18 The Eye and the Ear

Chapter Outline

THE EYE

Eyelids

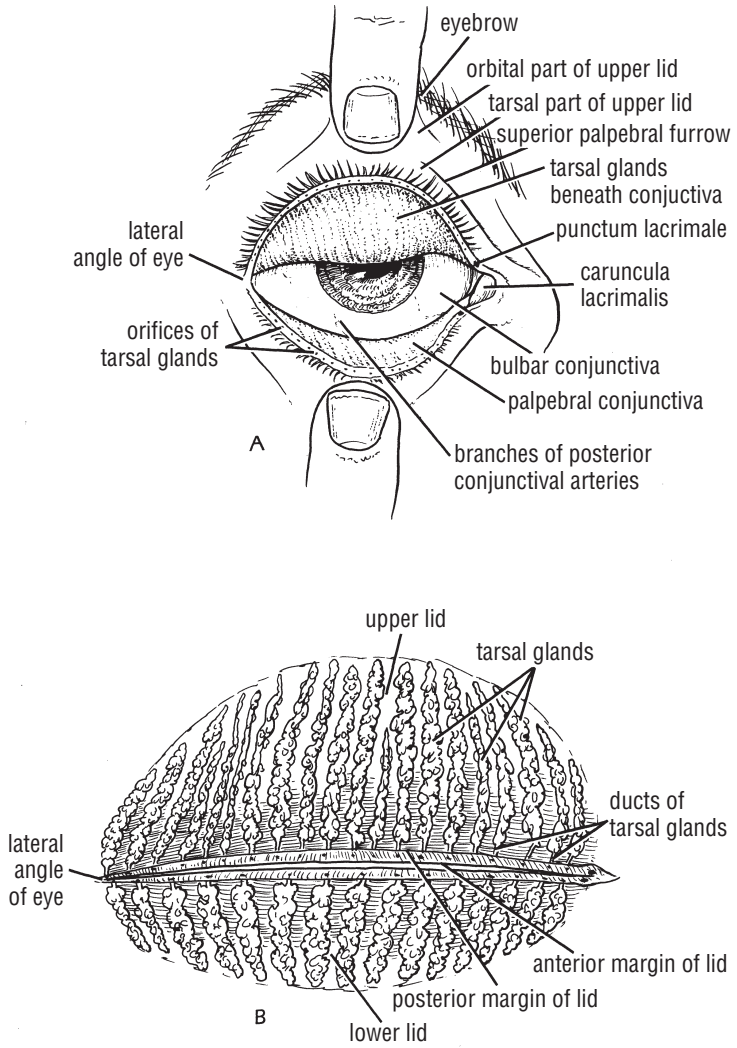
Clinical Examination of the Eyelids

Retraction of the eyelids: Both the upper and lower lids can be retracted by applying the thumbs to the patient's forehead and the cheek just above and below the orbital margins. The lids are then gently retracted away from the eyeball, and the lower lid may be easily everted (CD Fig. 18-1).

Eversion of the upper lid: Eversion of the upper lid is more difficult than that of the lower lid because of its size and muscular attachments. It is performed for purposes of inspection of the eye and removing a superficial conjunctival foreign body. With the patient looking downward, the upper lid is grasped by the central eyelashes and pulled downward while a cotton-tipped applicator is applied centrally to the skin on the upper surface of the upper lid. With the superior tarsal plate serving to stiffen the upper lid, the upper lid is gently flipped upward over the applicator tip so that the conjunctival surface is fully exposed (see CD Fig. 18-1).

Hordeolum (Stye)

An external hordeolum is an acute infection of a lash follicle or a sebaceous gland (of Zeis) or a ciliary sweat gland (of Moll); all drain externally to the skin surface of the lid.



CD Figure 18-1 **A.** Complete eversion of the upper eyelid of the right eye made possible by stiffness of the superior tarsal plate; the lower eyelid is pulled downward. Note the orifices of the tarsal glands and the puncta lacrimalia. **B.** Posterior view of the eyelids with the upper and lower lids nearly closed. Note the tarsal glands with their short ducts and orifices. In this diagram the conjunctiva has been removed from the back of the eyelids to reveal the tarsal glands in situ.

An internal hordeolum is an acute infection of a tarsal gland (of Meibom). The tarsal glands drain onto the conjunctival surface of the lid.

Chalazion

This is a localized, painless swelling of the lid resulting from chronic inflammation of a tarsal gland. Since the gland lies on the conjunctival surface of the tarsal plate, the swelling should be incised through the conjunctival surface of the lid.

Edema of the Eyelids

The looseness of the subcutaneous tissue of the eyelids explains why edema fluid secondary to renal failure or insect bites can rapidly accumulate, causing extensive swelling of the lids.

Subtarsal Sulcus and Foreign Bodies

Foreign bodies in the conjunctival sac produce severe pain and reflex tearing. The superior and inferior fornices can be examined for the foreign bodies by everting the eyelids as described previously. Small particles often migrate and become lodged in the subtarsal sulcus (see text Fig. 18-1). Corneal abrasions may occur as the result of the foreign body being carried across the cornea with the movement of the eyelids.

Ptosis (Drooping of the Upper Lid)

In Horner's syndrome, ptosis is caused by loss of sympathetic innervation of the smooth muscle component of the levator palpebrae superioris muscle. In third cranial nerve dysfunction, ptosis is due to paralysis of the striated muscle of the levator palpebrae superioris.

Lacrimal Apparatus

Inflammation of the Lacrimal Sac

This presents as a tender swelling above the upper margin of the medial palpebral ligament. Gentle pressure on the sac may result in a yellowish discharge emerging from the puncta lacrimalia.

Probing the Nasolacrimal Duct

Congenital or acquired blockage of the duct may occur. To relieve the blockage, a probe is passed downward starting at the punctum lacrimalia of the upper eyelid. The probe is first directed vertically upward and then medially into the lacrimal sac. It is then turned downward at right angles in the nasolacrimal duct to reach the inferior meatus in the nose. The end of the probe should then be visible within the nose. Remember that the nasolacrimal duct inclines downward, backward, and laterally as it descends to the nose.

Eye Trauma

Although the eyeball is well protected by the surrounding bony orbit, it is protected anteriorly only from large objects, such as tennis balls, which tend to strike the orbital margin but not the globe. The bony orbit provides no protection from small objects, such as golf balls, which can cause severe damage to the eye. Careful examination of the eyeball relative to the orbital margins shows that it is least protected from the lateral side.

Blowout Fractures of the Maxilla

Blowout fractures of the orbital floor involving the maxillary sinus commonly occur as a result of blunt force to the face. If the force is applied to the eye, the orbital fat explodes inferiorly into the maxillary sinus, fracturing the orbital floor. Not only can blowout fractures cause displacement of the eyeball, with resulting symptoms of double vision (diplopia), but also the fracture can injure the infraorbital nerve, producing loss of sensation of the skin of the cheek and the gum on that side. Entrapment of the inferior rectus muscle in the fracture may limit upward gaze.

Movements of the Eye

Clinical Testing for the Actions of the Superior and Inferior Recti and the Superior and Inferior Oblique Muscles

Since the actions of the superior and inferior recti and the superior and inferior oblique muscles are complicated when a patient is asked to look vertically upward or vertically downward, the examiner tests the eye movements in which the single action of each muscle predominates.

The origins of the superior and inferior recti are situated about 23° medial to their insertion and, therefore, when the patient is asked to turn the cornea laterally, these muscle are placed in the optimum position to raise the cornea (superior rectus) or lower it (inferior rectus). To test the superior rectus, have the patient look up and laterally; to test the inferior rectus, have the patient look down and out.

Using the same rationale, the examiner tests the superior and the inferior oblique muscles. The pulley of the superior oblique and the origin of the inferior oblique muscles lie medial and anterior to their insertions. The ophthalmologist tests the action of these muscles by asking the patient first to look medially, thus placing these muscles in the optimum position to lower the cornea (superior oblique) or to raise it (inferior oblique). In other words, when you ask a patient to look medially and downward at the tip of his nose, you are testing the superior oblique at its best position. Conversely, by asking the patient to look medially and upward, you are testing the inferior oblique at its best position.

Because the lateral and medial recti are neutrally placed relative to the axes of the eyeball, asking the patient to turn his or her cornea directly laterally tests the lateral rectus, and turning the cornea directly medially tests the medial rectus.

The cardinal positions of the eye and the actions of the recti and oblique muscles are shown in CD Fig. 18-2.

Lesions of the Cranial Nerves that Control the Eye Movements

Lesions of the oculomotor, trochlear, and abducent nerves are described on CD page 227.

Strabismus

Many cases of strabismus are nonparalytic and are caused by an imbalance in the action of opposing muscles. This type of strabismus is known as **concomitant strabismus** and is common in infancy.

Eye Structure

Sclera

The Lamina Cribrosa, the Cerebrospinal Fluid, and the Aqueous Humor Pressure

The lamina cribrosa is the area of the sclera that is pierced by the nerve fibers of the optic nerve. It is a relatively weak area and can be made to bulge into the eyeball by a rise of cerebrospinal fluid pressure in the tubular extension of the subarachnoid space, which surrounds the optic nerve.

If the intraocular pressure rises, due to blockage in the drainage of aqueous humor, as in glaucoma, the lamina cribrosa will bulge outward, producing a cupped disc, as seen through the ophthalmoscope.

Cornea

Aging Changes in the Cornea

With advancing years, the cornea becomes less translucent, and dust-like opacities may occur in the deeper parts of the substantia propria. **Arcus senilis** appears as white arcs near the edge of the cornea and is caused by an extracellular infiltration of lipid; it is present in almost every person over 60 years old.

CD Figure 18-2 The cardinal positions of the right and left eyes and the actions of the recti and oblique muscles *principally* responsible for the movements of the eyes. **A.** Right eye, superior rectus muscle; left eye, inferior oblique muscle. **B.** Both eyes, superior recti and inferior oblique muscles. **C.** Right eye, inferior oblique muscle; left eye, superior rectus muscle. **D.** Right eye, lateral rectus muscle; left eye, medial rectus muscle. **E.** Primary position, with the eyes fixed on a distant fixation point. **F.** Right eye, medial rectus muscle; left eye, lateral rectus muscle. **G.** Right eye, inferior rectus muscle; left eye, superior oblique muscle. **H.** Both eyes, inferior recti and superior oblique muscles. **I.** Right eye, superior oblique muscle; left eye, inferior rectus muscle.

Astigmatism

Often the cornea is not the section of a perfect sphere so that the refractive power is not the same in all directions, a condition known as astigmatism.

Trauma and the Cornea

Because a portion of the cornea is exposed between the eyelids, injuries from foreign bodies or abrasions are very common. Damage to the corneal epithelium causes considerable pain, reflex tearing, and vasodilatation of the conjunctival capillaries. Later, edema of the lids will be apparent. Fortunately, the stratified squamous epithelium covering the anterior surface of the cornea is capable of rapid regeneration after an abrasion.

Foreign bodies driven with great force may penetrate the cornea and enter the anterior chamber or even the deepest parts of the eyeball.

Corneal Ulcers

Corneal ulcers are caused by a bacterial invasion of the cornea with the formation of a stromal abscess. The ability of the cornea to resist bacterial invasion depends on the cleansing action of the tears and their normal circulation and the

integrity of the corneal epithelium. A breakdown of this mechanism can occur as the result of mild trauma, such as that which occurs when soft corneal lenses are worn for an excessive period of time, or in the presence of chronic disease.

Pupil

Flashlight Examination of the Pupil

Normally, the pupils should be of equal or nearly equal diameter (within 1 to 2 mm in diameter is normal). They should be round and react to light and accommodation.

Pupillary Reflexes

The pupillary reflexes—that is, the reaction of the pupils to light and accommodation—depend on the integrity of nervous pathways. In the **direct light reflex,** the normal pupil reflexly contracts when a light is shone into the patient's eye. The nervous impulses pass from the retina along the optic nerve to the optic chiasma and then along the optic tract. Before reaching the lateral geniculate body, the fibers concerned with this reflex leave the tract and pass to the oculomotor nuclei on both sides via the pretectal nuclei. From the parasympathetic part of the nucleus, efferent fibers leave the midbrain in the oculomotor nerve and reach the ciliary ganglion via the nerve to the inferior oblique. Postganglionic fibers pass to the constrictor pupillae muscles via the short ciliary nerves.

The **consensual light reflex** is tested by shining the light in one eye and noting the contraction of the pupil in the opposite eye. This reflex is possible because the afferent pathway just described travels to the parasympathetic nuclei of both oculomotor nerves.

The **accommodation reflex** is the contraction of the pupil that occurs when a person suddenly focuses on a near object after having focused on a distant object. The nervous impulses pass from the retina via the optic nerve, the optic chiasma, the optic tract, the lateral geniculate body, the optic radiation, and the cerebral cortex of the occipital lobe of the brain. The visual cortex is connected to the eye field of the frontal cortex. From here, efferent pathways pass to the parasympathetic nucleus of the oculomotor nerve. From there, the efferent impulses reach the constrictor pupillae via the oculomotor nerve, the ciliary ganglion, and the short ciliary nerves.

Retina

Detachment of the Retina

The neural retina is firmly attached to the underlying pigment epithelium at the optic disc and the ora serrata.

Pathologic separation of the two layers of the retina may follow trauma to the eyeball or degeneration of the neural retina. Vitreous traction of the retina, or the presence of a hole or tear, allows accumulation of fluid between the pigment epithelium and the neural retina, causing the layers to separate or become detached.

Central Retinal Artery Occlusion

At the point where the central artery pierces the lamina cribrosa (CD Fig. 18-3), it is subject to atherosclerosis and can undergo complete or partial occlusion. Disease changes in the arteriolar wall can be seen with the ophthalmoscope where the arteries cross the veins as a nicking or narrowing of the venous blood column.

In complete central artery occlusion there is a sudden onset of unilateral blindness. In branch arteriole occlusion there is a partial loss of sight corresponding to the sector supplied by the arteriole. Total arterial occlusion lasting longer than 1½ hours can produce irreversible retinal degeneration.

Papilledema, the Central Vein, and Increased Cerebrospinal Fluid Pressure

Since the optic nerve is surrounded by the dura and arachnoid sheaths, an increase in the intracranial pressure is transmitted through the cerebrospinal fluid along the extension of the subarachnoid space to the lamina cribrosa of the eyeball. Because the central artery and vein of the retina cross the subarachnoid space to enter or leave the optic nerve, they will be subject to a rise in cerebrospinal fluid pressure. The thick-walled artery is unaffected, but the thin-walled vein may be compressed, causing congestion of the retinal veins and edema of the retina; bulging of the disc may also occur.

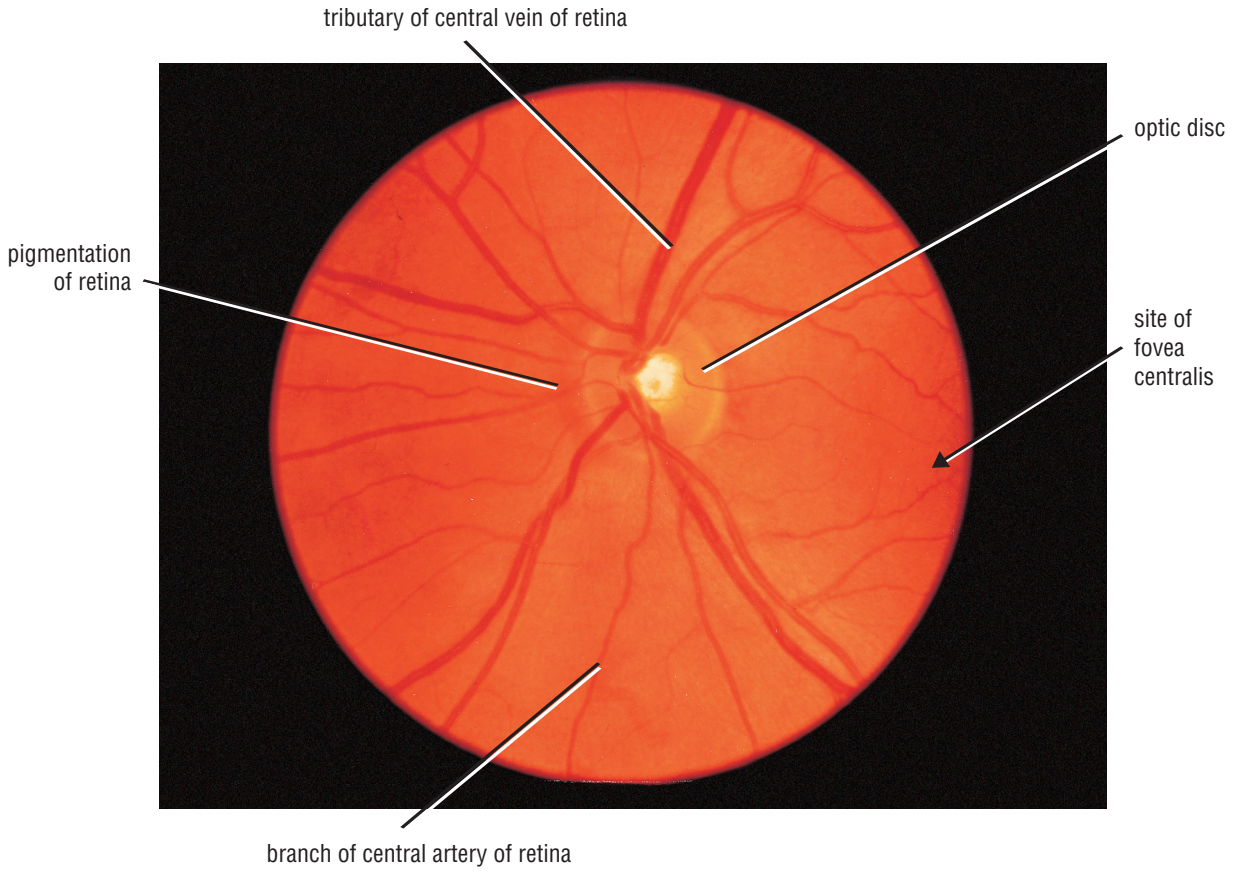
Lens

Cataract

In this condition the lens becomes opaque. Metabolic products accumulate within the lens fibers. Senile cataract is the most common form; its cause is unknown.

Examination of the Eye as Seen with the Direct Ophthalmoscope

Red reflex: On looking through the ophthalmoscope, holding it about 1 ft away from the patient, the examiner notes that the fundus appears red (see CD Fig. 18-3). The fundus shows red because the light is being reflected back from the blood in the choroidal blood vessels, with the intervening retina being transparent. An **absent red reflex** means that either there is an opacity in the refractive media or the retina is not against the choroid. The possible opacities include a cataract, a vitreous hemorrhage, and a detached retina.



CD Figure 18-3 The left ocular fundus as seen with an ophthalmoscope.

Fundus examination: Without pupillary dilatation, only about 15% of the fundus can be seen. With full pupillary dilatation, about 50% of the fundus can be viewed, but the area between the equator of the eyeball and the ora serrata cannot be seen.

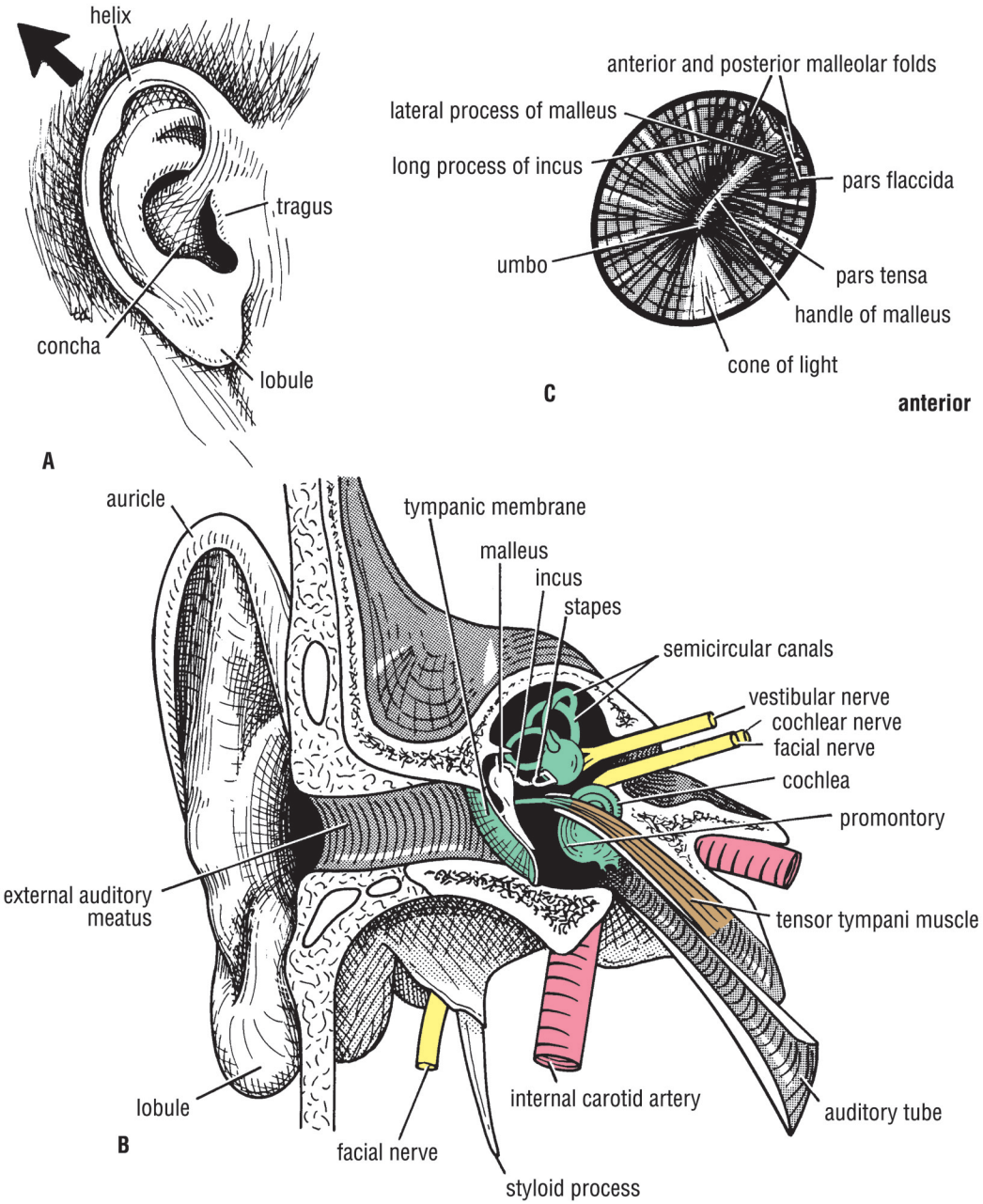
Optic disc: This structure is circular or oval with a vertical orientation (see CD Fig. 18-3). It is pink, with the temporal side slightly lighter than the nasal side. The disc measures about 1.5 mm in diameter and can be used as a unit of measurement. The center of the disc has a pale, almost white, depression called the **physiologic cup**. The edge of the disc is usually flat and sharply defined. In some individuals in whom the retina does not quite reach the margin of the disc, an arc of choroid pigment may be visible.

The bright red central artery of the retina becomes visible on the disc surface emerging from the optic cup, where it divides into its superior and inferior branches. The arteries do not normally pulsate. The darker red main tributaries of the central vein of the retina pass into the cup and unite in the cup or deeper out of site within the optic nerve.

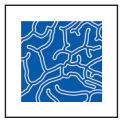
In glaucoma, the increase in intraocular pressure leads to atrophy of the optic nerve and defects in the visual field. Since the lamina cribrosa of the sclera at the optic disc is a weak area, a rise in intraocular pressure can cause it to bulge outward, producing a cupped disc that can be seen with the ophthalmoscope.

Retinal arteries and veins: The arteries are bright red; the veins are darker red (see CD Fig. 18-3). The arteries are smaller than the veins (about a 3:4 ratio). The arteries have thicker walls, which reflect the light as a shiny central reflex stripe. The walls of the arteries and the veins are transparent, so that the examiner observes a moving column of blood. The arteries usually cross the veins on their superficial or vitreal surface, and normally the arteries do not compress or nick the veins at the site of crossing. The branching of the vessels is variable.

Macula: The macula area lies about two disc diameters on the lateral side of the optic disc (see CD Fig. 18-3). It is darker than the surrounding retina. The superior and inferior temporal blood vessels arch above and below the macular area, and no blood vessels are visible in the center of the macula. The center of the macula shows a small, dark red area called the **fovea centralis.** A small white-yellow light reflex can be detected at the center of the fovea, caused by the reflection of the ophthalmoscope light from the concavity of the fovea.



CD Figure 18-4 **A.** Different parts of the auricle of the external ear. The *arrow* indicates the direction that the auricle should be pulled to straighten the external auditory meatus before insertion of the otoscope in the adult. **B.** External and middle portions of the right ear viewed from in front. **C.** The right tympanic membrane as seen through the otoscope.



THE EAR

External Ear

Tympanic Membrane Examination

Otoscopic examination of the tympanic membrane is facilitated by first straightening the external auditory meatus by gently pulling the auricle upward and backward in the adult (CD Fig. 18-4), and straight backward or backward and downward in the infant. Normally, the tympanic membrane is pearly gray and concave. Remember that in the adult the external meatus is about 1 in. (2.5 cm) long and is narrowest about 0.2 in. (5 mm) from the tympanic membrane.

Middle Ear

Infections and Otitis Media

Pathogenic organisms can gain entrance to the middle ear by ascending through the auditory tube from the nasal part of the pharynx. Acute infection of the middle ear (otitis media) produces bulging and redness of the tympanic membrane.

Complications of Otitis Media

Inadequate treatment of otitis media can result in the spread of the infection into the mastoid antrum and the mastoid air cells (acute mastoiditis). Acute mastoiditis may be followed by the further spread of the organisms beyond the confines of the middle ear. The meninges and the temporal lobe of the brain lie superiorly. A spread of the infection in this direction could produce a meningitis and a cerebral abscess in the temporal lobe. Beyond the medial wall of the middle ear lie the facial nerve and the internal ear. A spread of the infection in this direction can cause a facial nerve palsy and labyrinthitis with vertigo. The posterior wall of the mastoid antrum is related to the sigmoid venous sinus. If the infection spreads in this direction, a thrombosis in the sigmoid sinus may well take place. These various complications emphasize the importance of knowing the anatomy of this region.

Clinical Problem Solving Questions

Read the following case histories/questions and give the best answer for each.

A 49-year-old woman was found on ophthalmoscopic examination to have edema of both optic discs (bilateral papilledema) and congestion of both retinal veins. The cause of the condition was found to be a rapidly expanding intracranial tumor.

1. The following statements concerning this patient are correct **except** which?
   A. An intracranial tumor causes a rise in cerebrospinal fluid pressure.
   B. The optic nerves are surrounded by sheaths derived from the pia mater, arachnoid mater, and dura mater.
   C. The intracranial subarachnoid space extends forward around the optic nerve for about half its length.
   D. The thin walls of the retinal vein will be compressed as the vein crosses the extension of the subarachnoid space around the optic nerve.
   E. Because both subarachnoid extensions are continuous with the intracranial subarachnoid space, both eyes will exhibit papilledema and congestion of the retinal veins.

A 33-year-old woman was riding her bicycle when she swerved to avoid a pothole and lost her balance. She then crashed and hit her head hard on the sidewalk. When she regained consciousness in the hospital, it was immediately noted that she had medial strabismus (squint) of her left eye.

2. Which eye muscle was paralyzed in this injury?
   A. The medial rectus muscle
   B. The inferior rectus muscle
   C. The superior rectus muscle
   D. The lateral rectus muscle
   E. The superior obliques muscle

3. An 18-year-old student went to the clinic complaining of an acute tender area on the middle of his right upper eyelid. Examination revealed a localized red, indurated area on the eyelid margin. Close inspection showed a yellowish spot in the center of the swelling. Gentle eversion of the lid showed no evidence of swelling on its posterior surface. What is the diagnosis? Which anatomic structure(s) is (are) involved in the inflammatory process? On which part of the eyelid does the abscess tend to point?

4. A 13-year-old schoolboy was hit in the left eye by another boy during recess. During the next hour, both the eyelids of the victim swelled up until he could barely see. Examination in the emergency department revealed a bluish-red discoloration of both eyelids of his left eye with narrowing of the palpebral fissure. The discoloration extended to the forehead and the left cheek. Careful separation of the eyelids showed a localized hemorrhage of the inferolateral part of the bulbar conjunctiva (part of the conjunctiva adherent to the sclera of the eyeball). When the conjunctiva was gently moved with the tip of the examiner's little finger, the hemorrhage moved also.

   When the patient was asked to look medially, the physician could clearly see the posterior limit of the conjunctival hemorrhage. Does this patient have a simple "black eye," or is this a fracture of the anterior cranial fossa of the skull? What role does the orbital septum play in enabling one to distinguish between these lesions? Is the appearance of the conjunctival hemorrhage important in making the diagnosis?

5. A 6-month-old girl was seen in the emergency department because her mother had noticed a yellow, sticky discharge from the baby's left eye. On questioning, the mother said that she had first noticed the condition that morning when her daughter woke up. She also said that she had noticed that her daughter's left eye watered excessively when she cried ever since birth. The physician confirmed the epiphora of the left eye and noted the emergence of yellow pus into the lacus lacrimalis from the puncta when gentle pressure was exerted over the medial palpebral ligament. What is the diagnosis? What is the most likely cause in a child of this age? What are the posterior relations of the medial palpebral ligament? Describe the anatomy of the drainage passages of the conjunctival sac and give the direction of each of the tubes.

A 7-year-old boy with right-sided otitis media was treated with antibiotics. The organisms did not respond to the treatment, and the infection spread to the mastoid antrum and the mastoid air cells. The surgeon decided to perform a radical mastoid operation. After the operation, it was noticed that the boy's face was distorted.

6. The following signs and symptoms suggest that the right facial nerve had been damaged during the operation **except** which?
   A. The mouth was drawn upward to the right.
   B. He was unable to close his right eye.
   C. Saliva tended to accumulate in his right cheek.
   D. The saliva tended to dribble from the corner of his mouth.
   E. All the muscles of the right side of his face were paralyzed.

7. A 3-year-old boy was playing with his friend when they decided to see how many peas they could stick into each others ears. Later, the babysitter noticed that one of the boys had become completely deaf in his left ear. On examination in the emergency department of the local hospital, the physician's assistant noticed what appeared to be several peas deeply embedded in the left external auditory meatus. She decided to attempt the removal of the peas through an otoscope. Which direction should the auricle be pulled in a child to straighten the meatus and assist in the operation? How does this change in the adult?

8. Following a severe cold, a 10-year-old girl complained of severe right-sided earache. On examination by her pediatrician, the tympanic membrane looked reddened and bulged laterally. A diagnosis of otitis media was made. A yellowish area was apparent close to the umbo and it appeared that perforation of the tympanic membrane was about to take place. It was decided to do a myringotomy (incise the tympanic membrane). Where would you do a myringotomy? What structures do you have to avoid in this operation? What are the features normally seen on the tympanic membrane with an otoscope?

9. A 13-year-old boy was struck on his right ear by another boy's fist during a fight. By the time the boy was examined, the ear was extremely swollen and bluish and very painful. Explain in anatomic terms where the blood and edema fluid collect in such a case. Can the ear be treated conservatively or should the hematoma be drained? What is a cauliflower ear?

10. A 45-year-old woman with a severe cold had to make a business trip by plane. On takeoff she noticed that her hearing became impaired and she experienced acute pain in her right ear. She told the stewardess about her problem and asked for an aspirin. The stewardess advised the patient to relax and swallow hard several times. On reaching the cruising altitude the right ear suddenly popped and the deafness and pain disappeared. In anatomic terms explain this patient's condition.

Answers and Explanations

1. **C** is the correct answer. The intracranial subarachnoid space extends forward through the optic canal around the optic nerve as far as the back of the eyeball (see text Fig. 18-9).

2. **D** is the correct answer. The left abducent nerve was damaged by the head trauma and resulted in paralysis of the left lateral rectus muscle. As a consequence, the medial rectus muscle was unapposed and turned the eye medially (medial strabismus).

3. The student had a hordeolum or stye in his right eye. The usual cause is a staphylococcal infection of the eyelash follicle, the sebaceous gland of Zeis, or the ciliary gland of Moll. The suppurative infection tends to point on the anterior part of the lid margin. Repeated multiple styes tend to occur as the result of spread of infection along the eyelid margin.

4. This schoolboy has a severe "black eye." In this patient the contusion involved not only the eyelids but the skin of the cheek and forehead. In anterior cranial fossa fractures, the hemorrhage occurs into the orbital cavity and is limited anteriorly by the attachment of the orbital septum to the orbital margin. In such cases the discoloration tends to be circular. In fractures of the anterior cranial fossa, because the bleeding is deeply placed, it tends to be purplish from the start, whereas with a black eye the color is initially red.

5. This girl was suffering from chronic dacryocystitis secondary to congenital obstruction of the nasolacrimal duct. The obstruction results from failure of the nasolacrimal duct to open up and drain into the inferior meatus of the nose. The posterior relation of the medial palpebral ligament is the lacrimal sac. The drainage passages start at the puncta on the tip of the lacrimal papilla. The canaliculi first pass vertically in the eyelids for about 2 mm and then turn sharply at right angles and run medially for about 8 mm to enter the lacrimal sac. The lower end of the lacrimal sac is connected to the inferior meatus of the nose by the nasolacrimal duct, which is about 15 mm long. The duct passes downward, backward, and laterally.

6. **A** is the correct answer. The facial muscles on the left side of the mouth on contraction pull the mouth upward and to the left because the muscles on the right side were paralyzed.

7. In a young child, the external auditory meatus may be straightened by pulling the auricle directly backward. In an adult, the meatus is straightened by pulling the auricle backward and upward (see CD Fig. 18-4).

8. A myringotomy is performed through the lower quadrants of the tympanic membrane to avoid damaging the chorda tympani nerve that crosses the tympanic membrane on the medial side of the upper quadrants (see text Fig. 18-15A).The features seen on a normal tympanic membrane with an otoscope with a good light include (1) the long process of the malleus with the umbo; (2) the anterior and posterior malleolar folds with the pars flaccida; (3) the cone of light produced by light reflection on the concave tympanic membrane; (4) the tympanic membrane is pearl colored with no evidence of dilated blood vessels; (5) sometimes when the tympanic membrane is translucent, as in a young child, the long process of the incus and the promontory on the medial wall of the middle ear can be seen (see CD Fig. 18-4).

9. In auricular hematomas the blood tends to accumulate between the perichondrium and the underlying cartilage. The edema fluid has little room to spread since the skin is tightly bound down to the perichondrium; moreover, the pressure of the fluid causes extreme pain. Failure to aspirate the hematoma may lead to necrosis of the cartilage, since it has been deprived of its blood supply due to separation of the perichondrium from the cartilage. If cartilaginous necrosis takes place, fibrous replacement occurs followed by contraction and deformity, the so-called cauliflower ear.

10. Inflammation of the mucous membrane of the pharynx tends to spread upward to the middle ear via the auditory tube. The swelling of the mucous membrane lining the stiff wall of the tube results in blockage of the passageway. Very quickly, the trapped air in the middle ear becomes absorbed into the bloodstream, creating a vacuum. As a result, the tympanic membrane is pulled inward and causes deafness and acute pain. In a plane that is taking off and climbing quickly, the cabin pressures are subject to changes and this augments the pressure differences on the two sides of the tympanic membrane. Repeated swallowing causes the contraction of the salpingopharyngeus muscle and often allows sufficient air into the tympanic cavity through the auditory tube, thus relieving the problem.