
INTERNATIONAL SURGICAL
ANATOMY TEACHING
SERIES



ISATS
HANDOUT
2024/25

Eye and Orbit

High Yield | Surgical Relevance | CPD Accredited

EYE AND ORBIT ANATOMY

Objectives: Understand the bony anatomy of the orbit, gross anatomy of the eyeball, and arterial supply and venous drainage of the eye. Apply anatomical knowledge in the context of ophthalmology surgery.

Extraocular Muscles

1. Rectus muscles:

- Superior rectus (SR)
- Inferior rectus (IR)
- Medial rectus (MR)
- Lateral rectus (LR)

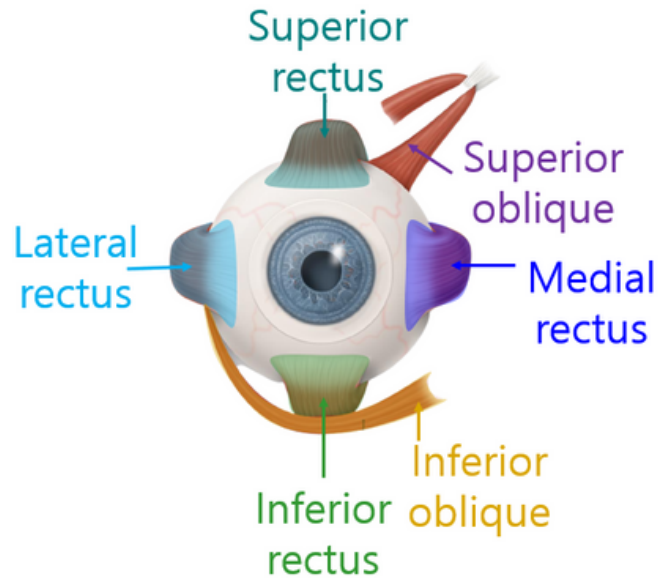
2. Oblique muscles:

- Superior oblique (SO)
- Inferior oblique (IO)

3. Levator palpebrae superioris (LPS)

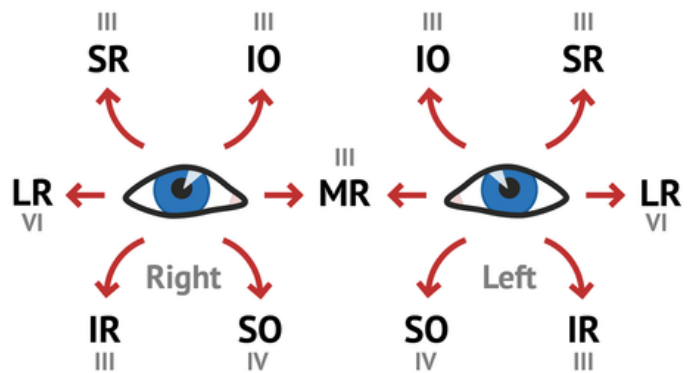
Innervation:

- CN III – SR, IR, MR, IO, LPS
- CN IV – SO
- CN VI – LR



Extraocular Muscles and Eyeball Movements

Muscles do not act in isolation → combined actions for achieving the desired movement of the eye.

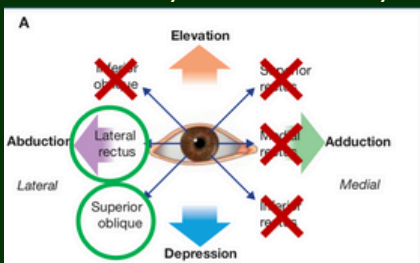


Cranial Nerve Palsies

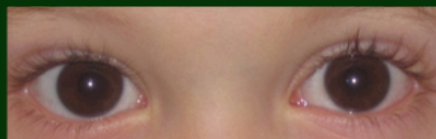
CN III PALSY



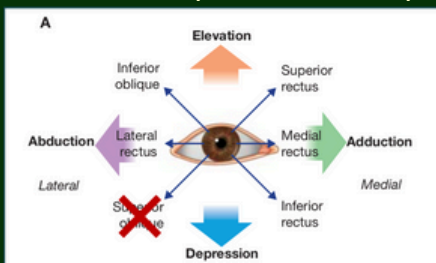
Affected eye Normal eye



CN IV PALSY



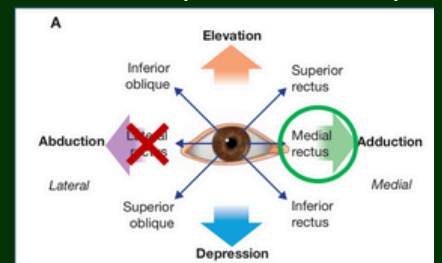
Affected eye Normal eye



CN VI PALSY



Affected eye Normal eye



EYE AND ORBIT ANATOMY

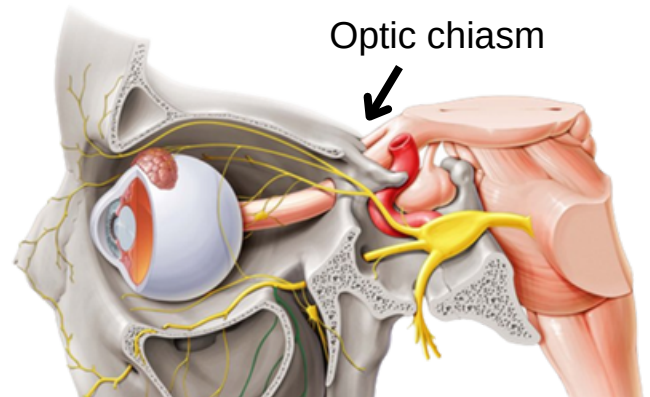
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The Visual System

- Components of the visual system:
 - optic **nerve**
 - optic **tract**
 - optic **radiation**
 - **visual cortex**

Optic Nerve

- Leaves orbit through **optic canal**
- From optic **disc** to optic **chiasm**
- Forms **optic chiasm** – partial decussation
- Special **somatic afferent (sensory) information**
- Formed by **retinal ganglion cell axons**
- Not a true cranial nerve = **extension of brain fibres**

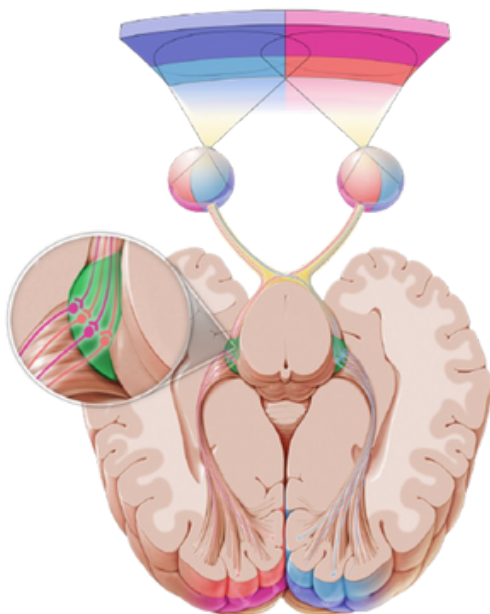


Clinical Note:

The optic nerve is surrounded by **cranial meninges** (i.e. sclera is continuous with dura mater). Raised **intraocular pressure** indicates increased ICP.

Visual Cortex

- In occipital lobe
- Processes visual information
- Primary (most studied) visual cortex; Secondary and Third visual cortices.



Visual Pathway

1. Left visual field
 - Nasal retina (Left eye)
 - Temporal retina (Right eye)
2. Optic nerves
3. Optic chiasm – only nasal retinal fibres cross
4. Optic tract – has all fibres conveying information from left visual field
5. Lateral geniculate nucleus
6. Optic radiation
7. Primary visual cortex (occipital lobe)



Retinal ganglion cell axons

R&L optic nerves

Optic chiasm

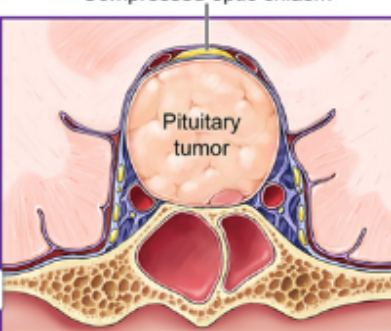
R&L optic tracts

R&L Lateral geniculate nuclei (LGN)

Superior & Inferior optic radiations (R&L)

Primary visual cortex (R&L)

Compressed optic chiasm



Clinical application!

Compression of the optic chiasm due to pathology of the pituitary gland (e.g. tumour – pituitary macroadenoma) results in bitemporal hemianopia. Raised ICP is seen as the optic nerve head is swollen on ophthalmoscopy.

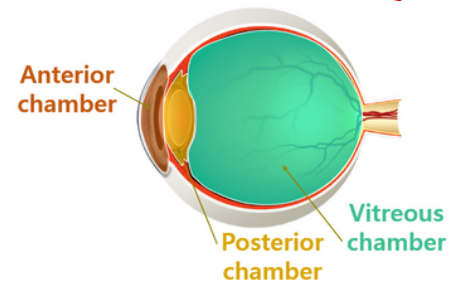
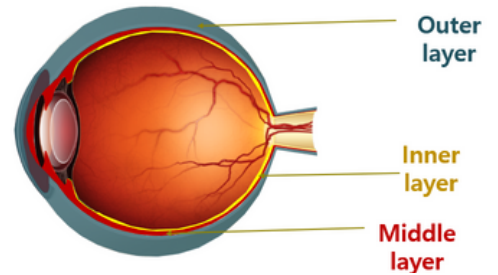


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Eye Anatomy

- Can be divided into 3 layers
 - **Outer** – maintains shape and allows light to enter eyeball anteriorly
 - **Middle** – pigmented layer having connective tissue, blood vessels and intrinsic muscles
 - **Inner** – retina which has 9 neurosensory layers and one pigmented layer
- Collects visible light -> Converts it into *nerve impulses*
- Filled with fluid
- 3 Chambers:
 - **Anterior** – between **cornea** and **iris**
 - **Posterior** – between **iris** and **lens**
 - **Vitreous** – between **lens** and **retina**

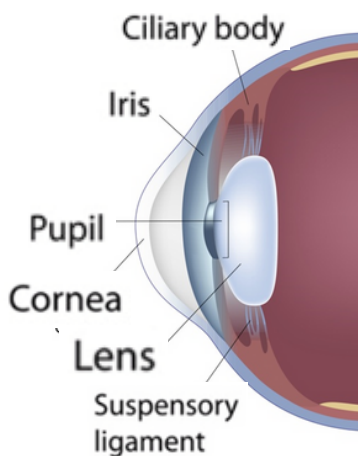


Aqueous humour (watery)

Vitreous humour (gel-like)

Outer layer

- **cornea** – 1/3 anterior (transparent)
- **sclera** – 2/3 posterior (white)



Middle layer – 3 components:

- Choroid
- Ciliary body
- Iris

Choroid

- 2/3rds of vascular layer
- Thin, highly vascular, attached to retina

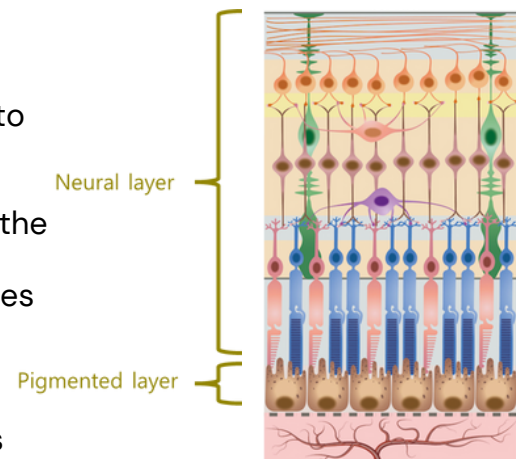
Ciliary body

- Ring-shaped structure around the lens
- Ciliary muscle + ciliary processes

Iris

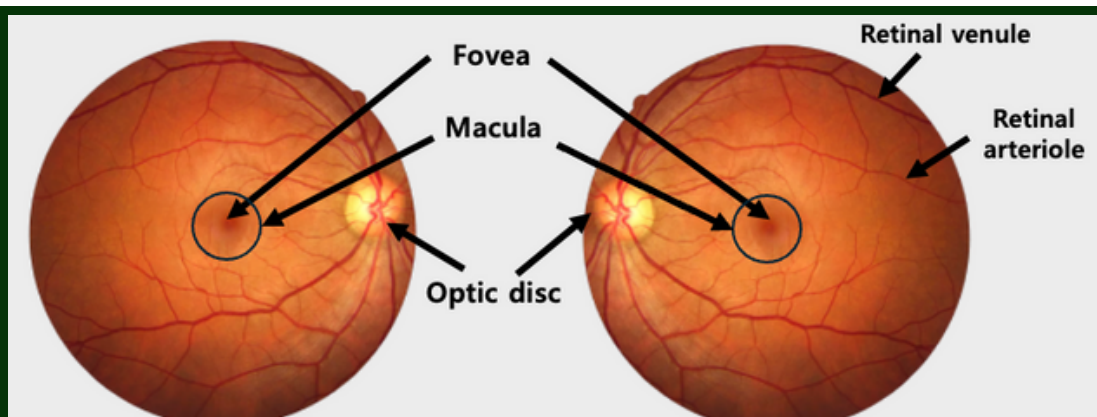
- Projects from ciliary body
- Central opening (pupil)
- Contains smooth muscle fibres

Inner layer – Retina – consists of 2 layers: neural layer and pigmented layer.



Clinical Correlation

- **Fundoscopy** – with *ophthalmoscope*
 - **Macula** – responsible for *central vision, colour vision, fine detail*
 - **Fovea** – only *cones, sharp central vision*

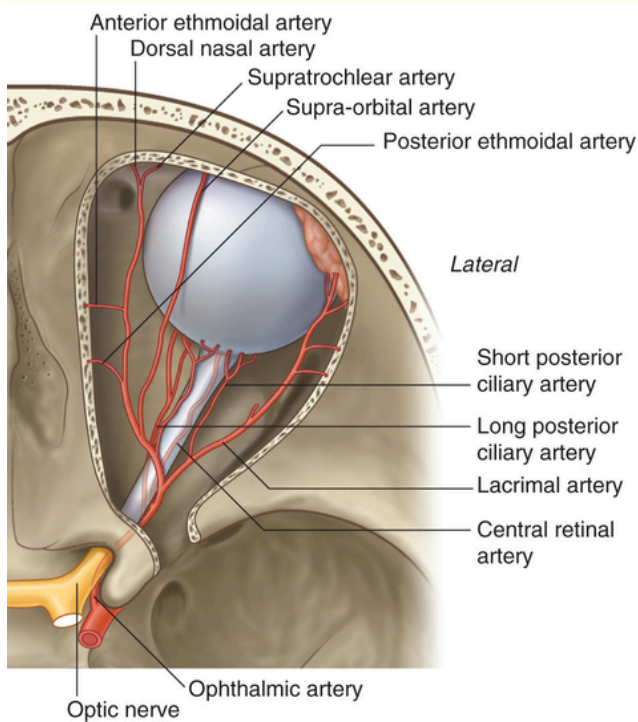


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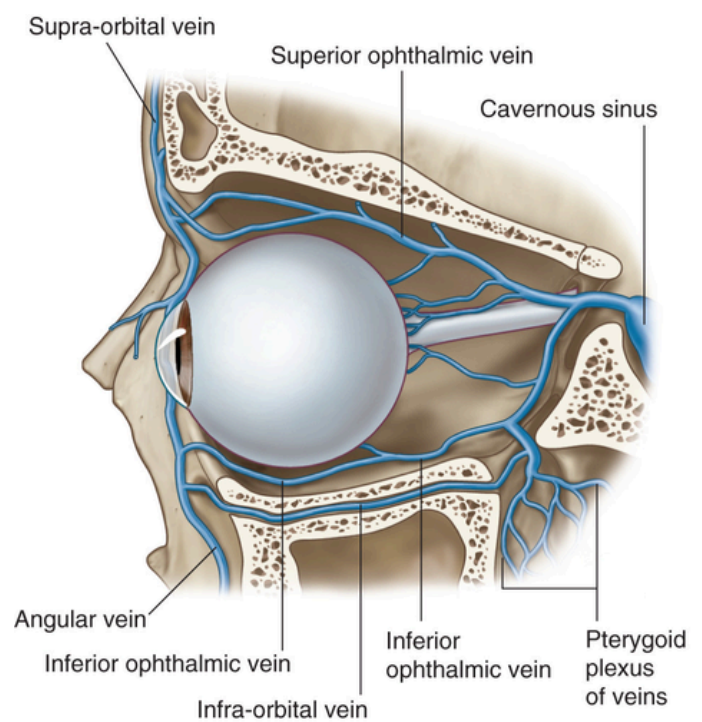
Arterial Supply

- **Ophthalmic artery**
 - from the **internal carotid artery**
 - branches into
 - **Central retinal artery** (end artery)
 - Short posterior ciliary arteries
 - Long posterior ciliary arteries
 - Anterior ciliary complex



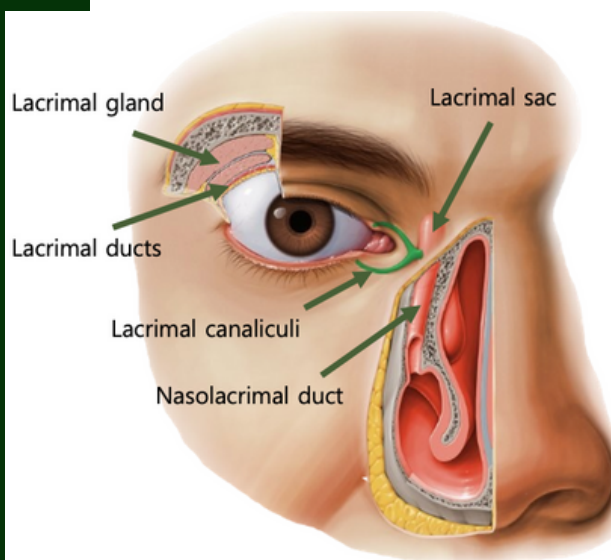
Venous Drainage

- **Superior ophthalmic vein**
- **Inferior ophthalmic vein**
- Connected to *cavernous sinus*
 - **Clinical relevance** - infection spread and cavernous sinus thrombosis.



Lacrimal apparatus

- **Function:**
 - Production and drainage of fluid from the surface of the eyeball
 - Reflex tear secretion
- **Components:**
 - Lacrimal gland + ducts
 - Lacrimal canaliculi
 - Lacrimal sac
 - Nasolacrimal duct



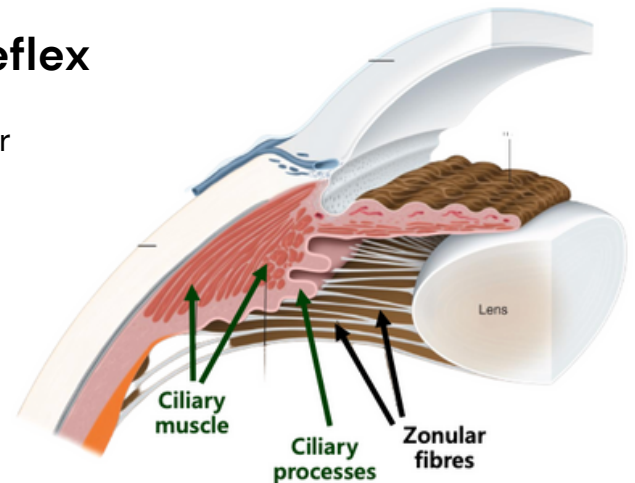
- **Eyelids:**
 - Thin, mobile folds
 - 5 layers
 - Skin + subcutaneous tissue
 - Orbicularis oculi
 - Tarsal plates
 - Levator apparatus
 - Palpebral conjunctiva
- **Conjunctiva**
Innervation:
 - Sensory: trigeminal nerve (V1, V2)
 - Motor: facial nerve (VII)

EYE AND ORBIT ANATOMY

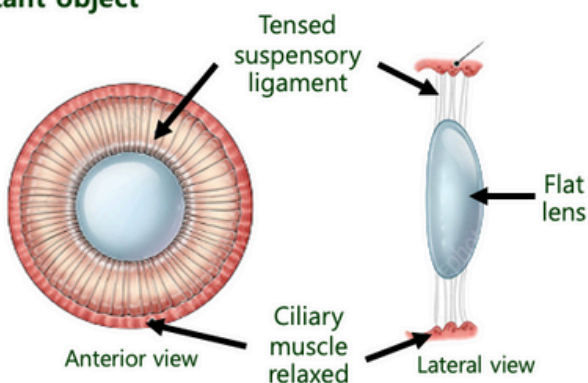
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Ciliary Body and Accommodation Reflex

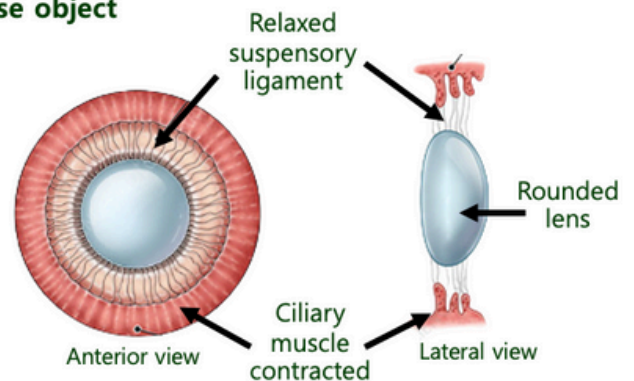
- Ciliary body - alters lens shape; produces humour
 - Ciliary **muscle** - smooth (CN III); longitudinal, circular, radial
 - Ciliary **process** - longitudinal, from ciliary muscle; **Zonular fibres (suspensory ligaments)**; attach ciliary muscles to lens.



Distant object

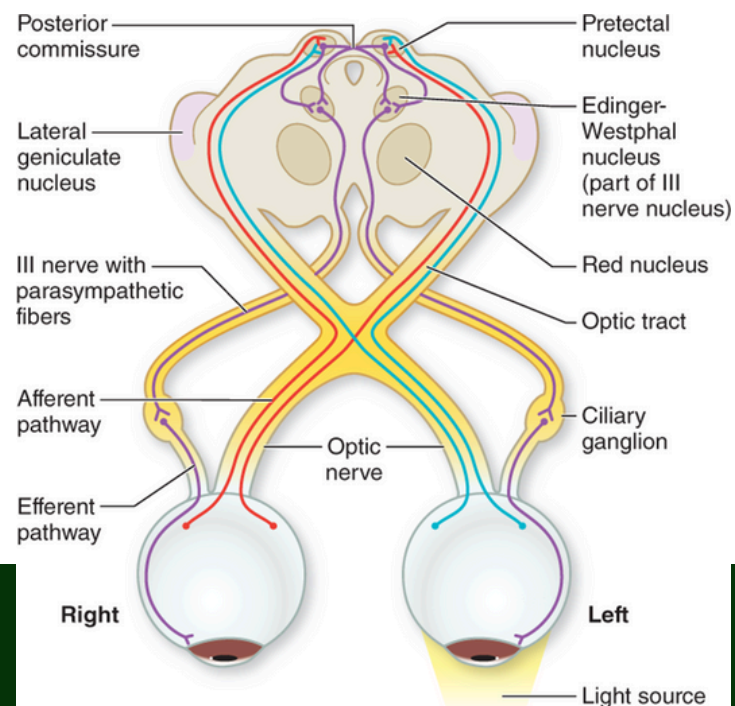


Close object



Iris and Pupillary Reflex

- Iris - alters pupil size
 - Pigmented epithelial cells and stroma → eye colour
 - **Circular fibres (sphincter pupillae muscle)**
 - **Radial fibres (dilator pupillae muscle)**
- Reflex **constriction of pupil** in response to light
 - Afferent: **Optic** nerve (CNII)
 - Efferent: **Oculomotor** nerve (CNIII)



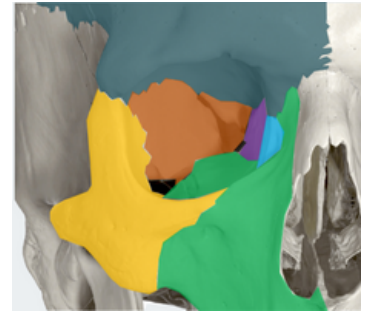
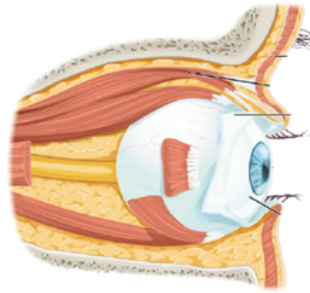
NOTE!: Bilateral innervation of the Edinger-Westphal nuclei allows both **direct and consensual pupil responses**.

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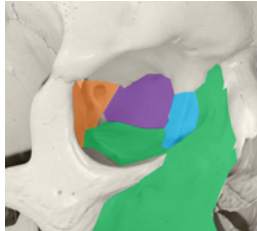
The Orbit

- The **eye** is the sensory organ of the visual system, sitting in the **orbit**.
- Position of the **orbits**:
 - bilaterally
 - **inferior to anterior cranial fossa**
 - **anterior to the middle cranial fossa**
 - **lateral to nasal cavity**
 - **superior to maxillary sinus**
- **Components**:
 - Fascia, Fat, Blood vessels
 - Extraocular muscles
 - CNII, CNIII, CNIV, CNV1+2, CNVI
 - Lacrimal gland, lacrimal duct, eyelids, ligaments.



Orbit - **7 bones**, forming a **pyramid**:

- roof
- floor
- medial wall
- lateral wall



Medial wall - 4 bones

- Maxilla
- Sphenoid bone
- Ethmoid bone
- Lacrimal bone



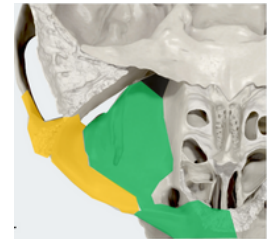
Lateral wall - 2 bones

- Zygomatic bone
- Sphenoid bone



Roof - 2 bones

- Frontal bone
- Sphenoid bone

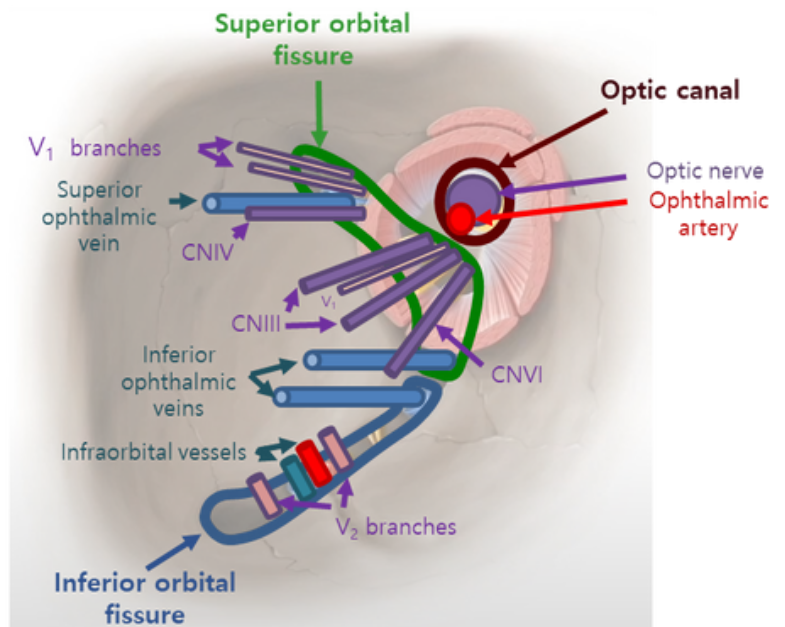


Floor - 3 bones

- Zygomatic bone
- Maxilla
- Palatine bone

Fissures and Foramina

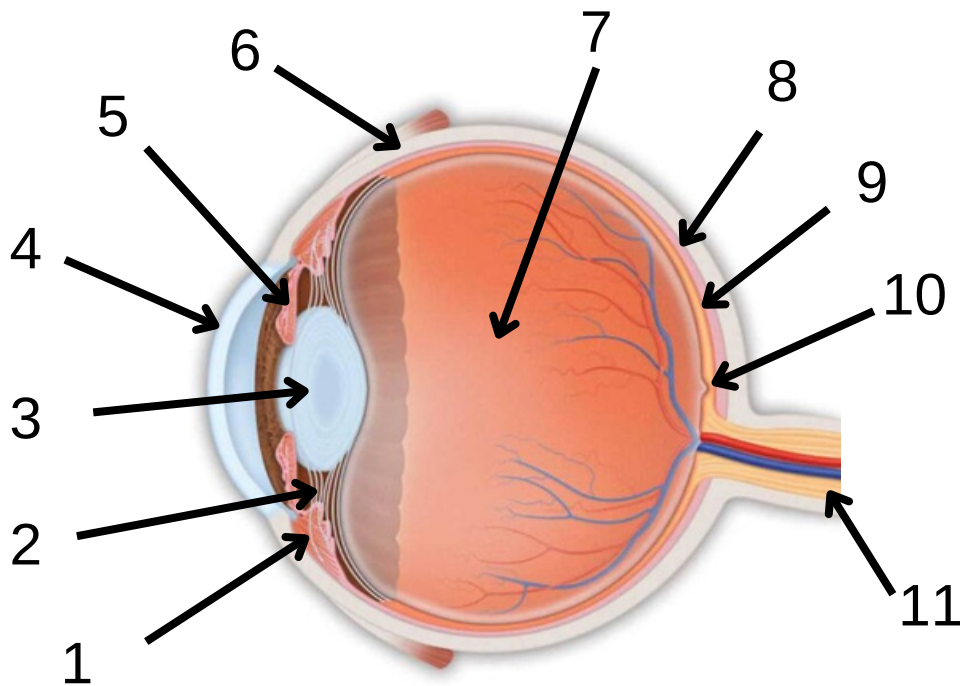
- **Optic canal**
 - optic nerve
 - ophthalmic artery
- **Superior orbital fissure**
 - Oculomotor nerve (CNIII)
 - Trochlear nerve (CNIV)
 - Ophthalmic nerve (CNV1)
 - Abducens nerve (CNVI)
 - Ophthalmic vein (superior & inferior)
- **Inferior orbital fissure**
 - CNV2 branches
 - Inferior ophthalmic vein (inferior)
 - Infra-orbital vessels



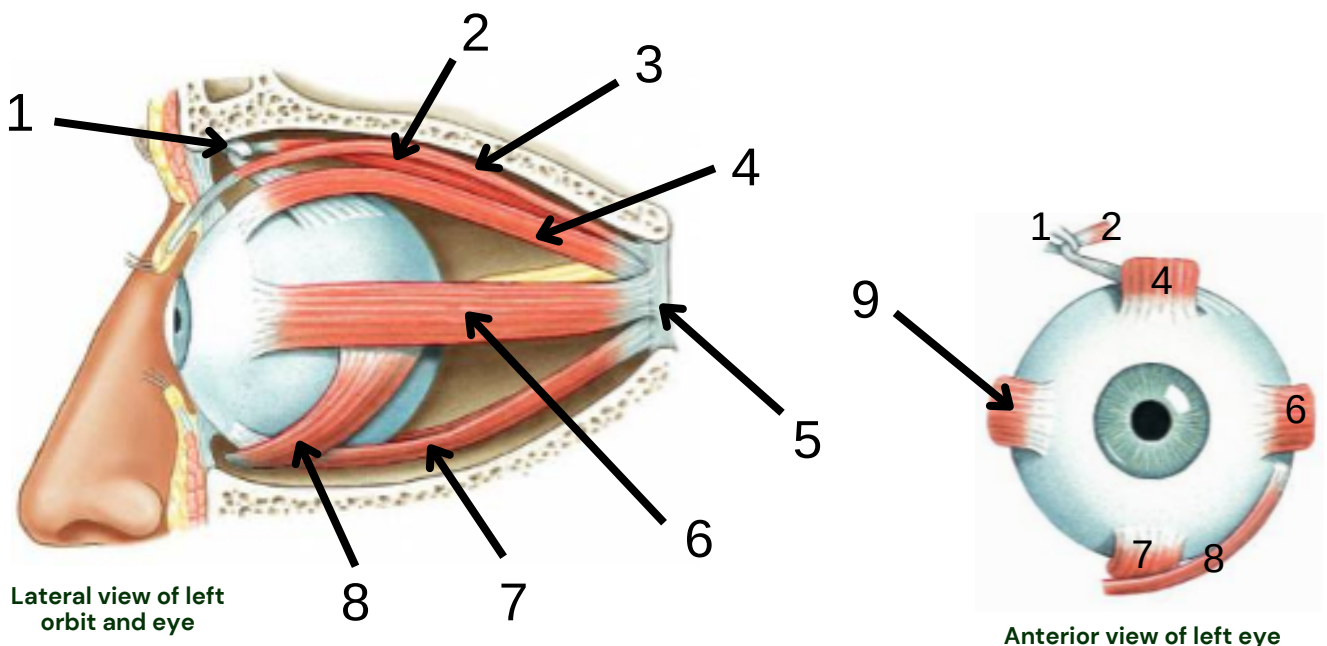
EYE AND ORBIT ANATOMY

Test yourself

A) Label the structures of the eye:



B) Label the extraocular muscles & associated structures:



EYE AND ORBIT ANATOMY

Test yourself

MCQ 1

Which extra-ocular muscle receives motor innervation from the abducens nerve?

- A. Superior oblique
- B. Medial rectus
- C. Inferior rectus
- D. Lateral rectus
- E. Inferior oblique

MCQ 3

Which is responsible for the strongest refraction of light in the eye?

- A. Aqueous humour
- B. Lens
- C. Cornea
- D. Tear film
- E. Vitreous humour

MCQ 5

At which point along the visual pathway would a compressive lesion cause a bitemporal hemianopia?

- A. Lateral geniculate nucleus
- B. Optic chiasm
- C. Primary visual cortex
- D. Optic tract
- E. Superior optic radiation

MCQ 2

What structure does not pass through the superior orbital fissure?

- A. Ophthalmic branch of the trigeminal nerve
- B. Superior ophthalmic vein
- C. Infraorbital vein
- D. Trochlear nerve
- E. Oculomotor nerve

MCQ 4

Which of the following is a feature of the fovea?

- A. Contains more cones than rods
- B. Contains only rods
- C. Exit site for ganglion cell axons leaving the eye
- D. Responsible for peripheral vision
- E. Contains only cones

MCQ 6

What is the most common cause of irreversible blindness worldwide?

- A. Cataract
- B. Diabetic retinopathy
- C. Glaucoma
- D. Refractive errors
- E. Macular degeneration

EYE AND ORBIT ANATOMY

Test yourself

OSCE Station – Case Based Discussion

A 68-year-old male presents to his GP with progressive blurring of vision and increasingly dull appearance of colours occurring over years in both eyes. He complains of difficulty reading books and watching TV, and has been experiencing glare when looking at lights. The patient has a past medical history of type 2 diabetes mellitus for which he takes Metformin. The GP suspects the patient to have cataracts and given the extent of the patient's symptoms, refers him to ophthalmology.



- Q1. What subtype of age-related cataracts is this patient most likely to have?
- Q2. State three risk factors for developing cataracts.
- Q3. State two typical clinical findings expected to be found on examination of this patient's eyes.
- Q4. What surgical treatment is commonly provided for cataracts?
- Q5. What is a common long-term complication following surgical treatment which results in the return of symptoms similar to the initial presenting complaint?
- Q6. What is the surgical management of this complication?

Answers

Labelling exercises:

A) 1) Ciliary body, 2) Suspensory ligaments, 3) Lens, 4) Cornea, 5) Iris, 6) Sclera, 7) Vitreous chamber/humour, 8) Choroid, 9) Retina, 10) Fovea, 11) Optic nerve. B) 1) Trochlea, 2) Superior oblique, 3) Levator palpebrae superioris, 4) Superior rectus, 5) Common tendinous ring, 6) Lateral rectus, 7) Inferior rectus, 8) Inferior oblique, 9) Medial rectus

MCQs: 1) D, 2) C, 3) C, 4) E, 5) B, 6) C

OSCEs:

1) Nuclear sclerotic,
 2) Any 3 of: increasing age/diabetes mellitus/smoking/corticosteroid use/alcohol/UV exposure/trauma to lens/radiation exposure;
 3) Loss of the red reflex, Grey/white/clouded lens;
 4) Phacoemulsification with an intraocular lens implant – opacified lens is broken down using ultrasound waves, the lens fragments are aspirated and an artificial lens is implanted;
 5) Posterior lens capsule opacification;
 6) Laser capsulotomy – laser used to make a hole in the lens capsule to allow light to pass through.