# The Orbit

OSAMA ABABNEH, MD

## Outline

- Anatomy of the orbit and its relation to adjacent anatomical structure
- Proptosis; it's types and causes
- Thyroid eye disease signs and symptoms
- Diplopia
- Differential diagnosis of orbital diseases
- Orbital tumors

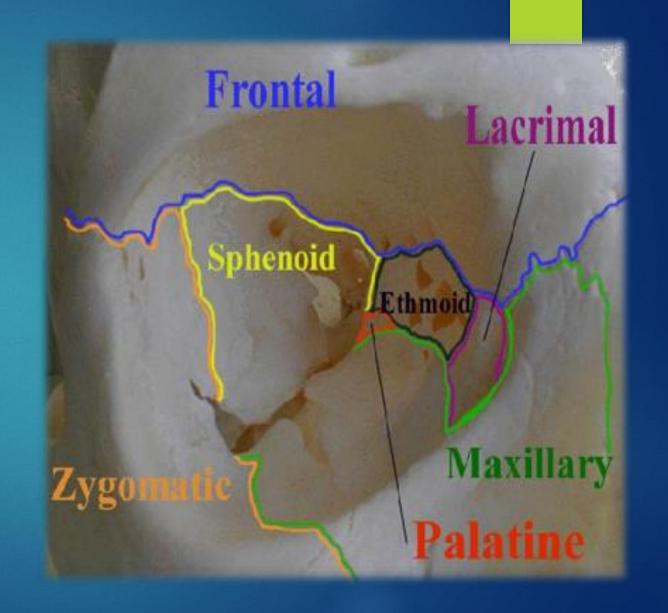
# Anatomy

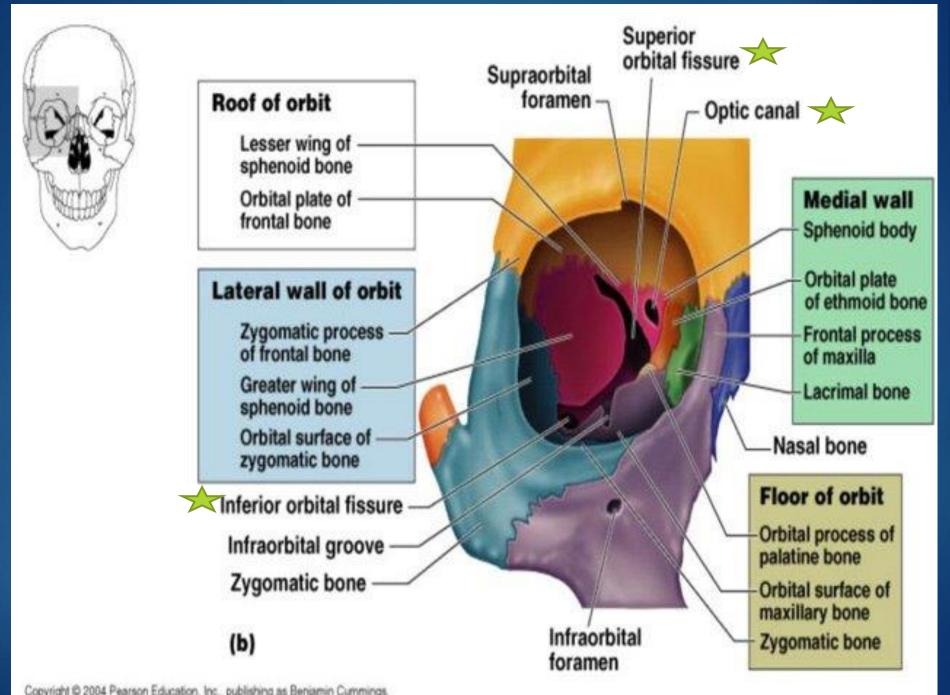
# Anatomy

The orbital cavity is the protective bony socket for the <u>globe</u> together with the <u>optic</u> <u>nerve</u>, <u>ocular muscles</u>, <u>nerves</u>, <u>blood vessels</u>, and <u>lacrimal gland</u>. It has the shape of a four-sided pyramid.

The bony socket consists of seven bones:

- 1. Frontal
- 2. Ethmoid
- 3. Lacrimal
- 4. Sphenoid
- Maxillary
- 6. Palatine
- 7. Zygomatic





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The major nerves and vessels to the orbit and globe enter through 3 openings.

 At the posterior apex of the orbit is the optic canal which transmits the optic nerve.

 The superior and inferior orbital fissures allow the passage of blood vessels and cranial nerves from the brain into the orbit, face and venous drainage back to brain.

# The optic canal

- ► The optic canal is at the apex of the orbit and lies within the sphenoid bone.
- The structures entering through the optic canal are:
- Optic nerve
- Ophthalmic artery
- Central retinal vein

### Orbital fissures

A. The superior will issure is bounded by the lesser and greater wings of the sphenoid. the structures passing through it are:

Branches of the

ophthalmic nerve

- Cranial nerves (CN) III, IV, and VI
- Lacrimal nerve
- Frontal nerve
- Nasociliary nerve
- Superior ophthalmic vein
- Orbital branch of middle meningeal artery
- Recurrent branch of lacrimal artery
- Superior orbital vein

B. The <u>greater wing of the sphenoid</u>, the <u>maxilla</u>, and the <u>palatine bones</u> of the orbit form the boundaries of **the inferior orbital fissure**. The structures entering through it are

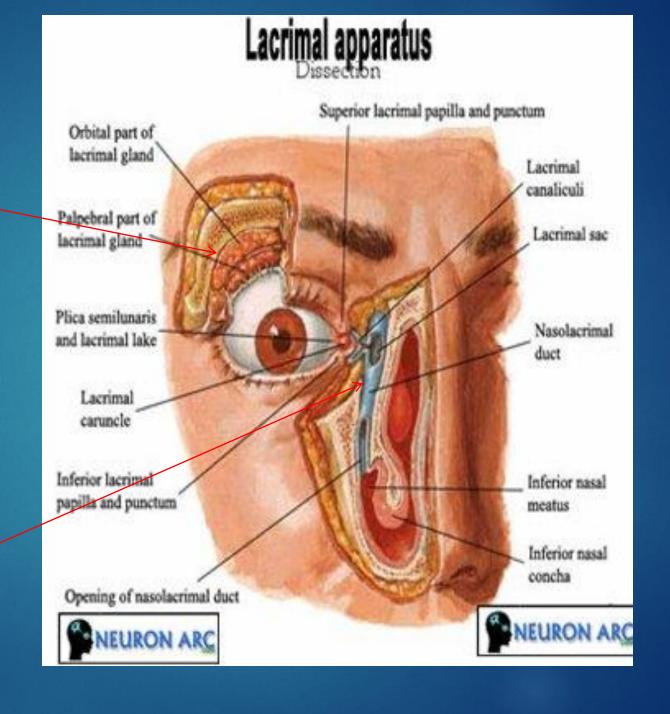
- Infraorbital nerve
- Zygomatic nerve

Maxillary nerve continuation and branch respectively

- Parasympathetics fibers to lacrimal gland
- Infraorbital artery: from maxillary artery
- Infraorbital vein
- Inferior ophthalmic vein

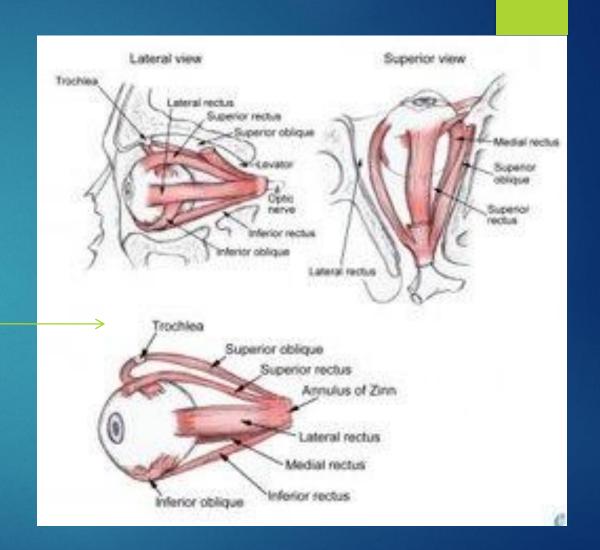
The lacrimal gland lies anteriorly in the superolateral aspect of the orbit.

On the anterior part of the medial wall lies the fossa for the lacrimal sac.



### Orbit's functions

- the protection of the globe.
- providing attachments which stabilize the ocular movements.
- \*\* The six ocular muscles originate at the apex around the optic nerve and insert into the globe.
- a conduit for the transmission of nerves and blood vessels.



# Proptosis



### Definition

Proptosis, or exophthalmos is defined as a bulging of the eye anteriorly out of the orbit, by a space-occupying lesion.

often seen in an orbital tumor).

# Causes of Proposis

- 1. Infectious
  - Orbital cellulitis (M.C.C of unilateral in children)
  - Mucormycosis
  - Sinus disease
  - (Rapid onset and may be painful)

### 2. Inflammatory

- Thyroidopathy (Grave's disese, most common cause in adults)
- Orbital inflammatory syndrome (orbital pseudotumor, benign orbital inflammation)

### 3. Neoplastic

- Lacrimal gland tumors (eye is displaced to one side/{lesion outside the muscle cone})
- Lymphoma
- Leukemia
- Meningioma (Directly forward in direction/{an intra conal lesion})
- Glioma
- Ossifying fibroma
- Metastatic (breast in women, lung and prostate in men, gastrointestinal, kidney)
- In children a rapidly developing proptosis may be caused by a rare rhabdomyosarcoma of the extraocular muscles.

- 4. Vasculitis
- Wegener granulomatosis
- Churg-Strauss syndrome

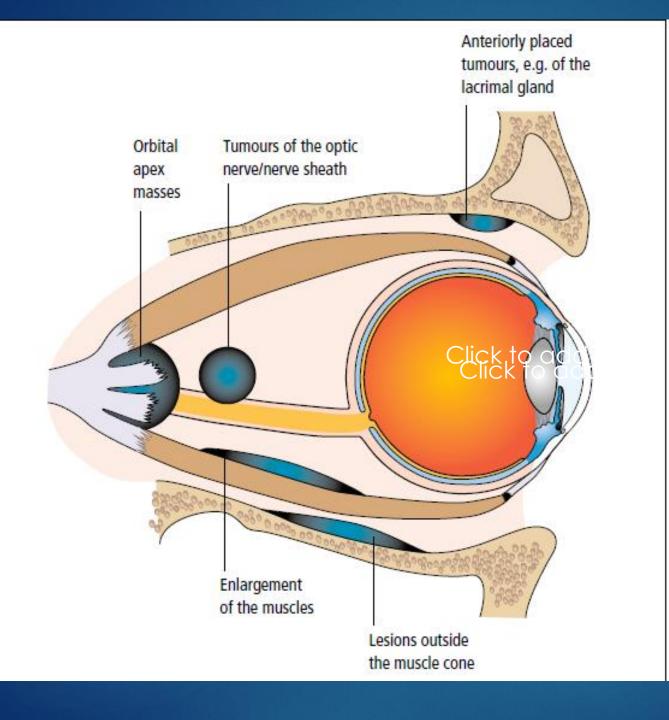
- 5. Orbital vascular disease
- Orbital varix (venous malformation)
- (A transient proptosis induced by increasing the cephalic venous pressure by a Valsalva maneuver)
- Orbital arteriovenous malformation (carotidcavernous sinus fistula, arteriovenous malformation)

#### 6. Trauma

- Traumatic or iatrogenic orbital hemorrhage
- Orbital fractures in acute phase
- Facial fractures

### 7. Pseudoproptosis (pseudoexophthalmos)

- Buphthalmos
- Contralateral enophthalmos
- Ipsilateral lid retraction
- Axial myopia
- Contralateral blepharoptosis



# Sites of orbital disease

### **Some Causes of Proptosis**

Cause	Suggestive Findings	Diagnostic Approach
Graves disease	Eye symptoms: Eye pain, lacrimation, dry eyes, irritation, photophobia, ocular muscle weakness causing diplopia, vision loss caused by optic nerve compression Systemic symptoms: Palpitations, anxiety, increased appetite, weight loss, insomnia, goiter, pretibial myxedema (see <a href="https://example.com/hyperthyroidism">Hyperthyroidism</a> : Symptoms and Signs)	Thyroid function tests
Carotid-cavernous sinus or dural- cavernous sinus fistula	Pulsating proptosis with an orbital bruit	Magnetic resonance angiography
Cavernous sinus thrombosis	Ophthalmoplegia, headache, ptosis, decreased visual acuity, fever	CT or MRI
C	T: blank	
Orbital tumors (eg, lymphoma, hemangioma, vascular malformations)	Decreased visual acuity, diplopia, pain	MRI or CT
Retrobulbar hemorrhage	Decreased visual acuity, diplopia, pain, ophthalmoplegia, risk factors	Immediate CT or treatment based on clinical findings
Spheno-orbital meningioma	Pain, headache, visual field defects, ophthalmoplegia	MRI or CT

# How to measure proptosis

It can be measured by exophthalmometer (Hertel). The Hertel exophthalmometer quantifies the anterior protrusion of the eye by measuring the distance in millimeters from the lateral orbital rim to the front surface of the cornea

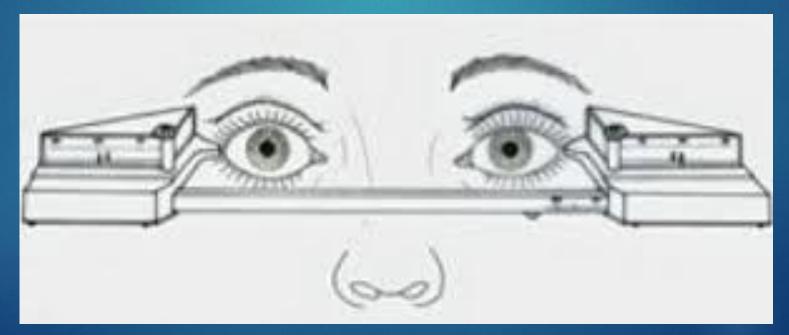
\* A difference of more than 2mm between the two

eyes is significant.

- Proptosis is graded as:
- mild (21–23 mm),
- moderate (24–27 mm)
- severe (28 mm or more)







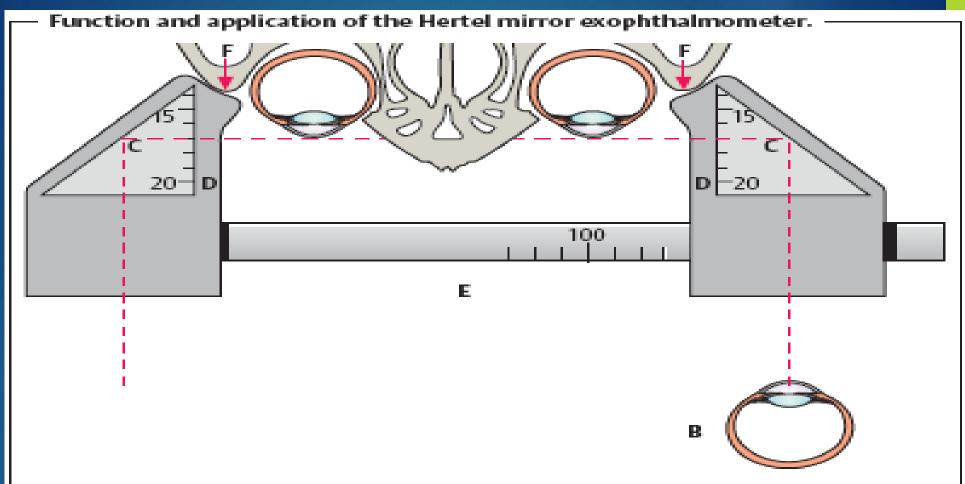


Fig. 15.2 a The device measures the extraorbital prominence of the eye from the anterior surface of the cornea (dashed line) to the temporal bony rim of the orbit (F). The examiner (B) views the anterior surface of the comea through a mirror (C). The extraorbital prominence in millimeters is then read off the integral scale (D). To obtain reproducible results, it is important to maintain a constant base setting in mm (E) every time the exophthalmometer is applied.

# Enophthalmus

 It is a backward (retraction) displacement of the globe.

- Seen in:
  - 1.Orbital fracture
  - 2.Horner's syndrome
  - 3. Orbital fat atrophy
  - 4. Congenital abnormality
  - 5.Metastatic disease



# Thyroid eye disease (TED)

# Thyroid eye disease (TED)

- Thyroid eye disease (TED) is a disease marked by swelling of the muscles and fatty tissues surrounding the eyeball within the eye socket (the orbit).
- The swelling is due to inflammation of these tissues.
   There is limited space inside the orbit so, as the tissues swell, the eyeball is pushed forward.
- The condition occurs particularly in hyperthyroidism but also in hypothyroidism .
- The commonest cause of unilateral and bilateral proptosis in adults.

What's the most commonly affected muscle ?
The inferior rectus .

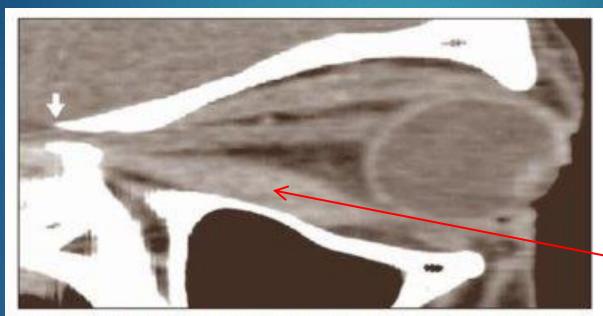


Figure 6. Sagittal CT image showing the optic nerve stretching resulting from proptosis and compression in the region of the orbital apex (arrow). Note the thickening of the inferior rectus muscle and the superior muscle complex.

# Symptoms and Signs of Graves' Opthalmopathy

- Red painful eye
- Periorbital edema
- Lid retraction
- Conjuctivitis
- Diplopia
- Proptosis
- Reduced visual acuity





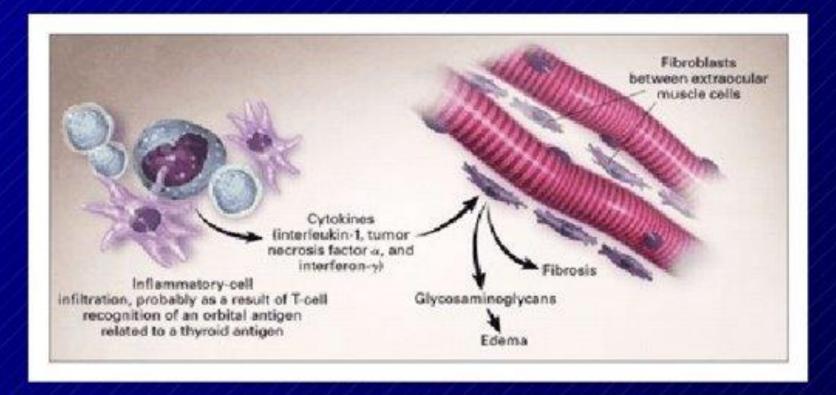
# On physical exam:

- Proptosis ( exophthalmos ) , can be asymmetrical .
- The conjunctive may be chemosed and the vessels dilated over the muscle insertion.
- Lid retraction (sclera is visible above the upper border of the cornea) → staring appearance.
- \*\* Why? due to increased sympathetic activity.
- Lid lag behind the movement of the globe on downgaze.
- +- Restricted eye movements.

# Pathogenesis of TED: Autoimmune

TSH receptor antigen → T-cell activation → cytokines ex. TNF - increased GAGs secretion by fibroblasts (principally <u>hyaluronic acid</u>) → GAGs accumulate  $\rightarrow \Delta$  osmotic pressure  $\rightarrow$  fluid accumulation, muscle swelling, pressure within the orbit -- forward displacement of the eyeball ( proptosis ) due to 1 volume of extraocular muscles, retroorbital connective tissue and adipose tissue, exposure of the globes and limitation of eye movements.

# Pathogenesis of TED



### What's the clue?

TSH receptor (TSHR) mRNA and protein can be detected in orbital fibroblasts and adipocytes, and preadipocytes from patients with Graves' ophthalmopathy. These cells express more TSH receptor mRNA and produce more cyclic adenosine monophosphate (AMP) in response to TSH than do similar cells from normal subjects.

CT image of a patient with Graves' disease.



Fig. 15.4 The image shows obvious thickening of the extraocular muscles in the right orbit, primarily the rectus medialis (1) and rectus lateralis (2), and of the rectus medialis (3) in the left orbit.

## Two serious complications:

- 1- Excessive exposure of the conjunctiva and cornea with chemosis and corneal ulcers i.e the cornea loses its protection → corneal perforation.
- 2 Compression and ischemia of the optic nerve by the thickened muscle leading to compressive optic neuropathy → Field loss and may be blindness.

These two complications require urgent treatment with

Systemic steroids

- Radiotherapy
- Surgical orbital decompression .

## Assessment of severity:

The severity ranges from 0 to VI.

Mnemonic: NO SPECS

- Class 0 No symptoms or signs
- Class I Only signs, no symptoms (ex.: lid retraction, stare, lid lag)
- Class II Soft tissue involvement
- Class III Proptosis
- Class IV Extraocular muscle involvement
- Class V Corneal involvement
- Class VI Sight loss (optic nerve involvement)

- Treatment aims:
- \*\* to improve eye movement problems.
- \*\* to improve the cosmetic appearance.

How \$

By prisms to manage the diplopia and corrective surgeries (on extraocular muscles and the upper eyelids).

# Diplopia

#### Definition

Diplopia or double vision is the simultaneous perception of two images of a single object that may be displaced horizontally, vertically, or diagonally (i.e. both vertically and horizontally) in relation to each other.



#### Causes

 Muscles involvement as in myosytis and dysthyroid diseases.

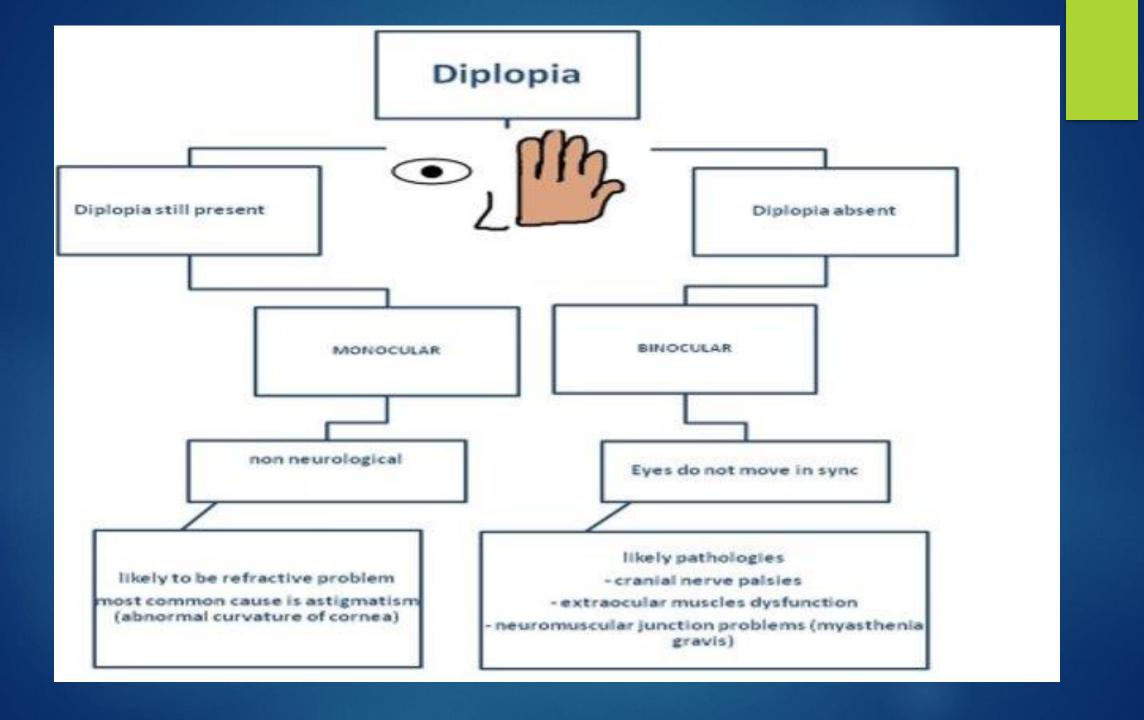
2. Nerve supply involvement.

## Types

monocular diplopia is usually the result of a refractive error

binocular diplopia is commonly due to impaired extraocular muscle function

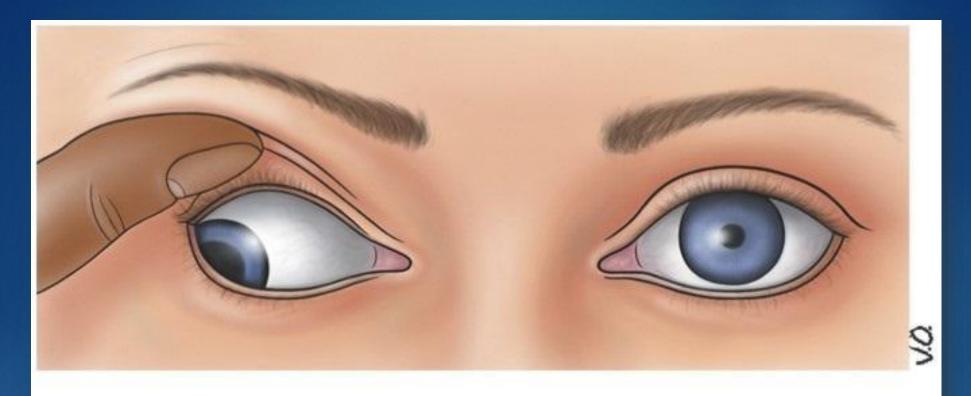
Telling them apart can be done by carrying out the cover – uncover test.



# History taking in diplopia

#### 1. Pain :

This is essential to ask about in order to rule out a third nerve palsy resulting from a posterior communicating artery aneurysm, which is a neurological emergency.



Right eye: Downward and outward gaze, dilated pupil, eyelid manually elevated due to ptosis

Left: Normal

#### 2. Image alignment:

Is the diplopia horizontal, vertical or oblique?

Horizontal diplopia with no vertical separation is due to impaired function of lateral rectus and/or medial rectus. This can also commonly occur due to a sixth nerve palsy.

Vertical or tilted diplopia can be indicative of a fourth nerve palsy.

#### 3. Constant or intermittent

the characteristic timing of the diplopia is important as intermittent diplopia which is worse at the end of the day can suggest myasthenia gravis

#### 4. Direction of gaze

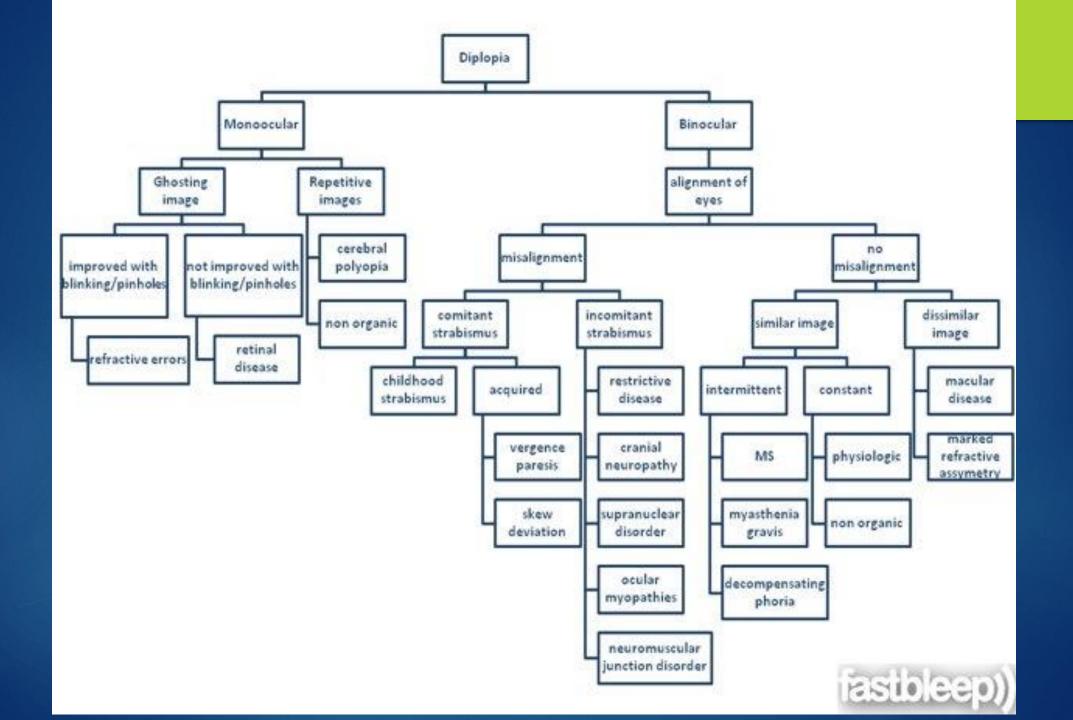
 This can be used to help locate the EOM involved and help to identify whether it is due to a paralytic or restrictive cause.

 Paralytic cause - diplopia when looking in direction of paralytic muscle (secondary to a neuropathy, myopathy, or neuromuscular junction disorder reveals slowed saccades)

 Restrictive cause - diplopia when looking away from restrictive muscle (normal saccadic velocity.) ▶ 5. Exacerbating or relieving factors - monocular diplopia can be improved by blinking if due to astigmatism or dry eyes, however there is no change if the diplopia is caused by macular disease or cataract.

▶ 6. Trauma - It is important to enquire about any recent trauma. Any eye or head injury could lead to diplopia through various mechanisms.

- Past medical history This is an integral part of assessing diplopia as any childhood strabismus, past prism correction via glasses and past ocular surgeries can lead to the development of subsequent diplopia.
- Other medical conditions It is important to remember the bigger picture and therefore other systemic diseases should be asked about such as diabetes, hypertension, temporal arteritis and thyroid disease. Neurological symptoms should also be asked about such as weakness, paraesthesia, blurred vision, loss of hearing, balance, dysphagia and headaches



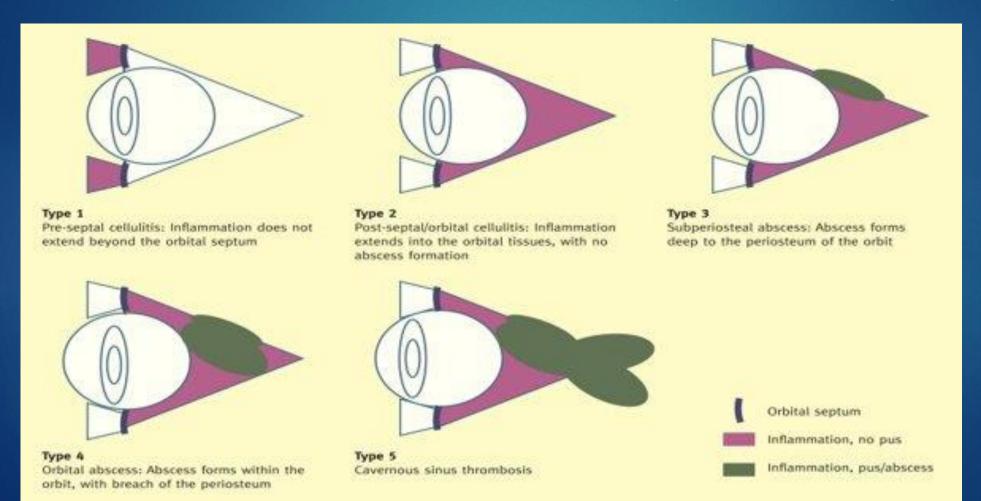
# Differential diagnosis of orbital disease

### Differential diagnosis of orbital disease

- Traumatic orbital disease
- Infective disorders
- Vascular abnormalities
- Orbital tumors

#### Infective disorders

Classification of orbital infections (Chandler's):



## A - Preseptal Cellulitis

Is the infection of soft tissue anterior to orbital septum ( lid structures )

- Etiology usually follows periorbital trauma or dermal infection
- Clinical Features
- tender, swollen, and erythematous lids.
- ± low-grade fever.
- Normal visual acuity, pupils, extraocular movements.
- NO exophthalmos.
- \*\* It may lead to orbital cellulitis.

#### Treatment

• systemic antibiotics (suspect H. injluenzae in children; S. aureus or Streptococcus in adults) e.g. amoxicillin-clavulanic acid.

• if severe or child < 1 yr treat as orbital cellulitis.



# Preseptal cellulitis



### **B - Orbital Cellulitis:**

- It's an ocular and medical <u>EMERGENCY!</u> Defined as an inflammation of orbital contents (fat +muscles) posterior to orbital septum, common in children, elderly, and immunocompromised.
- Etiology
- -usually 2ry° to sinus (ethmoid) / tooth infections or trauma
- -Most common microorganisms : Staphylococcus and streptococcus .

- Clinical Features
- 1. decreased visual acuity (visual loss is possible!).
- 2. red eye.
- 3. periorbital inflammation and swelling.
- 4. pain with and without eye movement.
- 5. headache and fever.
- 6. lid erythema, tenderness, and edema with difficulty opening eye.
- 7. conjunctival injection and chemosis (conjunctival edema).
- 8. proptosis, limitation of ocular movements (ophthalmoplegia).
- 9. +- ± RAPD (Relative afferent pupillary defect).

#### diagnosis:

MRI or CT

#### ▶ Treatment :

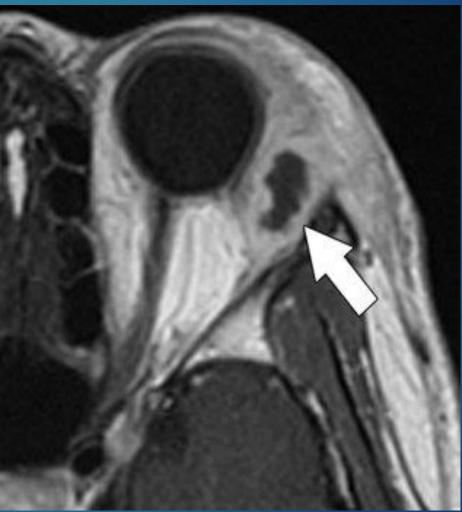
- Admit the patient, blood cultures, orbital CT, IV antibiotics (ceftriaxone + vancomycin) for 1 week.
- 2. Surgical drainage of abscess with close follow-up, especially in children.
- 3. Optic nerve decompression if it's compromised.

#### Complications

- 1. \*optic nerve inflammation
- 2. \*cavernous sinus thrombosis
- 3. \*meningitis and brain abscess
- 4. \* possible loss of vision
- 5. \*and in most severe cases death!

# Orbital cellulitis





# Orbital tumors

It can be <u>primary</u> neoplasm rising from any of the anatomical structures of the orbit.

Or <u>secondary</u> orbital invasion from direct extension from contiguous anatomical structures, lymphoproliferative disorders, and hematogenous metastasis.

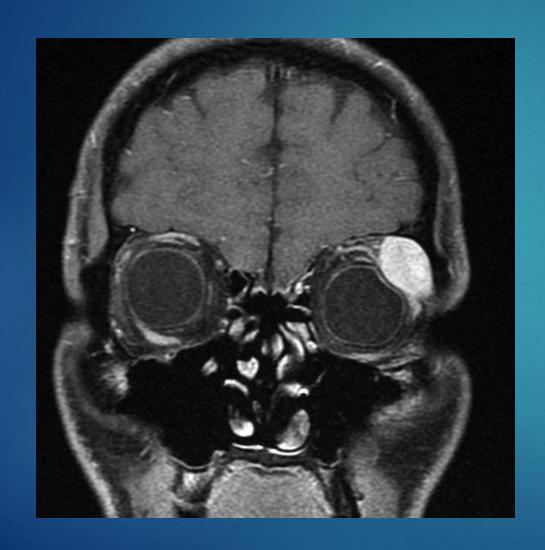
#### Lacrimal gland tumors:

Malignant lacrimal gland tumours carry a <u>poor</u> <u>prognosis</u>. Benign tumours still require complete excision to prevent malignant transformation.

#### Optic nerve gliomas:

may be <u>associated with neurofibromatosis</u>. They are difficult to treat but are often slow - growing and thus may require no intervention.

## Lacrimal gland tumors:

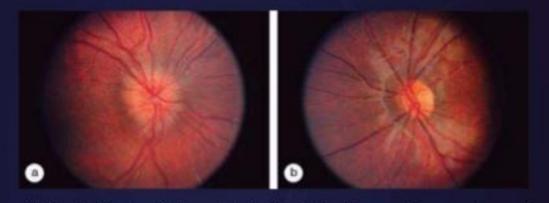




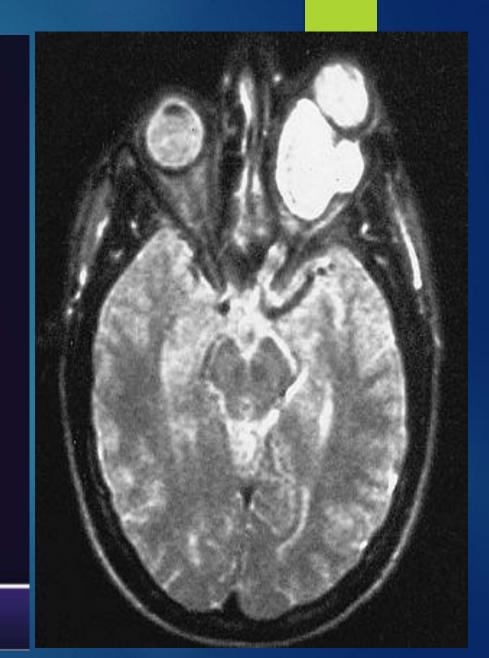
#### Optic nerve gliomas:



Face photo of a 5-year-old girl who developed noticeable proptosis OD and found to harbor an optic nerve glioma.



(a) The right fundus of a 5-year-old girl with a right optic nerve glioma reveals an optic nerve with mild edema. Her visual acuity was moderately to severely reduced. (b) The left nerve was normal.



#### Meningiomas

Meningiomas of the optic nerve are <u>rare</u>, and may also be <u>difficult to excise</u>.

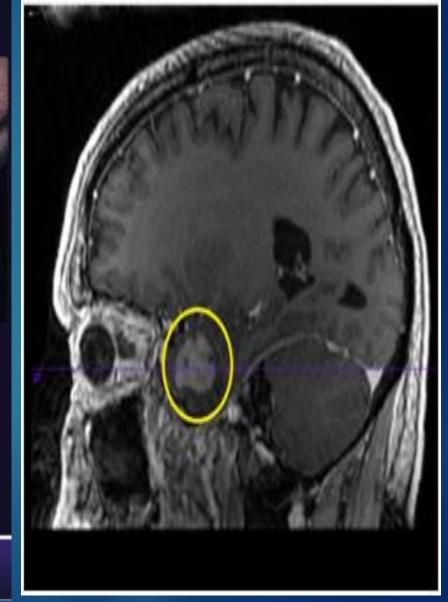
They can be monitored over time and some may benefit from treatment with radiotherapy.

Meningiomas arising from the middle cranial fossa, however, may spread through the optic canal into the orbit.

#### Meningiomas



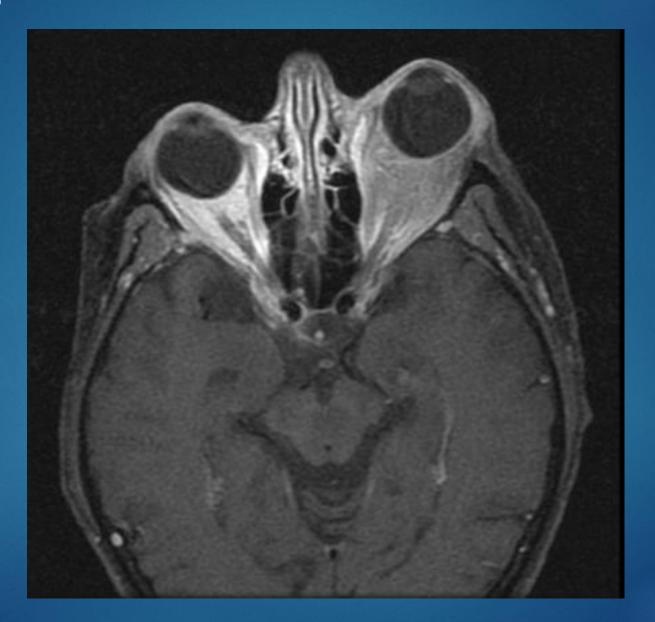
Face shot of a woman complaining of proptosis of the left eye. Neuroimaging revealed a left sided sphenoid wing meningioma. The left eye shows lid retraction and lagophthalmos with protrusion of the left globe. (b) Picture taken from above the patient demonstrating the degree of proptosis visually.



#### Lymphomas

Treatment requires a full systemic investigation to determine whether the lesion is indicative of widespread disease or whether it is localized to the orbit. In the former case the patient is treated with chemotherapy, in the latter with localized radiotherapy.

# Lymphomas



#### Rhabdomyosarcoma:

it's the commonest malignant primary orbital tumour in children (vs. capillary hemangiomas as the most common benign orbital tumors affecting children). Rhabdomyosarcoma is a rapidly growing, malignant tumour of striated muscle. Chemotherapy is effective if the disease is localized to the orbit.

#### Rhabdomyosarcoma:



Metastasis from other systemic cancers

\*Children:

Most commonly from :Neuroblastomas, Ewing sarcoma, Wilms tumor, and leukemias

\*Adults:

Breast, lung, prostate, or GI tract

# Dermoid cysts

- These congenital lesions are <u>caused by the</u> <u>continued growth of ectodermal tissue beneath</u> <u>the surface</u>, which may present in the medial or lateral aspect of the superior orbit.
- Excision is usually performed for <u>cosmetic</u> reasons and to <u>avoid traumatic rupture</u>, which may cause scarring.
- Some may be attached deeply by a stalk, and a CT scan may be necessary before surgery to identify this deeper connection.
- Dermoids may also occur at the limbus.



# THANK YOU!