#### "Orbit And Eye"

 The orbits are a pair of bony cavities in the face.

· Each orbit contains:

- The eyeballs - Their associated muscles - Nerves - Vessels - Fat - Most of the lacrimal apparatus

 Two thin, movable folds, the eyelids, guard the orbital opening.

<- Eyelids ->

» Protective Functions

 The eyelids protect the eye from injury and excessive light.

- » Anatomical Features
  - The upper eyelid is:

### - Larger - More mobile than the lower

• The eyelids meet at:

- The medial angle

- The lateral angle

» Palpebral Fissure

• The palpebral fissure is:

- The elliptical opening between the eyelids
  The entrance into the conjunctival sac
- » Eyelid Position Relative to the Cornea

· When the eye is closed:

- The upper eyelid completely covers the cornea
- When the eye is open and looking straight ahead:

# - The upper lid just covers the upper margin of the cornea

• The lower lid:

Lies just below the cornea when the eye is
 open
 Rises only slightly when the eye is closed

» Eyelid Surface Coverings

- The superficial surface of the eyelids is covered by skin
- The deep surface is covered by a mucous membrane called the conjunctiva
  - » Eyelashes and Associated Glands

> Eyelashes:

- Short, curved hairs on the free edges of the eyelids
  - Arranged in double or triple rows at the mucocutaneous junction

> Sebaceous glands (glands of Zeis):

· Open directly into the eyelash follicles

> Ciliary glands (glands of Moll):

· Modified sweat glands

· Open separately between adjacent lashes

> Tarsal glands:

· Long, modified sebaceous glands

 Pour their oily secretion onto the margin of the lid

· Their openings lie behind the eyelashes

· Function:

Prevent the overflow of tears
Help make the closed eyelids airtight

> Medial Angle Structures

 The more rounded medial angle is separated from the eyeball by a small space:

- Called the lacus lacrimalis

- In the center of the lacus lacrimalis is:
- A small, reddish yellow elevation called the caruncula lacrimalis
  - · On the lateral side of the caruncle lies:
  - A reddish semilunar fold called the plica semilunaris
    - » Papilla Lacrimalis and Tear Drainage
- A small elevation, the papilla lacrimalis, is present near the medial angle of the eye.
- On the summit of the papilla is a small hole, the punctum lacrimale.
  - The punctum lacrimale leads into the canaliculus lacrimalis.
    - The papilla lacrimalis:

- Projects into the lacus - The punctum and canaliculus carry tears down into the nose

# » Conjunctiva

 The conjunctiva is a thin mucous membrane that:

- Lines the eyelids - Is reflected at the superior and inferior fornices onto the anterior surface of the eyeball

 Its epithelium is continuous with that of the cornea

» Lacrimal Gland Ducts

· The ducts of the lacrimal gland:

- Pierce the upper lateral part of the superior fornix

» Conjunctival Sac

 The conjunctiva forms a potential space, the conjunctival sac

· It is open at the palpebral fissure

» Subtarsal Sulcus

- The subtarsal sulcus is a groove on the deep side of the eyelid
- Runs close to and parallel with the margin of the lid
  - Tends to trap small foreign particles introduced into the conjunctival sac
    - · Therefore, it is clinically important
      - » Orbital Septum
  - The orbital septum is a fibrous sheet
    - · Forms the framework of the eyelids
- » Orbital Septum and Associated Structures
  - The orbital septum is attached to the periosteum at the orbital margins.
  - The orbital septum is thickened at the margins of the lids to form:

- The superior tarsal plate

- The inferior tarsal plate

» Palpebral Ligaments

· Lateral palpebral ligament:

A band connecting lateral ends of the tarsal plates
 Attaches to a bony tubercle just within the orbital margin

Medial palpebral ligament:

- Attaches medial ends of the tarsal plates to the crest of the lacrimal bone
  - Tarsal Glands and Muscle Coverings
- Tarsal glands are embedded in the posterior surface of the tarsal plates
- The superficial surface of the tarsal plates and the orbital septum are covered by:
- The palpebral fibers of the orbicularis oculi muscle

# Levator Palpebrae Superioris and Superior Tarsal Muscle

 The aponeurosis of insertion of the levator palpebrae superioris muscle:

Pierces the orbital septum
Reaches the anterior surface of the superior tarsal plate and the skin

• A thin smooth muscle band, the superior tarsal muscle, underlies the levator palpebrae superioris

» Eyelid Movements

> Upper Eyelid Actions

 Eyelid muscle actions are most pronounced at the upper eyelid

 "Opening the eye" = elevating (lifting) the upper eyelid

 "Closing the eye" = depressing (lowering) the upper eyelid > Resting Position of Eyelids

· Depends on tone of:

- Orbicularis oculi muscle - Levator palpebrae superioris muscle - Superior tarsal muscle

· Also depends on the position of the eyeball

> Mechanism of Closing and Opening the Eye

· Closing the eyelids:

- Contraction of the orbicularis oculi

- Relaxation of levator palpebrae superioris and superior tarsal muscles

· Opening the eye:

- Contraction of the levator palpebrae superioris and/or superior tarsal muscle

- Raises the upper lid

> Eyelid Movement During Eye Movements

· Looking upward:

- Levator palpebrae superioris contracts - The upper lid moves with the eyeball

· Looking downward:

- Both upper and lower lids move - The upper lid continues to cover the upper part of the cornea

 The lower lid is pulled downward slightly by the conjunctiva, which is attached to:

> – The sclera – The lower lid

<- Lacrimal Apparatus ->

 Consists of structures that secrete and collect tears:

> - Lacrimal gland - Lacrimal ducts

 Proper function is critical to keep the cornea moist

» Lacrimal Gland

> Composed of:

- A large orbital part - A small palpebral part

 Both parts are continuous around the lateral edge of the aponeurosis of the levator palpebrae superioris

 Located above the eyeball in the upper anterolateral part of the orbit

· Positioned posterior to the orbital septum

- Opens into the lateral part of the superior fornix of the conjunctiva via approximately 12 ducts

> Nerve Supply of Lacrimal Gland

v-> Parasympathetic Secretomotor Supply

 Originates from the lacrimal nucleus of the facial nerve (CN VII)

 Pathway: Preganglionic fibers reach the pterygopalatine ganglion via:

Nervus intermedius
Its great petrosal branch
Nerve of the pterygoid canal

 Postganglionic fibers leave the ganglion and join the:

- Maxillary nerve (CN V2)

· Then pass into the:

- Zygomatic branch - Zygomaticotemporal nerve

 Finally reach the lacrimal gland via the lacrimal nerve

-> Sympathetic Postganglionic Supply

· Originates from the internal carotid plexus

· Travels through:

Deep petrosal nerve
Nerve of the pterygoid canal
Maxillary nerve (CN V2)
Zygomatic nerve
Zygomaticotemporal nerve
Ends at the lacrimal nerve

» Lacrimal Ducts and Tear Drainage

Tears secreted from the lacrimal gland:

Circulate across the cornea
Accumulate in the lacus lacrimalis

 Tears enter the canaliculi lacrimales through the puncta lacrimalis

- The canaliculi lacrimales pass medially and open into the lacrimal sac
- The lacrimal sac lies in the lacrimal groove behind the medial palpebral ligament
- The lacrimal sac is the upper blind end of the nasolacrimal duct

> Nasolacrimal Duct

- Length: approximately 0.5 inches (1.3 cm)
- Emerges from the lower end of the lacrimal sac

#### · Path:

- Descends downward, backward, and laterally
   in a bony canal
- Opens into the inferior nasal meatus in the inferior lateral wall of the nasal passage
- The opening is guarded by a fold of mucous membrane called the lacrimal fold

 The lacrimal fold prevents air from being forced up the duct into the lacrimal sac when blowing the nose

<- Orbit ->

· Shape: Pyramidal cavity with

· Base: Anterior

· Apex: Posterior

» Orbital Margin

Formed by parts of three bones,
 circumscribing the base of the orbit:

-> Superior margin: Frontal bone

-> Lateral margin: Processes of the frontal and zygomatic bones

-> Inferior margin: Zygomatic bone and maxilla

-> Medial margin: Processes of the maxilla and frontal bone

# » Orbital Walls

· Four walls, composed of multiple bones:

-> Roof (Superior Wall)

· Formed by:

- Orbital plate of the frontal bone - Lesser wing of the sphenoid bone

• Separates:

The orbital cavity from the anterior cranial fossa
 The orbital cavity from the frontal lobe of the cerebral hemisphere

-> Lateral Wall

· Formed by:

- Zygomatic bone - Greater wing of the sphenoid bone

-> Floor (Inferior Wall)

· Formed mainly by:

- Orbital plate of the maxilla (separates orbit from maxillary sinus)

· Also formed by small parts of:

- Zygomatic bone - Palatine bone

-> Medial Wall

Formed anteroposteriorly by:
Frontal process of the maxilla
Lacrimal bone
Orbital plate of the ethmoid bone (separates orbit from ethmoid sinuses)
Body of the sphenoid bone

» Openings into the Orbital Cavity

 Connect the orbit with neighboring regions and transmit neurovascular structures

#### -> Orbital Opening

 Large anterior opening forming the base of the orbit

· Communicates directly with the face

About 1/6th of the eyeball protrudes
 through this opening and is exposed; the rest
 is protected by the orbital walls

-> Supraorbital Notch (or Supraorbital Foramen)

 Located in the frontal bone on the superior orbital margin

• Transmits:

- Supraorbital nerve - Supraorbital blood vessels

-> Infraorbital Groove and Canal

 Located on the floor of the orbit, within the orbital plate of the maxilla

• Transmit:

- Infraorbital nerve (a continuation of the maxillary nerve, CN V2) - Infraorbital blood vessels

-> Nasolacrimal Canal

 Located anteriorly on the medial wall of the orbit, within the lacrimal bone

Transmits the nasolacrimal duct

 Communicates with the inferior meature of the nose

-> Ethmoidal Foramina

 Anterior and posterior ethmoidal foramina located on the medial wall, typically in the ethmoid bone

• Transmit:

Anterior ethmoid nerve (branch of the ophthalmic nerve, CN VI)
Posterior ethmoid nerve (branch of the ophthalmic nerve, CN VI)

-> Zygomatic Foramina

 Zygomaticotemporal and zygomaticofacial foramina located on the lateral wall, usually in the zygomatic bone

• Transmit:

- Zygomaticotemporal nerve (branch of maxillary nerve, CN V2) - Zygomaticofacial nerve (branch of maxillary nerve, CN V2)

-> Inferior Orbital Fissure

 Located posteriorly, between the maxilla and the greater wing of the sphenoid

 Communicates with the pterygopalatine fossa

Transmits:

Maxillary nerve (CN V2) and its branches (infraorbital and zygomatic)
Inferior ophthalmic vein
Sympathetic nerves

-> Superior Orbital Fissure

- Located posteriorly, between the greater and lesser wings of the sphenoid
- · Communicates with the middle cranial fossa

• Transmits:

- Oculomotor nerve (CN III)
  - Trochlear nerve (CN IV)
  - Ophthalmic nerve (CN VI)
  - Abducens nerve (CN VI)
  - Superior ophthalmic vein

-> Optic Canal

- Located posteriorly, in the lesser wing of the sphenoid, at the apex of the orbit
- Communicates with the middle cranial fossa

• Transmits:

- Optic nerve (CN II)
- Ophthalmic artery

#### » Orbital Fascia

- · The periosteum lining the bones of the orbit
  - · Loosely attached to the bone surfaces

 Continuous through the foramina and fissures with the periosteum covering the outer surfaces of the bones

- » Fascial Sheath of the Eyeball
- A fascial sheath (bulbar fascia) surrounds the eyeball from the optic nerve to the corneoscleral junction.
- It separates the eyeball from the fat that fills much of the orbit
- This allows the eyeball to float in the orbital fat and provides a socket for free movement.
  - » Extraocular Muscle Tendon Sheaths
  - The tendons of extraocular muscles perforate the fascial sheath.

 The fascial sheath reflects onto each tendon as a tubular sheath.

» Check Ligaments

 Sheaths for the medial and lateral recti tendons attach to the medial and lateral orbital walls via triangular ligaments.

 These triangular ligaments are called the medial and lateral check ligaments.

 Do not confuse check ligaments with the medial and lateral palpebral ligaments of the eyelids.

» Suspensory Ligament of the Eye

- The lower part of the fascial sheath passes beneath the eyeball and connects the check ligaments.
  - It is thickened and serves to suspend the eyeball.
    - This thickened portion is called the suspensory ligament of the eye.

• The eye is suspended from the medial and lateral walls of the orbit, like in a hammock.

- » Orbitalis Muscle (Muscle of Müller)
- The orbitalis muscle is a thin layer of smooth muscle.
- · It bridges the inferior orbital fissure.
  - It is supplied by sympathetic nerves.

• Its function is uncertain.

 It may assist in suspending the eyeball and posturing it in its normal forward orbital position.

> Net Mechanical Effect

 This anatomical architecture enables the eyeball to move freely, smoothly, and extremely quickly (in the twinkling of an eye).

 Movements can be of very fine or very large degrees. » Movement Terminology

> Anterior Pole Reference

 The center of the cornea or center of the pupil is used as the anatomic anterior pole of the eye.

 All movements are related to the direction of movement of the anterior pole.

• Movements occur as the eye rotates on one of three axes: horizontal, vertical, and sagittal

> Elevation/Depression

 Rotation about the transverse (horizontal) axis.

· Elevation: pupil moves upward.

· Depression: pupil moves downward.

> Abduction/Adduction

- · Rotation about the vertical axis.
- Adduction: pupil turns medially inward.

· Abduction: pupil turns laterally outward.

> Rotation (Medial/Lateral)

 Turning about the sagittal (anteroposterior) axis.

 Medial rotation: point on upper rim of pupil moves medially.

 Lateral rotation: point on upper rim of pupil moves laterally.

<- Extrinsic Ocular (Extraocular) Muscles ->

» Muscle Overview

Six skeletal muscles:

- Superior rectus
- Inferior rectus
  - Medial rectus
- Lateral rectus
- Superior oblique
- Inferior oblique

 These muscles run from the bony walls of the orbit to insertions on the exterior of the eyeball.

### » Origins

• The four rectus muscles arise from a common tendinous ring surrounding the optic foramen.

· The superior oblique arises nearby.

 Only the inferior oblique originates from the anterior floor of the orbit.

# » Summary Table

MUSCLE	ORIGIN	INSERTION	NERVE SUPPLY	ACTION
Platysma	Deep fascia over pectoralis major and deltoid	Body of the mandible and angle of the mouth	Facial nerve cervical branch	Depresses the mandible and angle of the mouth
Sternocleidomastoid	Manubrium sterni and medial third of the clavicle	Mastoid process of the temporal bone and occipital bone	Spinal part of accessory nerve and C2 and 3	Two muscles acting together extend the head and flex the neck; one muscle rotates the head to the opposite side
Digastric			12.201	
Posterior belly	Digastric notch on the mastoid process of the temporal bone	Intermediate tendon (held to hyoid by fascial sling)	Facial nerve	Depresses the mandible or elevates hyoid bone
Anterior belly	Body of the mandible		Nerve to mylohyoid	
Stylohyoid	Styloid process	Body of hyoid bone	Facial nerve	Elevates hyoid bone
Mylohyoid	Mylohyoid line of body of the mandible	Body of hyoid bone and fibrous raphe	Inferior alveolar nerve	Elevates floor of the mouth and hyoid bone or depresses the mandible
Geniohyoid	Inferior mental spine of the mandible	Body of hyoid bone	First cervical nerve	Elevates hyoid bone or depresses mandible
Sternohyoid	Manubrium sterni and clavicle	Body of hyoid bone	Ansa cervicalis; C1, 2, and 3	Depresses hyoid bone
Sternothyroid	Manubrium sterni	Oblique line on lamina of thyroid cartilage	Ansa cervicalis; C1, 2, and 3	Depresses the larynx
Thyrohyoid	Oblique line on lamina of thyroid cartilage	Lower border of body of hyoid bone	First cervical nerve	Depresses hyoid bone or elevates the larynx
Omohyoid	N 1 994 W. 1 1 1		( i )	10 10 10 10 10 10 10 10 10 10 10 10 10 1
Inferior belly	Upper margin of scapula and suprascapular ligament	Intermediate tendon (held to clavicle and first rib by fascial sling)	Ansa cervicalis; C1, 2, and 3	Depresses hyoid bone
Superior belly	Lower border of body of hyoid bone		1 × × 51	
Scalenus anterior	Transverse processes of third, fourth, fifth, and sixth cervical vertebrae	First rib	C4, 5, and 6	Elevates first rib; laterally flexes and rotates cervical part of the vertebral column
Scalenus medius	Transverse processes of upper six cervical vertebrae	First rib	Anterior rami of cervical nerves	Elevates first rib; laterally flexes and rotates cervical part of the vertebral column
Scalenus posterior	Transverse processes of lower cervical vertebrae	Second rib	Anterior rami of cervical nerves	Elevates second rib; laterally flexes and rotates cervical part of the vertebral column

#### » Actions and Axis Considerations

 The superior and inferior recti are inserted on the medial side of the vertical axis of the eyeball.

· As a result:

- Superior rectus raises the pupil but also rotates it medially. - Inferior rectus depresses the pupil but also rotates it medially.

• To raise the pupil directly upward, the inferior oblique must assist the superior rectus.

- To depress the pupil directly downward, the superior oblique must assist the inferior rectus.
  - » Superior Oblique Tendon Pathway

 The tendon of the superior oblique muscle passes through a fibrocartilaginous pulley (trochlea) attached to the frontal bone.

# At the trochlea, the tendon turns backward and laterally.

- It inserts into the sclera beneath the superior rectus muscle.
- » Nerve Supply of Extraocular Muscles
  - Three cranial nerves control the six extraocular muscles:
- Trochlear nerve (IV): supplies only the superior oblique muscle.
- Abducens nerve (VI): innervates only the lateral rectus muscle.
- Oculomotor nerve (III): governs all the remaining muscles.
- Mnemonic for Motor Supply: 504 (LR6)3:

504: Fourth cranial nerve (trochlear) supplies superior oblique.

LR6: Sixth cranial nerve (abducens) supplies lateral rectus.

# ()3: Third cranial nerve (oculomotor) supplies all the others.

"Clinical Notes"

» Eye Trauma

> Protection by Bony Orbit

 The eyeball is well protected by the surrounding bony orbit.

 It is protected anteriorly only from large objects (e.g. tennis balls) that strike the orbital margin, not the globe.

 The bony orbit does not protect against small objects (e.g. golf balls) which can cause severe eye damage.

 On examining the eyeball relative to the orbital margins, it is least protected from the lateral side.

Blowout Fractures

 Commonly involve the orbital floor and the maxillary sinus.

Caused by blunt force to the face.

· When force is applied to the eye:

- Orbital fat explodes inferiorly into the maxillary sinus, fracturing the orbital floor.

Results in displacement of the eyeball →
 causes double vision (diplopia).

• May injure the infraorbital nerve  $\rightarrow$  causes loss of sensation:

Skin of the cheek
 Gum on the same side
 May cause entrapment of the inferior rectus muscle → leads to limited upward gaze.

» Strabismus

> Concomitant Strabismus

Many cases are nonparalytic.

 Caused by imbalance in the action of opposing muscles.

Known as concomitant strabismus.

· Common in infancy.