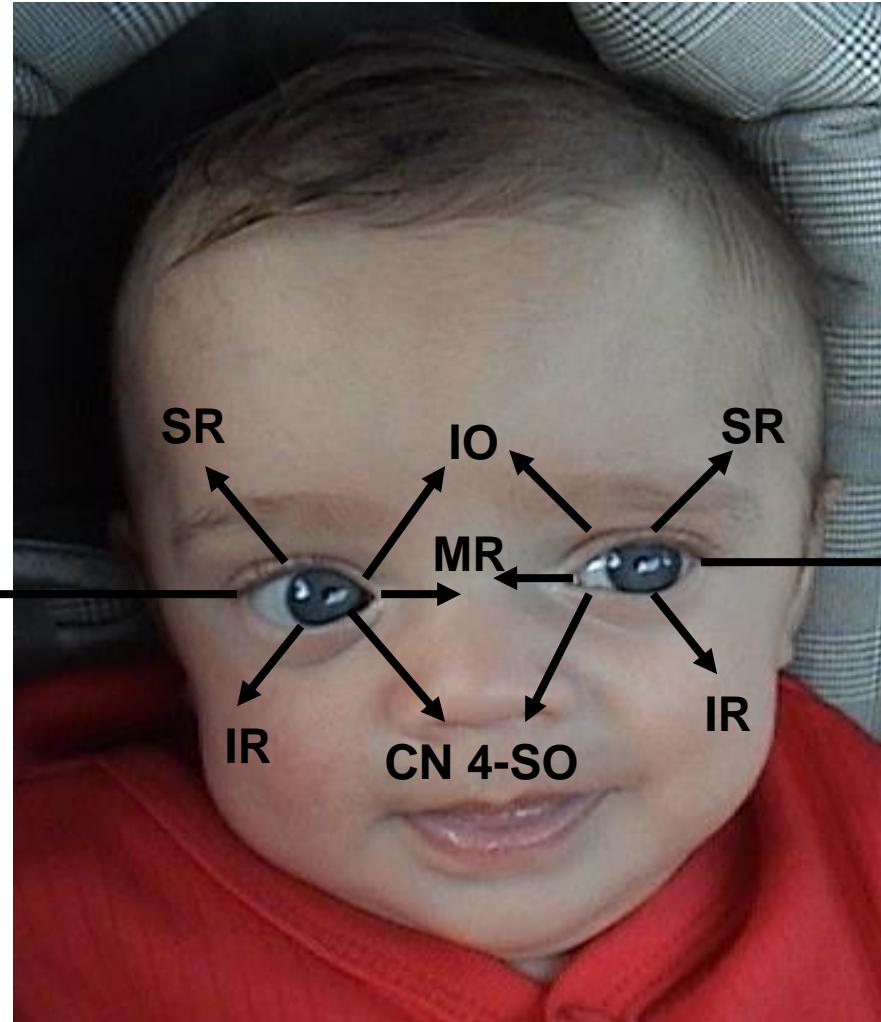
**SR**-Superior Rectus

**IR**-Inferior Rectus

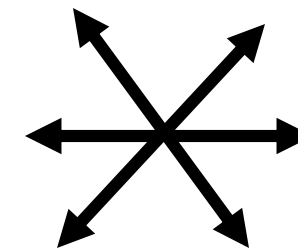
**SO**-Superior Oblique

**IO**-Inferior Oblique

**CN 6-LR**



**CN 6-LR**



**6 "Cardinal" Directions  
Movement**

**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-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

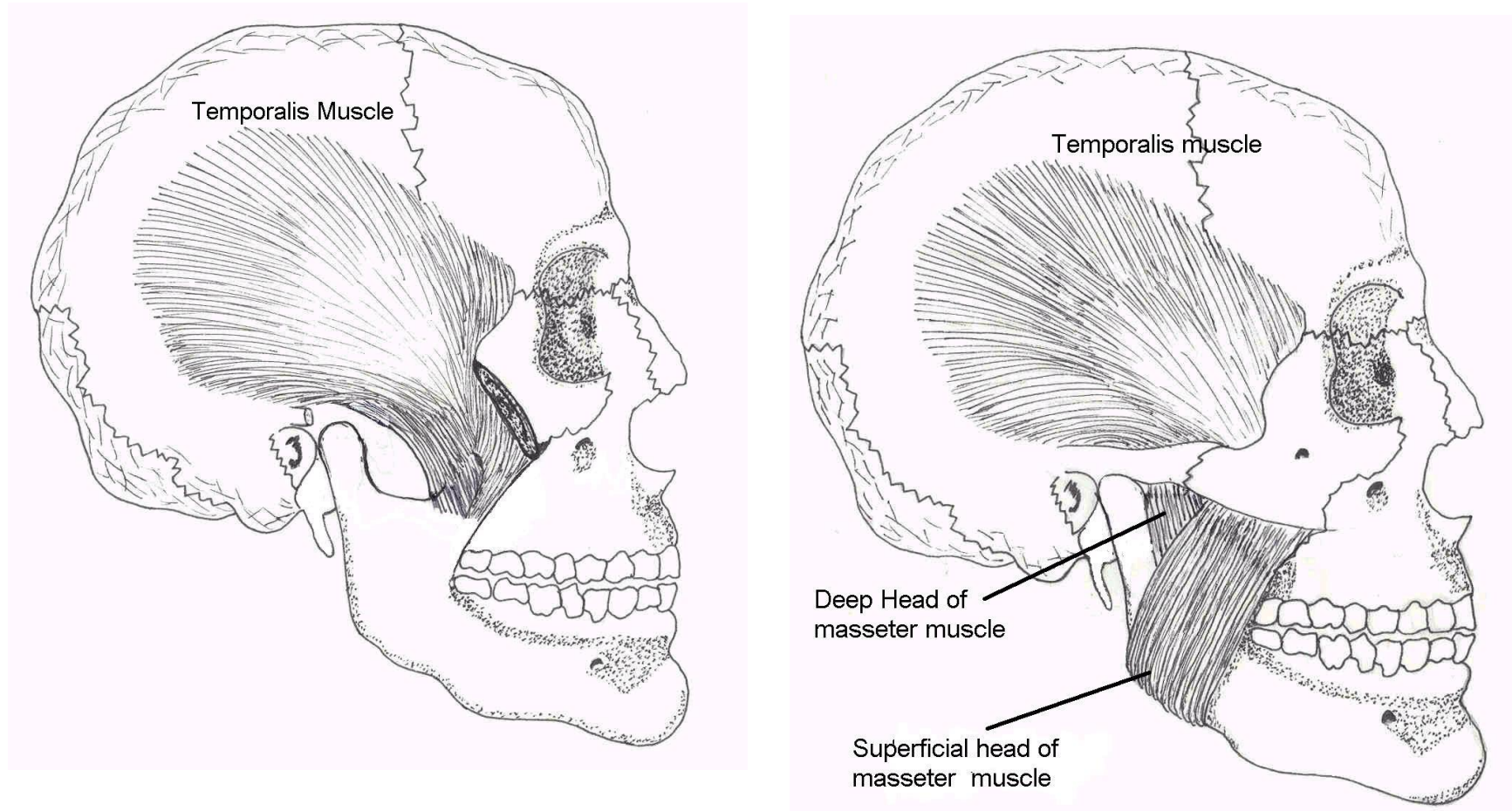


V2 (maxillary branch) Zoster





# Temporalis & Masseter Muscles



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

# Testing CN 5 - Trigeminal

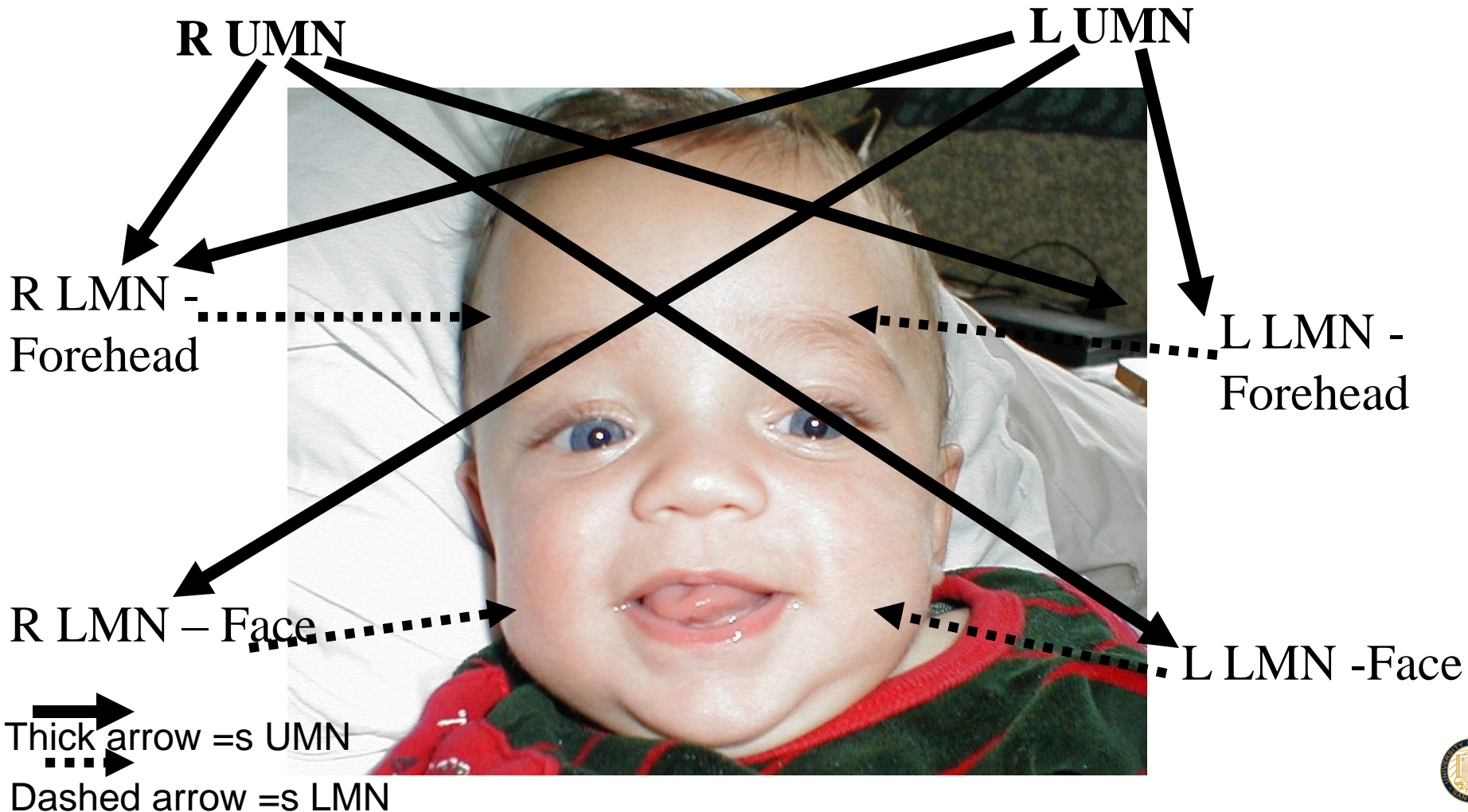
- Sensory:
  - Ask pt to close eyes
  - Touch ea of 3 areas (ophthalmic, maxillary, & mandibular) lightly, noting whether patient detects stimulus.
- Motor:
  - Palpate temporalis & mandibular areas as patient clenches & grinds teeth
- Corneal Reflex:
  - Tease out bit of cotton from q-tip - Sensory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





# Function CN 7 – Facial Nerve

## Facial Symmetry & Expression - Precise Pattern of Innervation



# CN 7 (Facial) – Exam

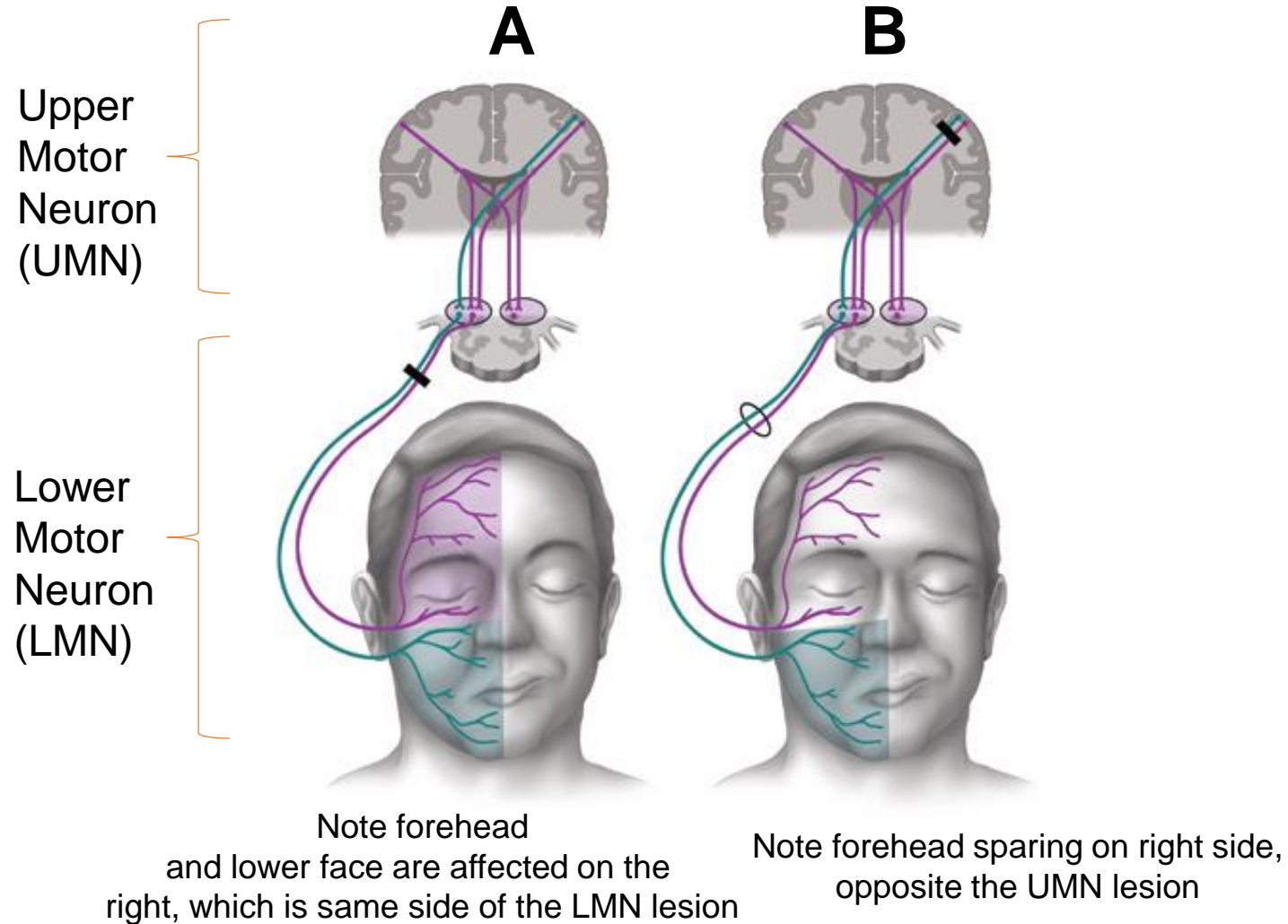
- Observe facial symmetry
- Wrinkle Forehead
- Keep eyes closed against resistance
- Smile, puff out cheeks



Cute.. and symmetric!

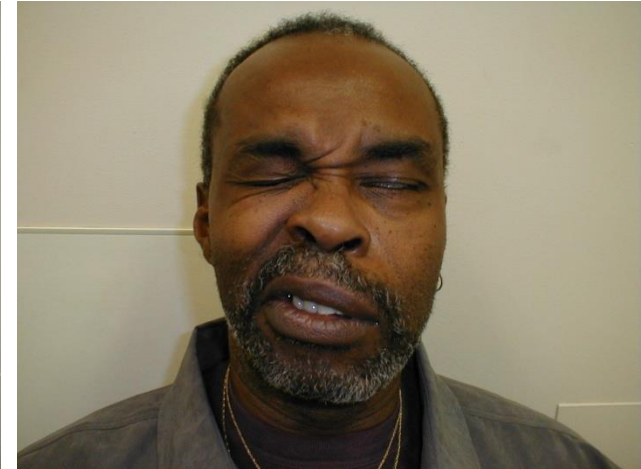
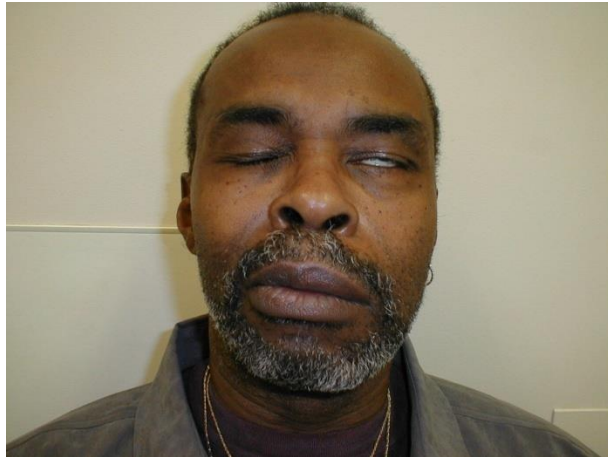
# Comparison of a patient with (A) a facial nerve (Bell's Type - LMN) lesion and (B) a supra-nuclear (UMN) lesion w/forehead sparing

Tiemstra J et al. Bell's Palsy: Diagnosis and Management, Amer J Fam Practice, 2007;76(7):997-1002.  
<http://www.aafp.org/afp/2007/1001/p997.pdf>



# 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



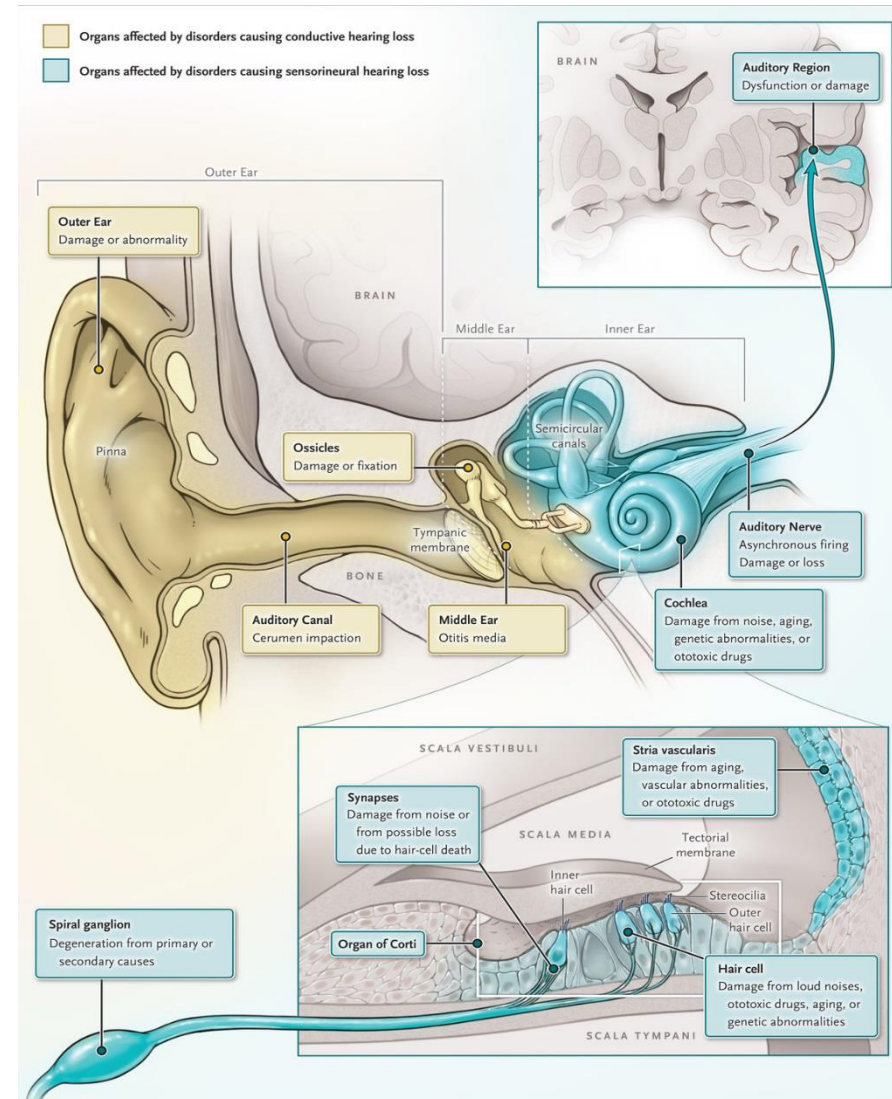
Central (i.e. UMN) CN 7 dysfunction (e.g. stroke) - not shown: Can wrinkle forehead bilaterally; will demonstrate loss of lower facial movement on side opposite stroke.



# 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 tuning fork vibrate → striking ends against heel of hand **or**  
Squeeze tips between thumb & 1<sup>st</sup> 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)

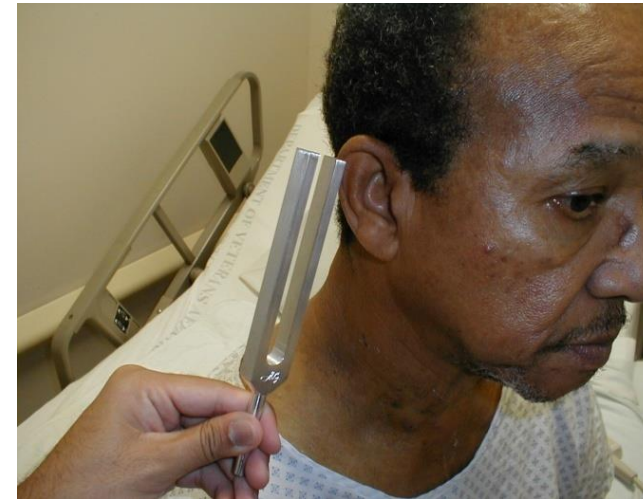
- If **conductive** hearing loss (e.g. obstructing wax in canal on L) → louder on L as less competing noise.
- If **sensorineural** on L → louder on R
- Finger in ear mimics conductive loss





# 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 than AC, suggests **conductive** hearing loss.
- If **sensorineural** loss, then AC still > BC

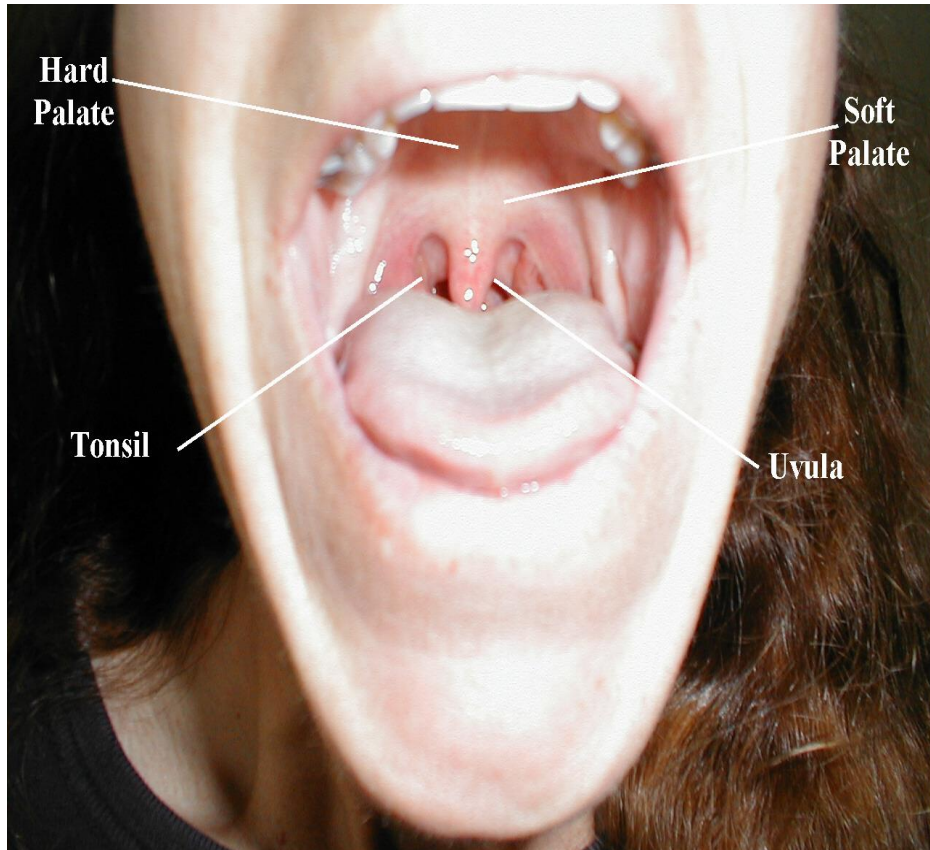


Note: Weber & Rinne difficult to perform in loud areas due to competing noise – repeat @ home in quiet room!

# 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