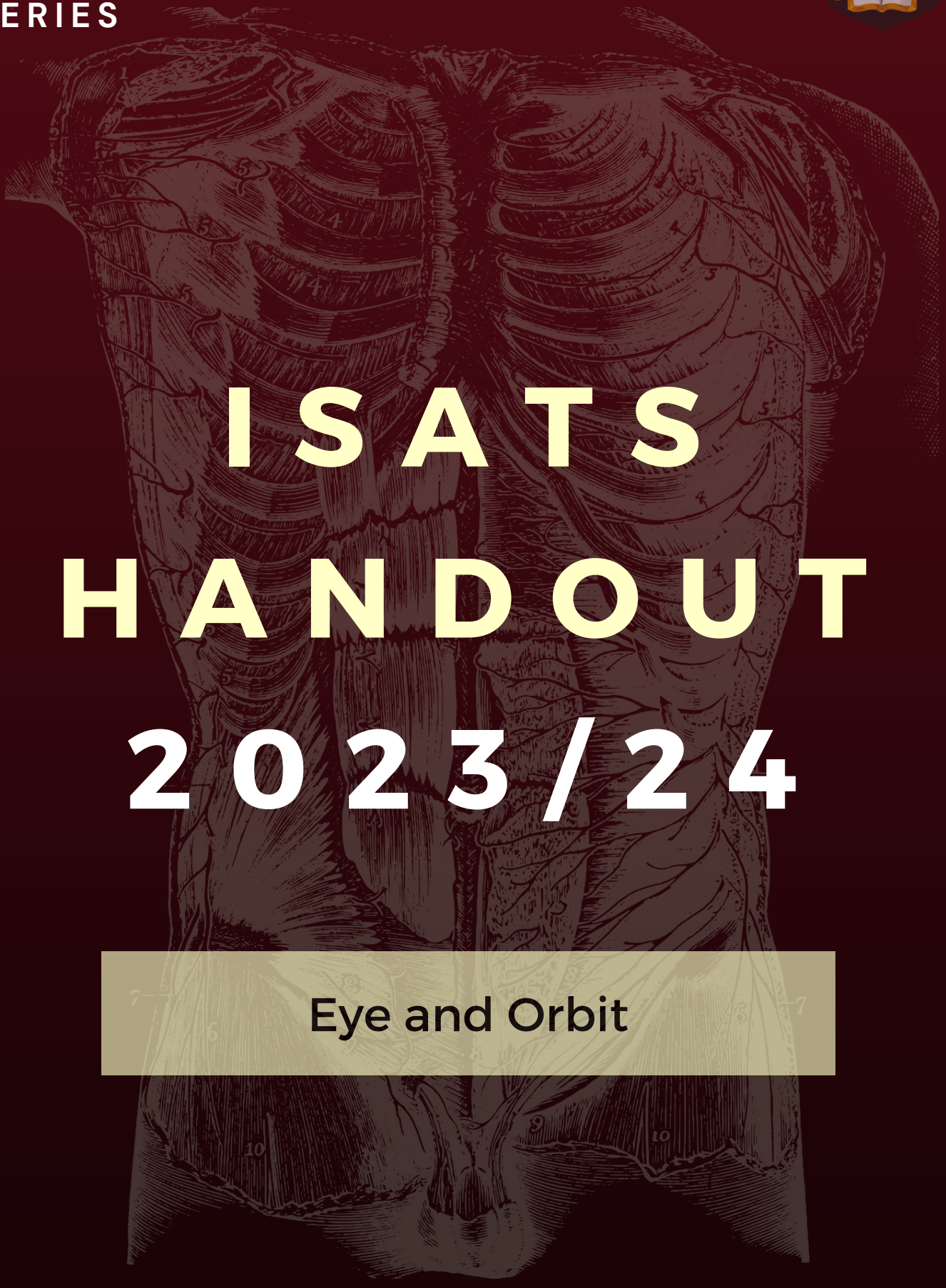
INTERNATIONAL SURGICAL ANATOMY TEACHING SERIES



ISATS HANDOUT 2023/24

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, particularly cataract surgery, retinal detachment repair, surgical management of glaucoma..*

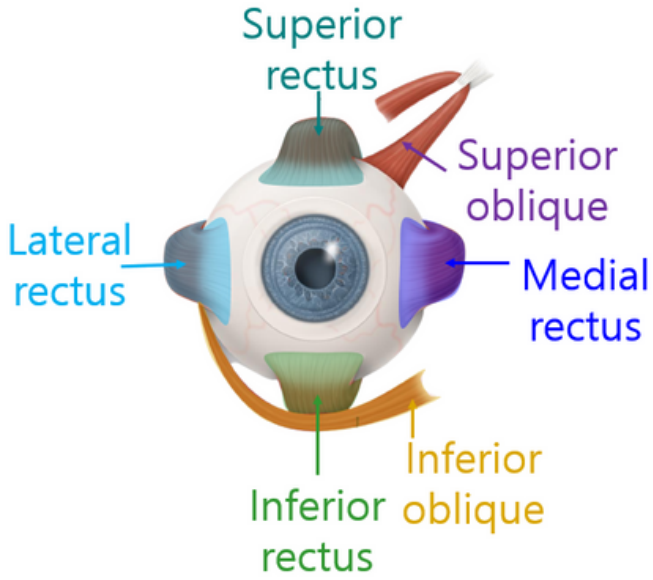
Extraocular Muscles

1.Rectus muscles:
- **Superior rectus (SR)**
- **Inferior rectus (IR)**
- **Medial rectus (MR)**
- **Lateral rectus (LR)**

2.Oblique muscles:
- **Superior oblique (SO)**
- **Inferior oblique (IO)**

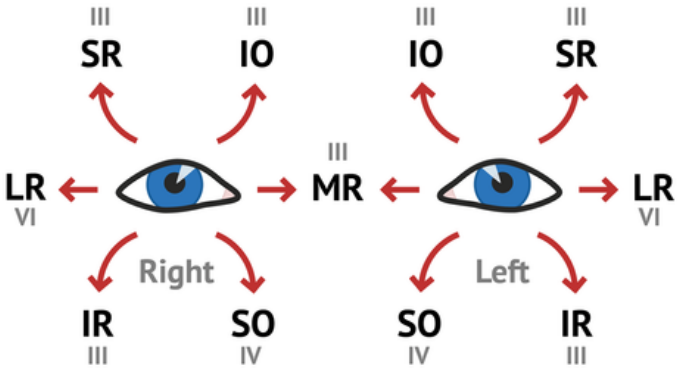
3.Levator palpebrae superioris (LPS)

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



Extraocular Muscles and Eyeball Movements

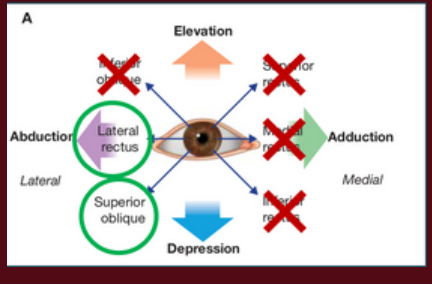
Muscles do not act in isolation -> combined actions for achieving the desired movement of the eye.



Cranial Nerve Palsies

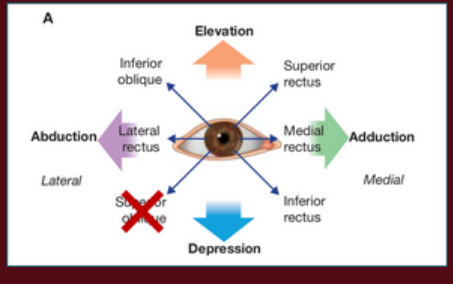
CN III PALSY

Affected eye Normal eye



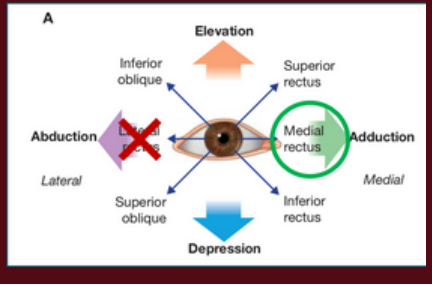
CN IV PALSY

Affected eye Normal eye



CN VI PALSY

Affected eye Normal eye

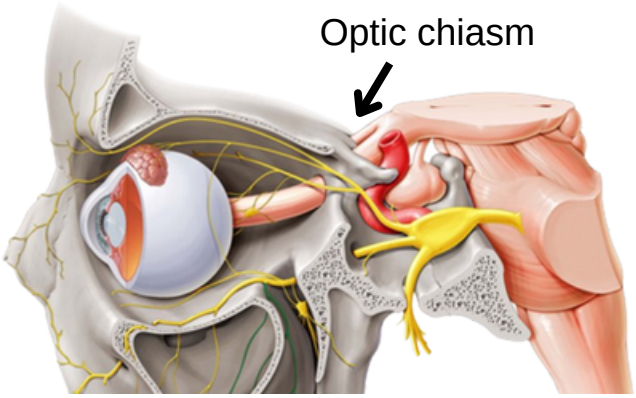


EYE AND ORBIT ANATOMY

***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, particularly cataract surgery, retinal detachment repair, surgical management of glaucoma..*

The Visual System

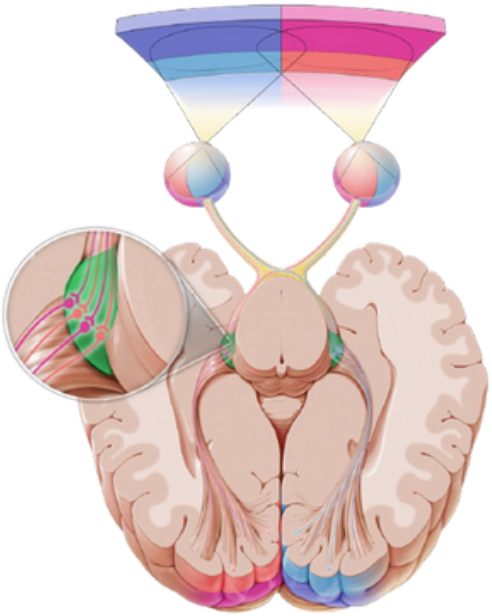
- Components of the visual system:
  - optic **nerve**
  - optic **tract**
  - optic **radiation**
  - **visual cortex**



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**.

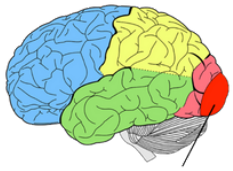


Visual Pathway

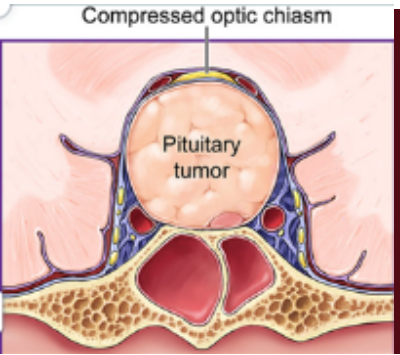
1. Left visual field
   - Nasal retina (Left eye)
   - Temporal retina (Right eye)
2. Optic nerves
3. Optic chiasm - only nasal retinal fibres cross
4. Optic tract - has all fibres conveying information from left visual field
5. Lateral geniculate nucleus
6. Optic radiation
7. Primary visual cortex (occipital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

Visual Cortex

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



Retinal ganglion cell axons → Optic nerve → Optic canal → Optic chiasm → Left & Right optic tracts → Lateral geniculate nucleus (LGN) → Primary visual cortex



Clinical application!

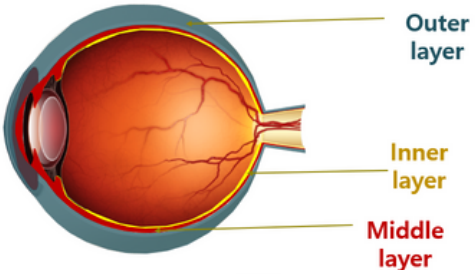
Compression of the optic chiasm due to pathology of the pituitary gland (e.g. tumour - pituitary macroadenoma) results in bitemporal hemianopia.
Raised ICP is seen as the optic nerve head is swollen on ophthalmoscopy.

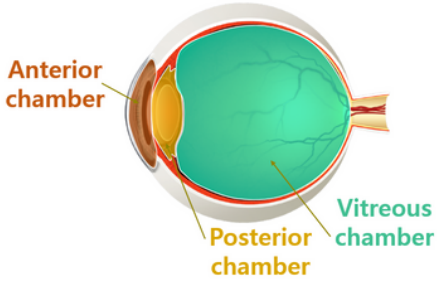
EYE AND ORBIT ANATOMY

***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, particularly cataract surgery, retinal detachment repair, surgical management of glaucoma..*

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**



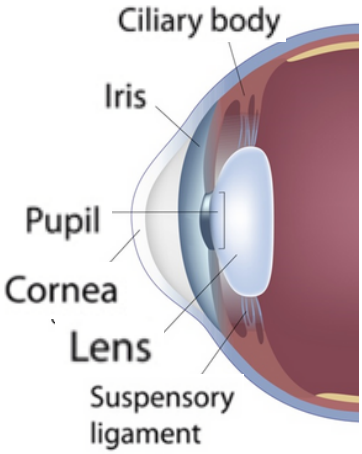


Aqueous humour (watery)

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

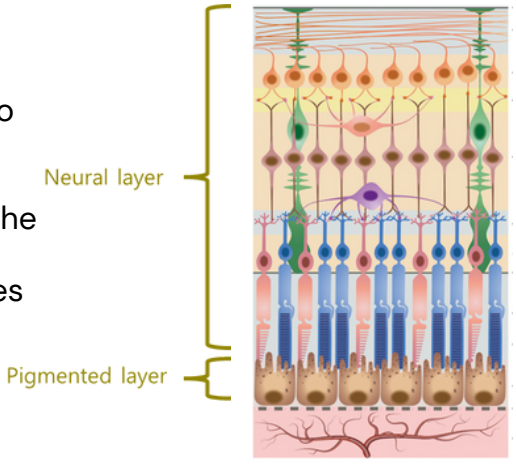
Ciliary body

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

Iris

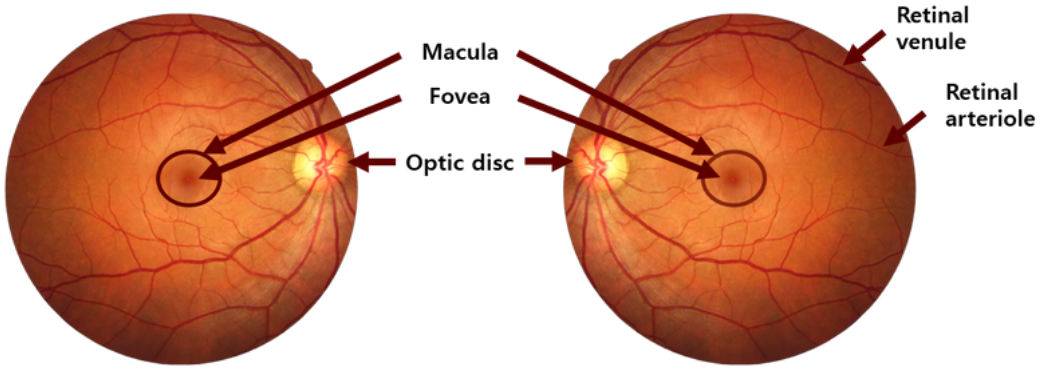
- Projects from ciliary body
- Central opening (pupil)
- Contains smooth muscle fibres

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

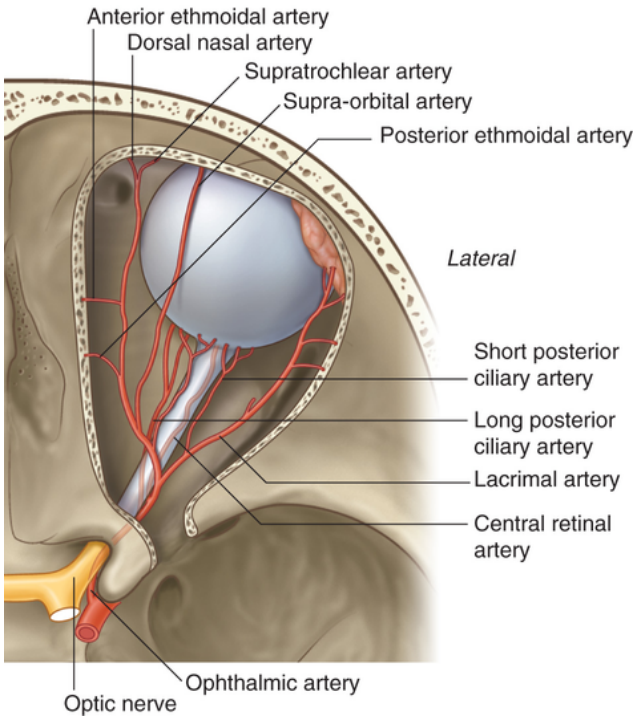


EYE AND ORBIT ANATOMY

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, particularly cataract surgery, retinal detachment repair, surgical management of glaucoma..*

Arterial Supply

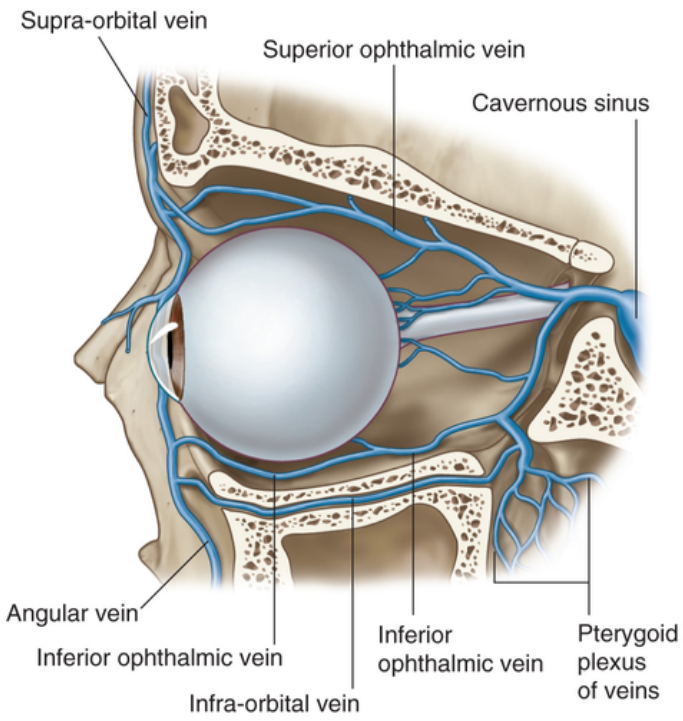
- **Ophthalmic artery**
  - from the **internal carotid artery**
  - branches into
    - **Central retinal artery** (end artery)
    - Short posterior ciliary arteries
    - Long posterior ciliary arteries
    - Anterior ciliary complex



Venous Drainage

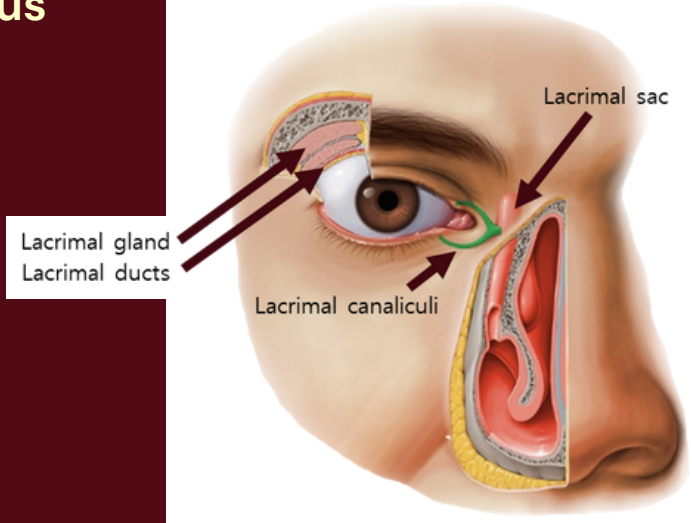
- **Superior ophthalmic vein**
- **Inferior ophthalmic vein**

- 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

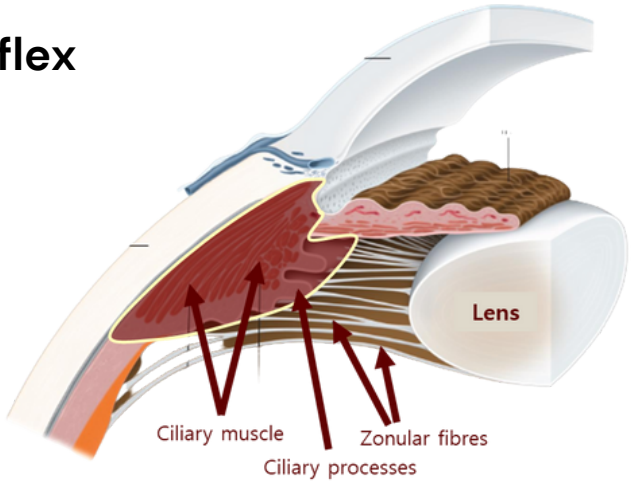
- **Conjunctiva**
  Innervation:
  - Sensory: trigeminal nerve (V1, V2)
  - Motor: facial nerve (VII)

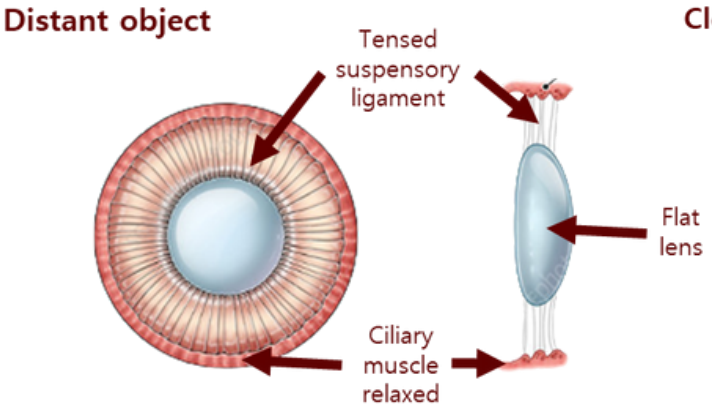
EYE AND ORBIT ANATOMY

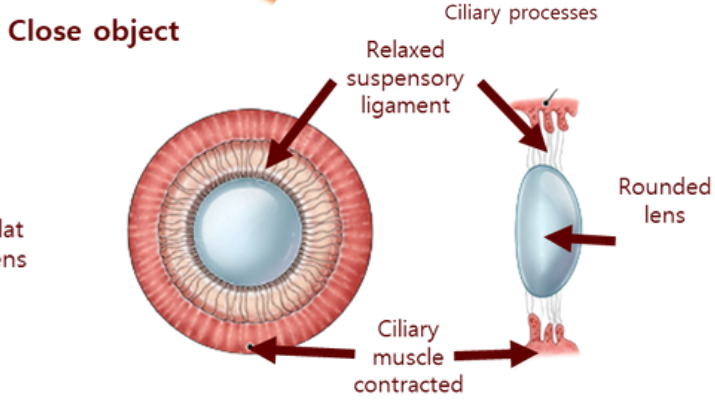
***Objectives**: Understand the bony anatomy of the orbit, gross anatomy of the eyeball, and arterial supply and venous drainage of the eye. Apply anatomical knowledge in the context of ophthalmology surgery, particularly cataract surgery, retinal detachment repair, surgical management of glaucoma..*

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.



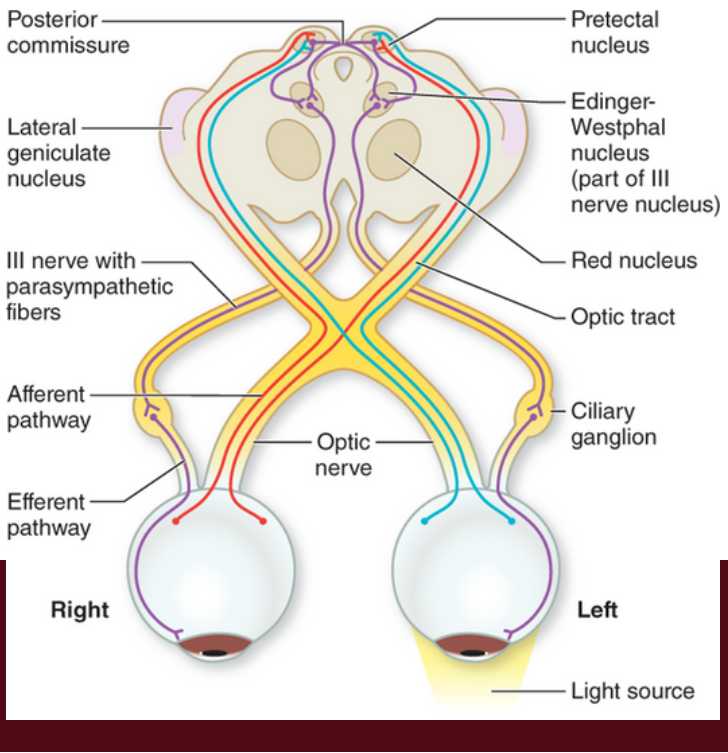




Iris and Pupillary Reflex

- **Iris** - alters **pupil** size
  - Pigmented epithelial cells and stroma à 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)



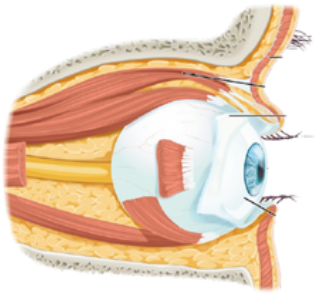
***NOTE!:** Bilateral innervation of the Edinger-Westphal nuclei allows both **direct** and **consensual** pupil responses.*

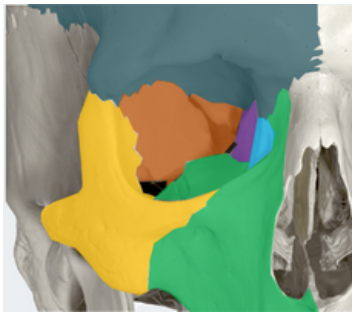
EYE AND ORBIT ANATOMY

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, particularly cataract surgery, retinal detachment repair, surgical management of glaucoma..*

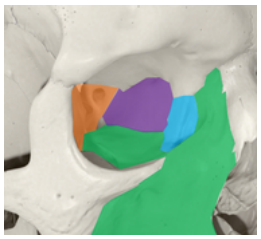
The Orbit

- 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.





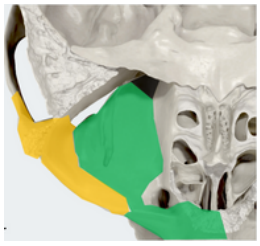
Orbit - **7 bones,** forming a **pyramid**:
- roof
- floor
- medial wall
- lateral wall



Medial wall - 4 bones
•Maxilla
•Sphenoid bone
•Ethmoid bone
•Lacrimal bone

Lateral wall - 2 bones
•Zygomatic bone
•Sphenoid bone

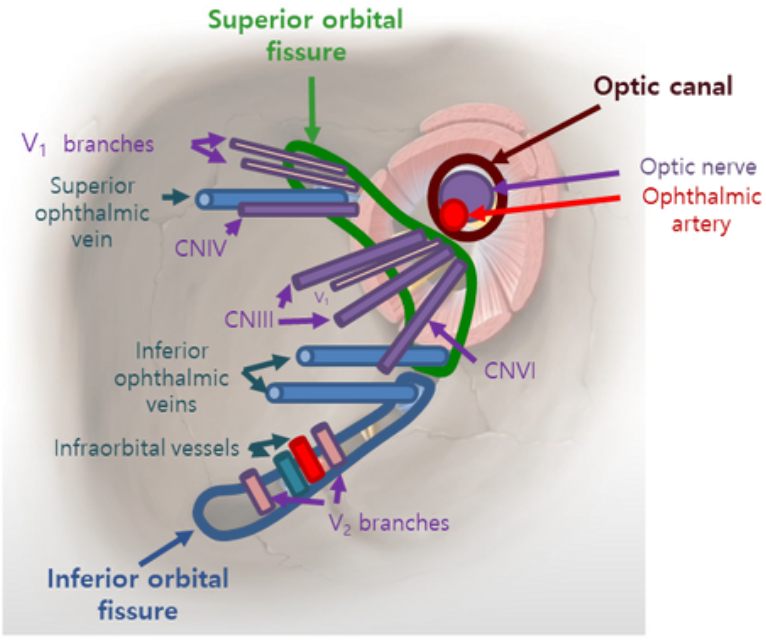
Roof - 2 bones
•Frontal bone
•Sphenoid bone



Floor - 3 bones
•Zygomatic bone
•Maxilla
•Palatine bone

Fissures and Foramina

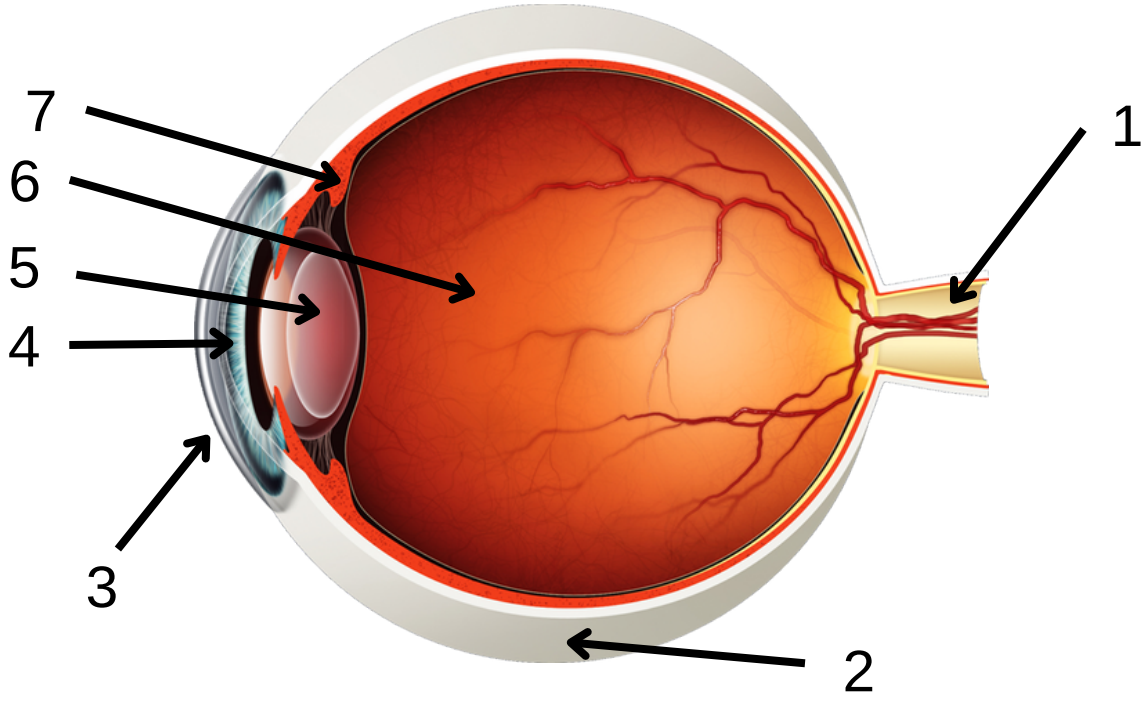
- **Optic canal**
  - optic nerve
  - ophthalmic artery
- **Superior orbital fissure**
  - Oculomotor nerve (CNIII)
  - Trochlear nerve (CNIV)
  - Ophthalmic nerve (CNV1)
  - Abducens nerve (CNVI)
  - Ophthalmic vein (superior & inferior)
- **Inferior orbital fissure**
  - CNV2 branches
  - Inferior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



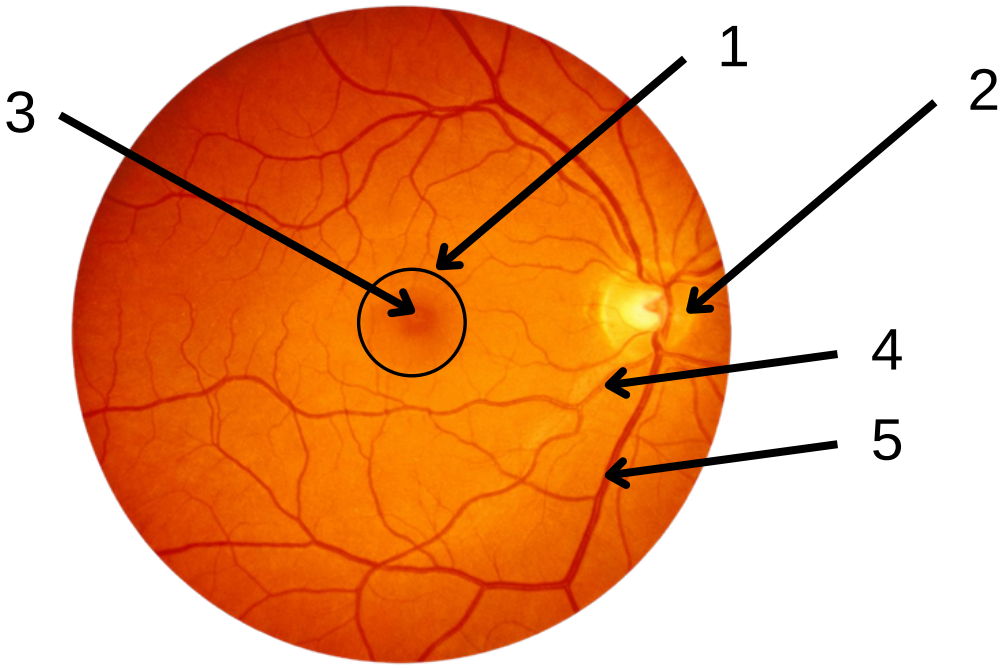
EYE AND ORBIT ANATOMY

Test yourself

1) Label the structures of the eye:



2) Label the structures of the retina:



EYE AND ORBIT ANATOMY

Test yourself

MCQ 1
The optic nerve carries visual information from the retina to which part of the brain?

A. Occipital lobe
B. Temporal lobe
C. Frontal lobe
D. Parietal lobe
E. Cerebellum

MCQ 2
What is the primary function of the vitreous humour in the eye?

A. To focus incoming light
B. To nourish the lens
C. To maintain intraocular pressure
D. To support the shape of the eye
E. To transmit visual signals to the brain

MCQ 3
What is the primary function of the macula?

A. Peripheral vision
B. Night vision
C. Colour vision
D. Central vision and fine detail
E. Converting light into electrical signals

MCQ 4
What is the name of the muscle responsible for elevating the upper eyelid, allowing the eye to open?

A. Levator palpebrae superioris
B. Superior oblique
C. Inferior oblique
D. Rectus lateralis
E. Superior rectus

MCQ 5
A patient presents with sudden, severe eye pain, a hazy cornea, and a fixed mid-dilated pupil. Which condition is the most likely cause of these findings?

A. Conjunctivitis
B. Retinal detachment
C. Corneal abrasion
D. Acute angle-closure glaucoma
E. Macular degeneration

MCQ 6
What is the most common cause of sudden, painless vision loss in older adults?

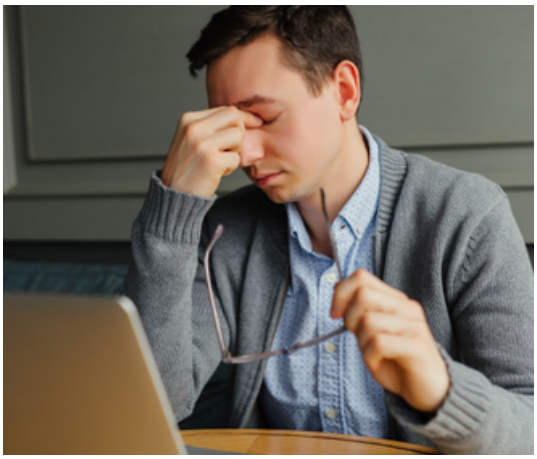
A. Central retinal artery occlusion
B. Acute angle-closure glaucoma
C. Retinal detachment
D. Macular degeneration
E. Optic neuritis

EYE AND ORBIT ANATOMY

Test yourself

OSCE Station - Case Based Discussion

You are in the eye emergency department, and a 45-year-old male named John Smith presents with sudden-onset right eye pain, redness, and decreased vision over the past 24 hours. He denies any recent trauma, systemic illness, fever, or headache but does report sensitivity to light (photophobia) and nausea. He regularly uses antihistamines



Q1. How would you assess this patient?

Q2. What is the likely diagnosis?

Q3. What initial treatment should be provided?

Q4. Why is prompt treatment necessary?

Q5. Which surgical treatment option could this patient receive?

Q6. What advice would you give this patient to minimise the risk of recurrence?

Answers
Labelling exercises:
1) 1 - optic nerve, 2 - sclera. 3 - cornea, 4 - iris, 5 - lens, 6 - vitrous chamber / humour, 7 - ciliary body
2) 1 - macula; 2 - optic disc; 3 - fovea; 4 - arteriole; 5- venule;
MCQs: 1) B 2) D 3) D 4) A 5) D 6) D.
OSCEs:
1) Examine both eyes, measurement of intraocular pressure, evaluation of visual acuity, pupillary assessment, and assessment for signs of systemic conditions contributing
2) Acute angle closure glaucoma
3) Eye drops to lower intraocular pressure e.g. timolol
4) Quick treatment prevents permanent vision loss and damage to the optic nerve
5) Iridotomy - to create a small hole in the iris, allowing eye fluid to flow and relieve pressure
6) Avoid using antihistamines - Antihistamines can dilate the pupil, which can further obstruct the angle in acute angle-closure glaucoma, worsening the condition