EXAMINATION OF THE CRANIAL NERVES
Olfactory nerve (I)

Inferior aspect of brain

- Olfactory nerve fibers
- Olfactory bulb
- Frontal lobe
- Olfactory nerves
- Mouth
The olfactory nerve - key questions

- Partial or total loss of smell?
- Altered sensation of smell?
- Nasal and post-nasal discharge? (mucus, serous, purulent, blood)
- Nasal obstruction? (polyps, inflammation, masses)
- Pain around the sinuses?
- History of allergies?
- Trauma to frontal lobes?
- Viral infections?
- Parkinson's disease?
The olfactory nerve - exam procedure

- Test for smell recognition
- Use familiar but gentle substances
- Test each nostril in turn by asking them to block the other nostril
- Place pressure / tap over the sinuses
- Ask them to lean forward for pain or discomfort
- Examine the nasal cavity with a rhinoscope
- Transilluminate the sinuses
The olfactory nerve - pathologies

- Frontal lobes tumours / abscess
- Trauma to the head / frontal
- Sinus problems
- Senile anosmia
- Blocked nostrils
- Nasal polyps or tumours
- Viral infections
- Parkinsons disease
Optic nerve (II)

Inferior aspect of brain

Optic (II) nerve

Optic tracts

Midbrain

Optic nerve

Lateral geniculate nucleus of thalamus

Optic radiations
The optic nerve - key questions

- Blurred vision?
- Double vision?
- Sensitivity to light?
- Poor night vision?
- Floaters?
- Vitreous haemorrhages?
- Obstructed visual fields?
- Tunnel vision?
- Poor macular vision?
  - unilateral / bilateral / symmetrical / non-symmetrical?
- Allergies?
- Sinus problems?
- Painful eyes?
- Transient loss of vision?
- History of hypertension and diabetes?
The optic nerve - exam procedure

- Visual acuity - Snellen & Jaeger charts
- Confirm with pinhole card
- Red reflex
- Direct and consensual pupillary light reaction (CN: II & III)
- Visual fields
- Blind spot
- Fundoscopy
Ophthalmoscope - beams

Normal beam  ➤ General examination

Narrow beam  ➤ Constricted pupils

Red-free filter (green)  ➤ Blood vessels
➤ Haemorrhages

Grid  ➤ Mapping out lesions

Slit light  ➤ Elevations
➤ Concavities
Fundoscopy (using ophthalmoscope)

- Observe red/pink appearance of fundus
- Set ophthalmoscope at +10 diopters
- Start examining anterior portion of eye
- Gradually reduce to 0 diopters

Examine integrity of:
- Retina
- Vessels
- Optic disc
- Fovea
Retinal change

‘Cotton wool spots’ or exudates

Diabetes
Hypertension
Vasculitis
HIV

Shiny yellow circumscribed patches 'hard exudates of lipids'

Diabetics
Retinal change

'Larger round blots'
These are haemorrhages deep in the retina

Diabetes

'Flame shaped' superficial haemorrhages
Along nerve fibres

Hypertension

Gross anaemia

Hyperviscosity

Bleeding diathesis

Peripheral new vessels

Ischaemic diabetic retinopathy

Retinal vein occlusion
Optic disc changes

Pale disk

- Multiple sclerosis
- Optic nerve compression
- Following optic neuritis

Enlarged optic cup and rim is diminished

- Glaucoma
Causes of papilloedema

- Increased intracranial pressure
- Severe hypertension
- Meningitis
- Trauma
- Subarachnoid haemorrhage
- Acute optic neuritis
The macula

"The area of central vision"

"A slightly darker area, free of vessels"

- Pale macula may signify a pathology
- Senile macular degeneration
- Macular oedema
Visual field defects and location of possible lesions:

1. Unilateral blindness
   - Defective vision
   - Intact vision

2. Bitemporal hemianopia

3. Right homonymous hemianopia

4. Right homonymous hemianopia with macula sparing

Optic nerve → Optic chiasma → Optic radiation → Occipital cortex
Loss of the red reflex

- Cataract
- Retinal detachment
- Haemorrhage into the vitreous body
- Rarely with
  - Floaters
  - Scars
  - Corneal lesions
Ophthalmoscopy procedure

- External features
- Red reflex
- Anterior structures
- Vitreous body
- Optic disc
- Retina and blood vessels
- Macula
Oculomotor
Trochlear
Abducent

Cranial nerves III, IV, VI
Nerves III, IV, VI - exam procedure

- Observe for diplopia and strabismus
- Observe the pupils and level of eyelids
- Test for direct and consensual pupillary reaction to light
- Test for visual pursuit
- Test for accommodation & convergence
The oculomotor nerve - pathologies

- Basilar skull fractures
- Uncal herniation
  (increased intracranial pressure)
- Lesions in the cavernous sinus
- Syphilis
- Aneurysms
- In diabetes
- Pituitary tumours
- Vascular diseases
Clinical manifestations:

- Ptosis
- Inferolateral displacement of the affected eye causing diplopia or strabismus
- Mydriasis (dilated pupil)
The trochlear nerve - pathologies

- Fracture of the wing of the sphenoid bone
- Intracranial hemorrhage / pressure
- Tumours or aneurysm

**Manifestations:**

- Extorsion of the affected eye
- Diplopia worsens with downgaze
- Diplopia improves when head is tilted to the contralateral side
The abducent nerve - pathologies

- Lesions of the cavernous sinus
- Aneurysms
- Fractures

Manifestations:
- Medial deviation of affected eye
  (Diplopia improves when affected eye looks medially or when the contralateral eye is abducted)
Horner's syndrome

Sympathetic lesion emerging from T1

- Miosis
- Enophthalmos
- Anhydrosis
- Ptosis (partial)

PEAS: Ptosis-Enophthalmos-Anhydrosis-Small pupil
Oculomotor (III)

- **Nucleus:** Mid brain
- **Structures supplied:** Extra and Intra ocular muscles, eyelids
- **Function:** Eye movement, elevation of eyelid, constriction of pupil, parasympathetic component
- **Test:**
  - Light reflex
  - Pursuit of an object
  - Accommodation
Trigeminal nerve (V)

- Motor nucleus
- Main sensory nucleus
- Spinal nucleus
- Ophtalmic (V1 sensory)
- Maxillary (V2 sensory)
- Mandibular (V3 sensory & motor)
Trigeminal nerve - key questions

- Facial pain (trigeminal neuralgia)?
- Any areas of numbness on the face?
- Any corneal lesions?
- Problems with the jaw?
- Difficulty chewing?
Motor component:
- Observe facial symmetry & jaw deviation
- Lower & elevate jaw
- Clench teeth and feel for muscle strength

Sensory component:
- Test skin with cotton wool and pin
- Elicit corneal reflex using cotton wool
- Test jaw jerk
Lesions of the trigeminal nerve

Lesions of the spinal tract and nucleus
- Pain and temperature

Lesions of the ophthalmic division
- Corneal reflex
  (Afferent = trigeminal nerve)
  (Efferent = facial nerve)
The trigeminal nerve - pathologies (A)

- Spinal tract lesions
  Manifestations:
  Reduced skin sensation

- Ophthalmic division lesions
  Manifestations:
  Reduced corneal reflex

- Skull fractures
- Tumours
The trigeminal nerve - pathologies (B)

- Facial surgery
- Trigeminal neuralgia (Tic Doloureux)
- Herpes zoster
- Lesions in cavernous sinus

**Manifestations:**
- Weakness in muscles of mastication
- Jaw asymmetry
Facial nerve (VII)

Inferior aspect of brain

Temporal branches
Zygomatic branches
Buccal branches
Mandibular branch
Cervical branch

Facial (VII) nerve

Facial nerve

Posterior auricular branch of facial nerve
The facial nerve - key questions

- Facial weakness?
- Dribbling?
- Spontaneous movements?
- Inability to frown or whistle?
- Loss or altered taste sensation?
- Altered hearing?
- Endocrine disorders: hyper/hypothyroidism,
- Acromegaly, Paget's disease of bone,
- Cushing's disease?
The facial nerve - exam procedure

- Observe the face. Note the symmetry of wrinkles, nasolabial folds, drooping of lips at corners of the mouth.
- Check for Bells palsy
- Perform facial expressions: Raise eyebrows, frown, close eyes and lips tightly and attempt to open them, show teeth, whistle, blow out cheeks and feel the resistance.
- Test taste sensation; anterior two thirds of tongue

FACE-EAR-TASTE-TEAR AND SALIVA!
The facial nerve - pathologies

- **Bell’s palsy** (idiopathic, unilateral paralysis of lower motor neurones)
- Fractures of the petrous bone
- Space occupying lesions (tumours or aneurysm)
- **Peripheral lesions** involves muscles of both the upper and lower face and can affect taste from the anterior 2/3 of the tongue (via the chorda tympani).
  Upper & lower parts of face will be affected
- **Central lesions** (ie tumours or haemorrhage), due to crossed innervation the upper aspect of face and orbicularis occuli will not be affected.
  Only lower parts of face will be affected
Bell's palsy

A unilateral paralysis of the lower motor neurones

- Facial distortion:
  - Sagging of the mouth
  - Dribbling (or dry mouth)

- Loss of taste

- Inability to frown or close the eyes tightly

- Excessively watery eyes (or dry eyes)

- Hyperacusis (distorted hearing)
Vestibulocochlear nerve (VIII)

Inferior aspect of brain

Vestibular branch
Cochlear branch

Vestibulocochlear (VIII) nerve
Vestibulocochlear nerve - pathologies

Vestibular division:
- Loss of balance?
- Dizziness / vertigo?
- Nausea?
- Paget's disease?
- Viral / bacterial infections of the ears?
- Meniere's disease?
- Blast injury?

Cochlear division:
- Partial or total loss of hearing?
- Tinnitus?
- History of grommets?
Vestibulocochlear nerve - exam procedure

Balance:
- Positional test: Hallpike’s test
- Check for dizziness and nystagmus
- Warm and cold caloric tests

Hearing:
- Whisper a few words from distance
- Rinne’s test
- Weber’s test
- Otoscopy
Rinne's test

- Compares air and bone conduction of sound

- Use tuning fork of 512Hz

- Place vibrating fork firmly on mastoid process

- When patient no longer feels vibration, place tuning fork close to ear, he should still be able to hear it

- Repeat with other ear

- Compare with findings from Weber’s test
Rinne's test

Makes a comparison of sound conducted to the ear through bone and air

Air Conduction > Bone Conduction

Conductive deafness BC > AC
Causes of conduction deafness

- Ear wax
- Middle ear disease
- Loss of elasticity in the ossicular chain
Weber’s test

1. Place a vibrating tuning fork (512Hz) firmly on the vertex or the forehead

2. Ask the patient if they hear the buzzing equally in both ears / sides

3. Compare your findings with Rinne’s test
Weber's test

Assesses the transmission of sound through bone to both ears simultaneously

Makes a comparison between the two ears

Affected ear ➡ Sound will be reduced

Normal ear ➡ Sound will be perceived louder
Weber's test findings

- Weak side suffers from sensory-neural deficit

- The stronger side may appear to be so because of blockage in the external auditory meatus, ie ear wax
Vestibulocochlear nerve - pathologies

- Middle and inner ear infections
- Fractures of the petrous bone
- Acoustic neuroma (may also affect facial nerve)
- Tumours and vascular lesions, esp. at cerebellopontine angle
- Otosclerosis
- Meniere's disease
Examination of the ears

Examine the walls of the external ear canal:

- Walls should be skin coloured
- Some hairs
- Some ear wax

Check for:

- Redness
- Inflammation
- Exudates (serous, pus or blood)
- Excess build up of wax
Vestibulocochlear (VIII)

Nucleus: Pons

Structures supplied:
- Vestibular branch: vestibular apparatus (balance mechanism)
- Cochlear branch: Cochlea (organ of Corti)

Function: Balance & hearing

Tests:
- Balance: Posture & balance, nystagmus, Hallpike’s manoeuvre, caloric tests
- Hearing: Rinne's & Weber's tests
Glossopharyngeal nerve (IX)

Inferior aspect of brain

- Parotid gland
- Parasympathetic fibers
- Glossopharyngeal nerve
- Jugular foramen
- Superior ganglion
- Inferior ganglion
- Otic ganglion
- Carotid sinus
- Pharyngeal muscles
- Common carotid artery
Hypoglossal nerve (XII)

Inferior aspect of brain

- Hypoglossal (XII) nerve
- Hypoglossal nucleus
- Tongue
- Hypoglossus muscle
- Sternohyoid muscle
- Inferior ganglion of vagus
- Superior cervical ganglion
- Omohyoid muscle
Testing of Glossopharyngeal & Vagus nerves (IX, X)

- Note voice: hoarse?
- Assess quality of cough: bovine-like?
- Observe uvula and tonsilar arches
- Ask patient to say “Ahhh”: Note symmetry in elevated tonsilar arches
- Test gag reflex: Is it present, is elevation symmetrical
Testing the Hypoglossal (XII)

1. Observe symmetry of tongue in mouth
2. Note any wasting and fasciculations
3. Note size of tongue
4. Ask patient to protrude tongue: is it symmetrical or does it deviate?
5. Assess strength of tongue: feel it being pushed inside his cheek

*Note: The tongue deviates toward the weak side*
Cranial nerves IX, X, XII - exam procedure

Glossopharyngeal:
- Say 'Ahhh..'
- Gag reflex
- Taste (posterior 1/3 of tongue)

Vagus:
- Note voice production
- Gag reflex and palatal movement of fauces & uvula

Hypoglossal:
- Observe the tongue for fasciculations and atrophy
- Protrusion of tongue - check for deviation
- Assess its strength - pushing against inside of cheeks
Cranial nerve IX - pathologies

- Isolated lesions of the glossopharyngeal nerve are rare
- Tumour or aneurysm of the posterior fossa
- Glossopharyngeal neuralgia (idiopathic)
- If the lesion is near the jugular foramen then:
  - Numbness of ipsilateral pharynx
  - Dysphagia
  - Absent gag reflex
Lesions of the vagus nerve

- Lesions in the brainstem
- Extramedullary lesions
- Jugular foramen lesions
- Bulbar palsy
Cranial nerve X - pathologies

- Isolated lesions of the vagus nerve are rare
- Tumours or aneurysm. This will cause:
  - Ipsilateral depression of soft-palate and uvular deviation towards the affected side
  - Cardiac and gastrointestinal dysfunction due to its parasympathetic component
- The recurrent laryngeal nerve has a long course, hooked under the arch of the aorta, may be affected by mediastinal / aortic lesions
- This will cause hoarseness, dysphagia, dysphonia, reduced gag reflex, bovine cough
Recurrent laryngeal nerve (vagus nerve)

- Superior laryngeal nerve
- Medulla oblongata
- Thyroid cartilage
- Vagus nerve
- Left recurrent laryngeal nerve
- Arch of the aorta
Cranial nerves IX, X, XII - pathologies

- Tumours, aneurysms, or other external compressive lesions
- In upper motor neuron lesion the tongue will deviate away from side of lesion
- In a lower motor neuron lesion the deviation will be towards the side of the lesion
- Wasted fasciculating tongue may signify motor neurone disease
Glossopharyngeal (IX)

- **Nucleus:** Medulla oblongata

- **Structures supplied:** Post. 1/3 of tongue, mucous membranes of mouth & tonsillar fossae, parotid glands, carotid sinuses and aortic bodies

- **Function:** Taste post 1/3 tongue, salivation, sensation to oropharynx, baroreception & chemoreception

- **Tests:**
  - Inspection of mouth, phonation taste, gag reflex
Vagus (X)

Nucleus: Medulla oblongata

Structures supplied: Baroreceptors, pharynx & larynx, tympanic membrane, ext. auditory canal & ear, parasympathetic to many visceral structures

Function: Blood pressure sensing, phonation, motor factions of oro/laryngopharynx

Tests:
- Phonation, gag reflex, inspection of mouth & throat
Hypoglossal (XII)

Nucleus: Medulla oblongata

Structures supplied: Intrinsic muscles of the tongue

Function: Movement of the tongue

Tests:
- Inspection of tongue muscle bulk & fasciculations
- Protrusion and symmetry of tongue
- Assess tongue strength pushing inside cheek
Accessory nerve (XI)

Inferior aspect of brain

Cranial root of accessory nerve
Jugular foramen
Spinal root of accessory nerve
Sternocleidomastoid
Trapezius
Accessory nerve - key questions

- Weakness elevating shoulders?
- Weakness lifting head off the pillow?
- Any evidence of muscle wasting?
Accessory nerve - exam procedure

- Observe shape and symmetry of shoulders and neck

- Trapezius: Resist elevation of shoulders

- Sternocleidomastoids: Resist rotation of neck (testing of contralateral muscle to the direction of rotation)

- Resisting the raising of the head off the pillow
The accessory nerve - pathologies

- Bilateral lesions may suggest a myopathy
- Tumours or aneurysm
- Neck surgery (seek ipsilateral signs)
The 1st CN, the Olfactory Nerve

Supplies:
- The nasal mucosa

Assessments:
- Test with familiar substances
- Examine the nasal passages
The 2nd CN, the Optic nerve

Supplies:

- Supplies the retina with vision

Assessments:

- Evaluate visual acuity
- Test the visual fields
- Check for light reflex
- Perform fundoscopy
The 3rd, 4th, and 6th CNs
Oculomotor, Trochlear and Abducent

Supplies:

- The muscles that move the eyes, eyelids and pupils

Assessments:

- Observe the eyelids and pupils
- Test for pursuit (eye movements) and check for diplopia
- Check convergence & accommodation
- Test the pupillary reaction
The 5th CN, the Trigeminal Nerve

Supplies:

- Muscles of mastication
- Skin of the face

Assessments:

- Test sensation over the skin of the face
- Check for corneal reflex
- Assess the muscles of mastication for symmetry
- Test the strength of the muscles of mastication
- Test the jaw reflex
The 7th CN, the Facial Nerve

Supplies:
- Muscles of facial expression
- The tongue (taste)
  (also eardrum, tear, saliva)

Assessments:
- Check the symmetry of facial lines
- Perform active facial expressions
- Evaluate taste sensation
- Check for lacrimation and saliva production
The 8th CN, the Vestibulocochlear Nerve

Supplies:

- The acoustic and vestibular apparatus

Assessments:

- Assess balance
- Perform Hallpike’s test
- Observe for nystagmus
- Assess hearing
- Perform Rinne’s and Weber’s tests
The 9th and 10th CNs
The Glossopharyngeal and Vagus Nerves

Supplies:
- The larynx & pharynx
- Parasympathetic supply to viscera

Assessments:
- Inspect the pharynx
- Check voice production (Ahh)
- Perform the gag reflex
The 11th CN – The Accessory Nerve

Supplies:
- The sternocleidomastoid muscles
- Trapezius muscles

Assessments:
- Observe symmetry of neck and shoulders
- Test the strength of the sternocleidomastoid and trapezius muscles
The 12th CN – The Hypoglossal Nerve

Supplies:

➢ The tongue

Assessments:

➢ Examine the shape of the tongue, size, and look for fasciculations
➢ Evaluate the strength of the tongue
END