

Special Senses

CHAPTER

15

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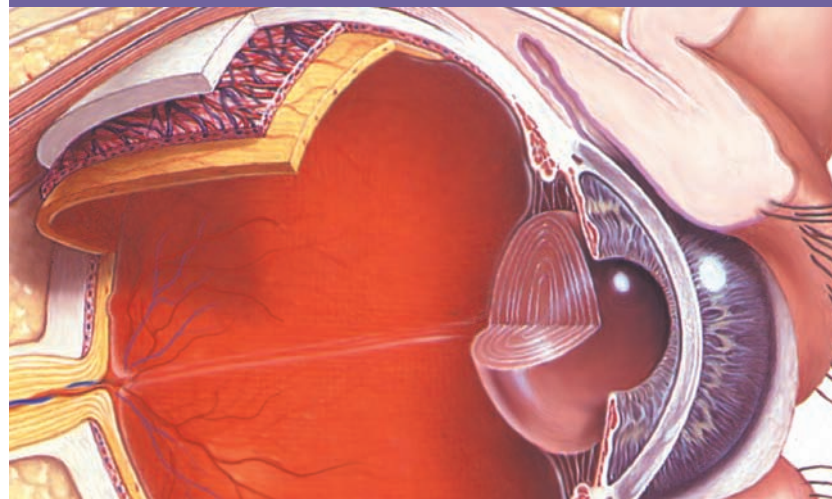
Operative report: Retained foreign bodies

Operative report: Phacoemulsification and lens implant

Objectives

Upon completion of this chapter, you will be able to:

- Locate and describe the main structures of the eye and ear.
- Recognize, pronounce, spell, and build words related to the special senses.
- Describe pathological conditions, diagnostic and therapeutic procedures, and other terms related to the special senses.
- Explain pharmacology related to the treatment of eye and ear disorders.
- Demonstrate your knowledge of this chapter by completing the learning and medical record activities.



Anatomy and Physiology

General sensations perceived by the body include touch, pressure, pain, and temperature. These sensations are not identified with any specific site of the body. Specific sensations include smell (**olfaction**), taste (**gustation**), vision, hearing (**audition**), and equilibrium. Each specific sensation is connected to a specific organ or structure in the body. (For a discussion of olfaction, see Chapter 7, Respiratory System; for a discussion of gustation,

see Chapter 6, Digestive System.) This chapter presents information on the sense of vision provided by the eye and senses of hearing and equilibrium provided by the ear.

Eye

The eye is a globe-shaped organ composed of three distinct **tunics**, or layers: the fibrous tunic, the vascular tunic, and the sensory tunic. (See Figure 15–1.)

Anatomy and Physiology Key Terms

This section introduces important terms associated with the special senses and their definitions. Word analyses for selected terms are also provided.

| Term | Definition |
|---|--|
| accommodation ă-kŏm-ō-DĀ-shŭn | Adjustment of the eye for various distances so that images fall on the retina of the eye |
| acuity ă-KŪ-ĭ-tē | Clearness or sharpness of a sensory function |
| adnexa ăd-NĚK-să | Tissues or structures in the body adjacent to or near a related structure <i>The adnexa of the eye include the extraocular muscles, orbits, eyelids, conjunctiva, and lacrimal apparatus.</i> |
| articulating ăr-TĪK-ŭ-lăt-ing | Being loosely joined or connected together to allow motion between the parts |
| humor | Any fluid or semifluid of the body |
| labyrinth LĀB-ĭ-rĭnth | Series of intricate communicating passages <i>The labyrinth of the ear includes the cochlea, semicircular canals, and vestibule.</i> |
| opaque ō-PĀK | Substance that does not allow the passage of light; not transparent |
| perilymph PĚR-ĭ-lĭmf | Fluid that very closely resembles spinal fluid but found in the cochlea |
| photopigment fŏ-tŏ-PĪG-mĕnt | Light-sensitive pigment in the retinal cones and rods that absorbs light and initiates the visual process; also called <i>visual pigment</i> |
| refractive rĭ-FRĀK-tĭv | Ability to bend light rays as they pass from one medium to another |
| tunic TŪ-nĭk | Layer or coat of tissue; also called <i>membrane layer</i> <i>The fibrous, vascular, and sensory tunics are the three tunics of the eyeball.</i> |
| Pronunciation Help | Long Sound Short Sound ā—rate ă—alone ē—rebirth ě—ever ĩ—isle ĩ—it ō—over ō—not ŭ—unite ŭ—cut |

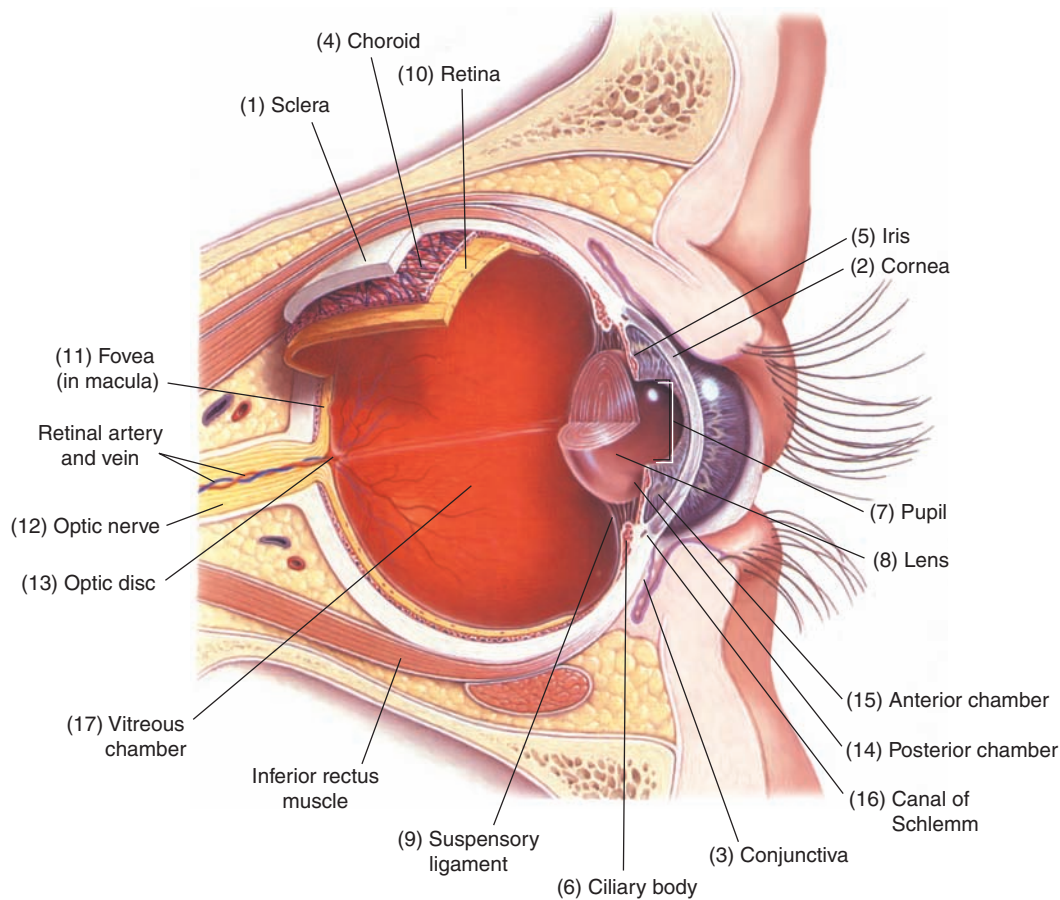


Figure 15-1. Eye structures.

Fibrous Tunic

The outermost layer of the eyeball, the **fibrous tunic**, serves as a protective coat for the more sensitive structures beneath. It includes the (1) **sclera** and the (2) **cornea**. The sclera, or “white of the eye,” provides strength, shape, and structure to the eye. As the sclera passes in front of the eye, it bulges forward to become the cornea. Rather than being **opaque**, the cornea is transparent, allowing light to enter the interior of the eye. The cornea is one of the few body structures that does not contain capillaries and must rely on eye fluids for nourishment. A thin membrane, the (3) **conjunctiva**, covers the outer surface of the eye and lines the eyelids.

Vascular Tunic

The middle layer of the eyeball, the **vascular tunic**, is also known as the *uvea*. The **uvea** consists of the choroid, iris, and ciliary body. The (4) **choroid** provides the blood supply for the entire eye. It contains pigmented cells that prevent extraneous light from entering the inside of the eye. An opening in the

choroid allows the optic nerve to enter the inside of the eyeball. The anterior portion of the choroid contains two modified structures, the (5) **iris** and the (6) **ciliary body**. The iris is a colored, contractile membrane whose perforated center is called the (7) **pupil**. The iris regulates the amount of light passing through the pupil to the interior of the eye. As environmental light increases, the pupil constricts; as light decreases, the pupil dilates. The ciliary body is a circular muscle that produces aqueous **humor**. The ciliary body is attached to a capsular bag that holds the (8) **lens** between the (9) **suspensory ligaments**. As the ciliary muscle contracts and relaxes, it alters the shape of the lens making it thicker or thinner. These changes in shape allow the eye to focus on an image, a process called **accommodation**.

Sensory Tunic

The innermost **sensory tunic** is the delicate, double-layered (10) **retina**. It consists of a thin, outer **pigmented layer** lying over the choroid and a thick, inner **nervous layer**, or visual portion. The

retina is responsible for the reception and transmission of visual impulses to the brain. It has two types of visual receptors: rods and cones. **Rods** function in dim light and produce black-and-white vision. **Cones** function in bright light and produce color vision. In the central portion of the retina is a highly sensitive structure called the **macula**. In the center of the macula is the (11) **fovea**. When the eye focuses on an object, light rays from that object are directed to the fovea. Because the fovea is composed of only cones that lie very close to each other, it provides the greatest **acuity** for color vision.

Other Structures

Rods and cones contain a chemical called **photopigment**, or **visual pigment**. As light strikes the photopigment, a chemical change occurs that stimulates rods and cones. The chemical changes produce impulses that are transmitted through the (12) **optic nerve** to the brain, where they are interpreted as vision. The optic nerve and blood vessels of the eye enter at the (13) **optic disc**. Its center is referred to as the **blind spot** because the area has neither rods nor cones for vision.

One of two major fluids (**humors**) of the eye is **aqueous humor**. It is found in the (14) **posterior chamber** and (15) **anterior chamber** of the anterior segment and provides nourishment for the lens and the cornea. Aqueous humor is continually produced by the ciliary body and is drained from the eye through a small opening called the (16) **canal of Schlemm**. If aqueous humor fails to drain from the eye at the rate at which it is produced, a condition called **glaucoma** results. The second major humor of the eye is **vitreous humor**, a jellylike substance that fills the interior of eye, the (17) **vitreous chamber**.

The vitreous humor, lens, and aqueous humor are the **refractive** structures of the eye, focusing light rays sharply on the retina. If any one of these structures does not function properly, vision is impaired.

The **adnexa** of the eye include all supporting structures of the eye globe. Six extraocular muscles control the movement of the eye: the superior, inferior, lateral, and medial rectus muscles and the superior and inferior oblique muscles. These muscles coordinate the eyes so that they move in a synchronized manner.

Two movable folds of skin constitute the eyelids, each with eyelashes that protect the front of the eye. (See Figure 15–2.) The (1) **conjunctiva** lines the inner surface of the eyelids and the cornea. Lying superior and to the outer edge of each eye are the (2) **lacrimal glands**, which produce tears that bathe and lubricate the eyes. The tears collect at the inner edges of the eyes, the **canthi** (singular, *canthus*), and pass through pinpoint openings, the (3) **lacrimal canals**, to the mucous membranes that line the inside of the (4) **nasal cavity**.

Ear

The ear is the sense receptor organ for hearing and equilibrium. Hearing is a function of the cochlea; the semicircular canals and vestibule control equilibrium.

Hearing

The ear consists of three major sections: the outer ear, or **external ear**; the middle ear, or **tympanic cavity**; and the inner ear, or **labyrinth**. (See Figure 15–3.) The external ear conducts sound waves through air; the middle ear, through bone; and the

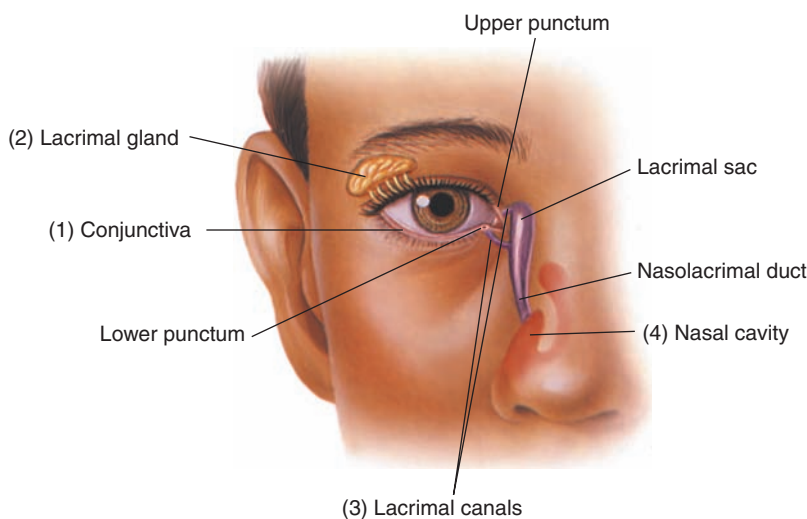


Figure 15-2. Lacrimal apparatus.

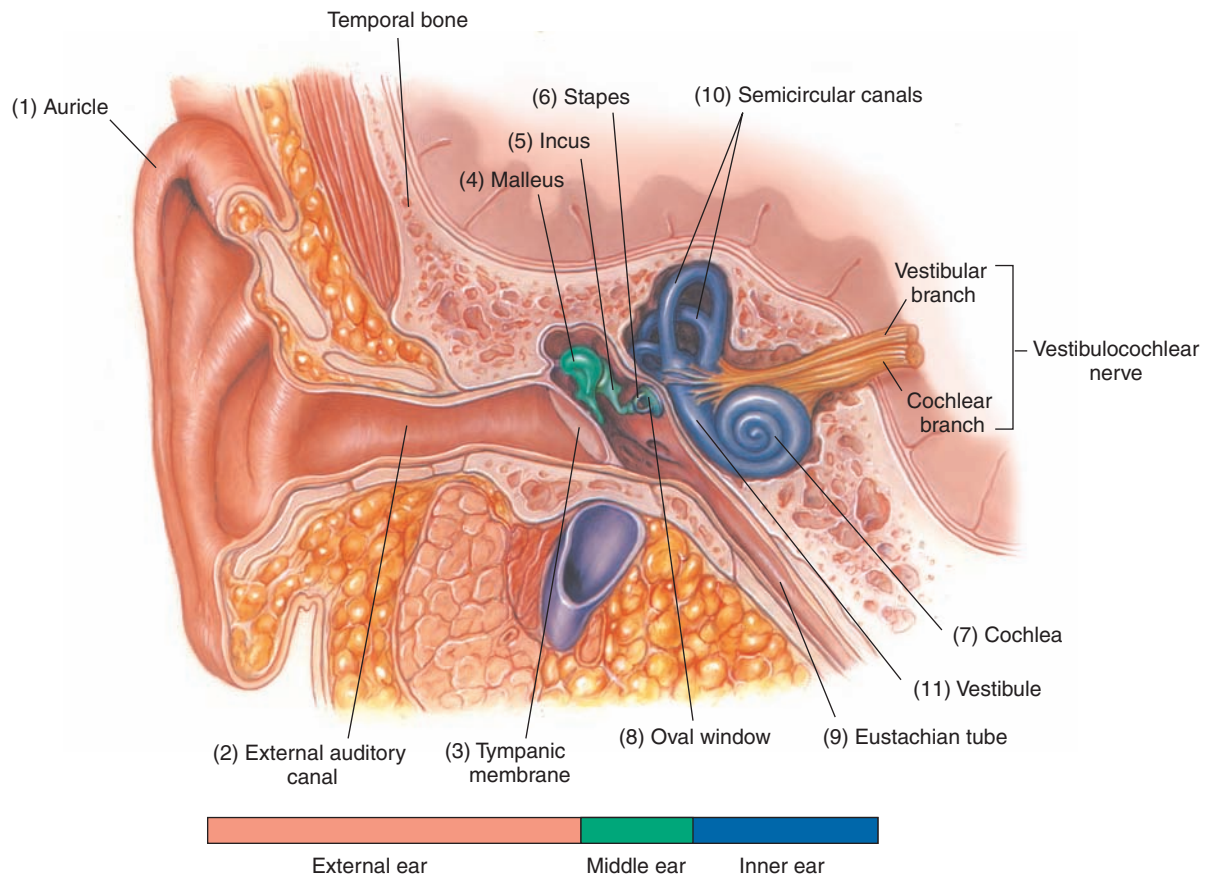


Figure 15-3. Ear structures.

inner ear, through fluid. This series of transmissions ultimately generates impulses that are sent to the brain and interpreted as sound.

An (1) **auricle** (or *pinna*) collects waves traveling through air and channels them to the (2) **external auditory canal**, also called the *ear canal*. The ear canal is a slender tube lined with glands that produce a waxy secretion called *cerumen*. Its stickiness traps tiny foreign particles and prevents them from entering the deeper areas of the canal. The (3) **tympanic membrane** (also called the *tympanum* or *eardrum*) is a flat, membranous structure drawn over the end of the ear canal. Sound waves entering the ear canal strike against the tympanic membrane, causing it to vibrate. These vibrations cause movement of the three smallest bones of the body, collectively called the *ossicles*. These tiny **articulating** bones, the (4) **malleus** (or *hammer*), the (5) **incus** (or *anvil*), and the (6) **stapes** (or *stirrups*), are located within the tympanic cavity and form a coupling between the tympanic membrane and the (7) **cochlea**, the first structure of the inner ear. The cochlea is a snail-shaped structure filled with a fluid

called *perilymph*. Its inner surfaces are lined with a highly sensitive hearing structure called the **organ of Corti**, which contains tiny nerve endings called the **hair cells**. A membrane-covered opening on the external surface of the cochlea called the (8) **oval window** provides a place for attachment of the stapes. The movement of the ossicles in the middle ear causes the stapes to exert a gentle pumping action against the oval window. The pumping action forces the perilymph to disturb the hair cells, generating impulses that are transmitted to the brain by way of the auditory nerve, where they are interpreted as sound. The (9) **eustachian tube** connects the middle ear to the pharynx. It equalizes pressure on the outer and inner surfaces of the eardrum. When sudden pressure changes occur, pressure can be equalized on either side of the tympanic membrane by a deliberate swallow.

Equilibrium

The inner ear consists of a system of fluid-filled tubes and sacs as well as nerves that connect these structures to the brain. Because of its mazelike

design, it is referred to as the *labyrinth*. The labyrinth, which rests inside the skull bones, includes not only the cochlea (the organ devoted to hearing) but also the vestibular system, which is devoted to the control of balance and eye movements. The vestibular system contains the (10) **semicircular canals** and the (11) **vestibule**. The vestibule joins the cochlea and the semicircu-

lar canals. Many complex structures located in this maze are responsible for maintaining both static and dynamic equilibrium. **Static equilibrium** refers to the orientation of the body relative to gravity. It allows an individual to maintain posture and orientation while at rest. **Dynamic equilibrium** refers to maintaining body position in response to movement.



It is time to review eye and ear anatomy by completing Learning Activities 15–1 and 15–2.

Medical Word Elements

This section introduces combining forms, suffixes, and prefixes related to the special senses. Word analyses are also provided.

| Element | Meaning | Word Analysis |
|------------------------|--|---|
| <i>Combining Forms</i> | | |
| Eye | | |
| ambly/o | dull, dim | ambly/o opia (ăm-blē-Ō-pē-ă): dimness of vision -opia: vision <i>In amblyopia, visual stimulation through the optic nerve of one eye (lazy eye) is impaired, thus resulting in poor or dim vision.</i> |
| aque/o | water | aque/o us (Ā-kwē-ŭs): pertaining to water -ous: pertaining to |
| blephar/o | eyelid | blephar/o /ptosis (blĕf-ă-rō-TŌ-sĭs): prolapse or downward displacement of the eyelid -ptosis: prolapse, downward displacement |
| choroid/o | choroid | choroid/o /pathy (kō-roy-DŎP-ă-thē): disease of the choroid -pathy: disease |
| conjunctiv/o | conjunctiva | conjunctiv /al (kŏn-jŭnk-TĪ-văl): pertaining to the conjunctiva -al: pertaining to |
| core/o | pupil | core/o /meter (kō-rē-ŎM-ĕ-tĕr): instrument for measuring the pupil -meter: instrument for measuring |
| pupill/o | | pupill/o /graphy (pŭ-pĭ-LŎG-ră-fĕ): process of recording (movement of) the pupil -graphy: process of recording |
| corne/o | cornea | corne /al (KOR-nē-ăl): pertaining to the cornea -al: pertaining to |
| cycl/o | ciliary body of eye; circular; cycle | cycl/o /plegia (sĭ-klō-PLĒ-jē-ă): paralysis of the ciliary body -plegia: paralysis |
| dacry/o | tear; lacrimal apparatus (duct, sac, or gland) | dacry/o ma (dăk-rē-Ŏ-mă): tumorlike swelling of the lacrimal duct -oma: tumor |

| Medical Word Elements—cont'd | | |
|------------------------------|-------------------------------|--|
| Element | Meaning | Word Analysis |
| lacrim/o | | lacrim/o /tomy (lāk-rī-MŎT-ō-mē): incision of the lacrimal duct or sac -tomy: incision |
| dacryocyst/o | lacrimal sac | dacryocyst/o /ptosis (dāk-rē-ō-sīs-tōp-TŎ-sīs): prolapse of the lacrimal sac -ptosis: prolapse, downward displacement |
| glauc/o | gray | glauc/oma (glaw-KŎ-mā): gray tumor -oma: tumor <i>If not treated, glaucoma results in increased intraocular pressure (IOP) that destroys the retina and optic nerve. Because of diminished blood flow to the back of the eye, the optic nerve appears pale gray, hence the name glaucoma.</i> |
| goni/o | angle | goni/o /scopy (gō-nē-ŎS-kō-pē): visual examination of the irideocorneal angle -scopy: visual examination <i>Gonioscopy is used to differentiate the two forms of glaucoma (open- and closed-angle).</i> |
| irid/o | iris | irid/o /plegia (īr-īd-ō-PLĒ-jē-ă): paralysis of (the sphincter of) the iris -plegia: paralysis |
| kerat/o | horny tissue; hard; cornea | kerat/o /tomy (kēr-ă-TŎT-ō-mē): incision of the cornea -tomy: incision |
| ocul/o | eye | ocul/o /myc/osis (ōk-ū-lō-mī-KŎ-sīs): fungal infection of the eye (or its parts) myc: fungus -osis: abnormal condition; increase (used primarily with blood cells) |
| ophthalm/o | | ophthalm/o /logist (ōf-thāl-MŎL-ō-jīst): specialist in the study of the eye -logist: specialist in study of <i>Ophthalmologists are physicians who specialize in the medical and surgical management of diseases and disorders of the eyes.</i> |
| opt/o | eye, vision | opt/o /metry (ōp-TŎM-ē-trē): act of measuring vision -metry: act of measuring <i>Optometry is the science of diagnosing, managing, and treating nonsurgical conditions and diseases of the eye and visual system.</i> |
| optic/o | | optic/al (ŎP-tī-kāl): pertaining to the eye or vision -al: pertaining to |
| phac/o | lens | phac/o /cele (FĀK-ō-sēl): herniation (displacement) of the lens into the interior chamber of the eye -cele: hernia, swelling <i>The usual cause of phacocoele is blunt trauma to the eye.</i> |
| phot/o | light | phot/o /phobia (fō-tō-FŎ-bē-ă): abnormal fear of (intolerance to) light -phobia: fear <i>Intolerance to light is associated with people who suffer from migraines or have light-colored eyes or glaucoma. Some medications also cause a marked intolerance to light.</i> |
| presby/o | old age | presby/opia (prēz-bē-Ŏ-pē-ă): (poor) vision (associated with) old age -opia: vision <i>Presbyopia is the loss of accommodation due to weakening of the ciliary muscles as a result of the aging process.</i> |

(continued)

| Medical Word Elements—cont'd | | |
|------------------------------|--|--|
| Element | Meaning | Word Analysis |
| retin/o | retina | retin/o/sis (rĕt-ĭ-NŌ-sĭs): abnormal condition of the retina - <i>osis</i> : abnormal condition; increase (used primarily with blood cells) <i>Retinosis includes any degenerative process of the retina not associated with inflammation.</i> |
| scler/o | hardening; sclera (white of eye) | scler/o/malacia (skĕ-rŏ-mă-LĀ-shĕ-ă): softening of the sclera - <i>malacia</i> : softening |
| scot/o | darkness | scot/o/ma (skŏ-TŌ-mă): dark, tumorlike spot - <i>oma</i> : tumor <i>Scotoma is an area of diminished vision in the visual field.</i> |
| vitr/o | vitreous body (of eye) | vitr/ectomy (vĭ-TRĚK-tŏ-mĕ): removal of the (contents of the) vitreous chamber - <i>ectomy</i> : excision, removal <i>The removal of the vitreous allows surgical procedures that would otherwise be impossible, including repair of macular holes and tears in the retina.</i> |
| Ear | | |
| audi/o | hearing | audi/o/meter (aw-dĕ-ŌM-ĕ-tĕr): instrument to measure hearing - <i>meter</i> : instrument for measuring |
| labyrinth/o | labyrinth (inner ear) | labyrinth/o/tomy (lăb-ĭ-rĭn-THŌT-ŏ-mĕ): incision of the labyrinth - <i>tomy</i> : incision |
| mastoid/o | mastoid process | mastoid/ectomy (măs-toyd-ĚK-tŏ-mĕ): removal of the mastoid process - <i>ectomy</i> : excision, removal |
| ot/o | ear | ot/o/py/o/rrhea (ŏ-tŏ-pĭ-ŏ-RĚ-ă): discharge of pus from the ear <i>py/o</i> : pus - <i>rrhea</i> : discharge, flow |
| salping/o | tubes (usually fallopian or eustachian [auditory] tubes) | salping/o/scope (săl-PĪNG-gŏ-skŏp): instrument to examine the eustachian tubes - <i>scope</i> : instrument to view or examine |
| staped/o | stapes | staped/ectomy (stă-pĕ-DĚK-tŏ-mĕ): excision of the stapes - <i>ectomy</i> : excision, removal <i>Stapedectomy is performed to improve hearing, especially in cases of otosclerosis.</i> |
| myring/o | tympanic membrane (eardrum) | myring/o/myc/osis (mĭr-ĭn-gŏ-mĭ-KŌ-sĭs): abnormal condition due to fungal infection of the tympanic membrane <i>myc</i> : fungus - <i>osis</i> : abnormal condition; increase (used primarily with blood cells) |
| tympan/o | | tympan/o/stomy (tĭm-pă-NŌS-tŏ-mĕ): forming an opening in the tympanic membrane - <i>stomy</i> : forming an opening (mouth) <i>This procedure is usually performed to insert small pressure-equalizing (PE) tubes through the tympanum.</i> |

| Medical Word Elements—cont'd | | |
|------------------------------|-------------------------|--|
| Element | Meaning | Word Analysis |
| Suffixes | | |
| -acusia | hearing | an/ acusia (ăn-ă-KŪ-sē-ă): not hearing (deafness) <i>an-</i> : without, not |
| -cusis | | presby/ cusis (prēz-bī-KŪ-sīs): hearing (loss) associated with old age <i>presby</i> : old age <i>Presbycusis generally occurs in both ears and primarily affects high-pitched tones.</i> |
| -opia | vision | dipl/ opia (dīp-LŌ-pē-ă): double vision <i>dipl-</i> : double, twofold |
| -opsia | | heter/ opsia (hēt-ēr-ŌP-sē-ă): inequality of vision (in the two eyes) <i>heter-</i> : different |
| -tropia | turning | eso/ tropia (ēs-ō-TRŌ-pē-ă): turning inward (of the eyes); also called <i>convergent strabismus</i> or <i>crossed eyes</i> <i>eso-</i> : inward |
| Prefixes | | |
| exo- | outside, outward | exo/tropia (ēks-ō-TRŌ-pē-ă): abnormal turning outward of (one or both eyes); also called <i>divergent strabismus</i> <i>-tropia</i> : turning |
| hyper- | excessive, above normal | hyper/opia (hī-pēr-Ō-pē-ă): excess (farsighted) vision <i>-opia</i> : vision |



It is time to review medical word elements by completing Learning Activity 15–3. For audio pronunciations of the above-listed key terms, you can visit www.davisplus.fadavis.com/gylys/systems to download this chapter's Listen and Learn! exercises or use the book's audio CD (if included).

Pathology

Common signs and symptoms of eye disorders include decrease in visual acuity, headaches, and pain in the eye or adnexa. However, many disorders of the eye are serious but asymptomatic; therefore, regular eye checkups are necessary. For diagnosis, treatment, and management of visual disorders, the medical services of a specialist may be warranted. **Ophthalmology** is the medical specialty concerned with disorders of the eye. The physician who treats these disorders is called an **ophthalmologist**. Optometrists work with ophthalmologists in a medical practice or practice independently. **Optometrists** are not medical doctors, but are doctors of optometry (OD). They diagnose vision problems and eye disease, prescribe eyeglasses and contact lenses, and prescribe drugs to treat eye disorders. Although they cannot perform surgery, they commonly provide preoperative and postoperative care.

Common signs and symptoms of ear disorders include hearing impairment, ringing in the ears, pain or drainage from the ears, loss of balance, dizziness,

or nausea. Young children are especially vulnerable to middle ear infections that, if not treated, may cause hearing loss. For diagnosis, treatment, and management of hearing disorders, the medical services of a specialist may be warranted. **Otolaryngology** is the medical specialty concerned with disorders of the ear, nose, and throat. The physician who treats these disorders is called an **otolaryngologist**. Many otolaryngologists employ audiologists. **Audiologists** are allied health-care professionals who work with patients with hearing, balance, and related problems. They perform hearing examinations, evaluate hearing loss, clean and irrigate the ear canal, fit and dispense hearing aids or other assistive devices, and provide audiological rehabilitation, including auditory training and instruction in speech or lip reading.

Eye Disorders

Eye disorders include not only visual deficiencies associated with refractive errors, but also disorders of associated structures, such as the eye muscles,

nerves, and blood vessels. A complete examination of the eye and its adnexa is necessary to identify the source of any disorder. Most ocular examinations begin by recording visual acuity (VA) and visual field (VF). Then the eyelids, pupils, cornea, and lacrimal structures are examined and intraocular pressure is assessed as well. If infection is detected, it must be located and identified by culturing eye and nasal discharges and performing computed tomography (CT) of the sinuses. Occasionally, the patient may be referred for dental examination to determine if abscesses in the mouth are the source of infection. Family history is important because many eye disorders have a genetic predisposition, including glaucoma. Common eye disorders include errors of refraction, cataracts, glaucoma, strabismus, and macular degeneration.

Errors of Refraction

An error of refraction (**ametropia**) exists when light rays fail to focus sharply on the retina. This may be due to a defect in the lens, cornea, or the shape of the eyeball. If the eyeball is too long, the image falls in front of the retina, causing nearsightedness. (See Figure 15–4.) In farsightedness (**hyperopia, hypermetropia**), the opposite of

myopia, the eyeball is too short and the image falls behind the retina. A form of farsightedness is **presbyopia**, a defect associated with the aging process. The onset of presbyopia usually occurs between ages 40 and 45. Distant objects are seen clearly, but near objects are not in proper focus. In another form of ametropia called **astigmatism (Ast)**, the cornea or lens has a defective curvature. This curvature causes light rays to diffuse over a large area of the retina rather than being sharply focused.

Corrective lenses usually compensate for the various types of ametropia. An alternative to corrective lenses is **laser-assisted in situ keratomileusis (LASIK)** surgery. This procedure changes the shape of the cornea and, in most instances, the change is permanent. A small incision is made in the cornea to produce a flap. The flap is lifted to the side while a laser reshapes the underlying corneal tissue. At the completion of the procedure, the corneal flap is replaced. The procedure usually takes less than 15 minutes. However, not all people are candidates for this surgery. Some medical conditions, certain medications, or the shape and structure of the eye may preclude this procedure as a viable alternative to corrective lenses.

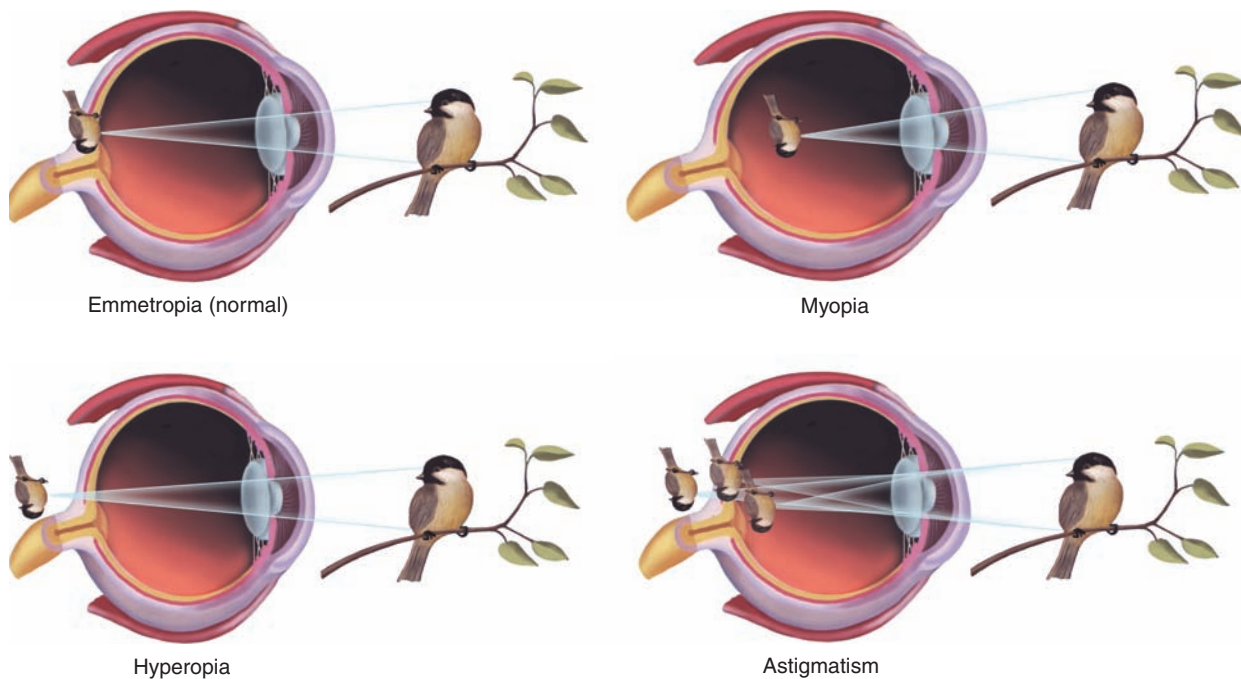


Figure 15-4. Refraction of the eye.

Cataracts

Cataracts are opacities that form on the lens and impair vision. These opacities are commonly produced by protein that slowly builds up over time until vision is affected. The most common form of cataract is age related. More than one half of Americans older than age 65 have cataracts to a greater or lesser extent. Congenital cataracts found in children are usually a result of genetic defects or maternal rubella during the first trimester of pregnancy. This rare form of cataract is treated in the same manner as age-related cataract. The usual treatment is removal of the clouded lens by emulsifying it using ultrasound or a laser probe (**phacoemulsification**). This method is typically referred to as **small incision cataract surgery (SICS)** because the cataract is broken into very small particles that can be removed through the tiny incision. (See Figure 15–5.) An artificial, bendable intraocular lens (IOL) is then inserted into the capsule. Once in position, the lens unfolds. The surgery is usually performed using a topical anesthetic, and the incision normally does not require stitches. This is one of the safest and most effective surgical procedures performed in medicine.

Glaucoma

Glaucoma is characterized by increased intraocular pressure (IOP) caused by the failure of aqueous humor to drain from the eye through a tiny duct called the **canal of Schlemm**. (See Fig. 15–6.) The increased pressure on the optic nerve destroys it, and vision is permanently lost.

Although there are various forms of glaucoma, all of them eventually lead to blindness unless the condition is detected and treated in its early

stages. Glaucoma may occur as a primary or congenital disease or secondary to other causes, such as injury, infection, surgery, or prolonged topical corticosteroid use. Primary glaucoma can be chronic or acute. The **chronic form** is also called **open-angle, simple** or **wide-angle glaucoma**. The **acute form** is called **angle-closure** or **narrow-angle glaucoma**. Chronic glaucoma may produce no symptoms except gradual loss of peripheral vision over a period of years. Headaches, blurred vision, and dull pain in the eye may also be present. Cupping of the optic discs may be noted on ophthalmoscopic examination. Acute glaucoma is accompanied by extreme ocular pain, blurred vision, redness of the eye, and dilation of the pupil. Nausea and vomiting may also occur. If untreated, acute glaucoma causes complete and permanent blindness within 2 to 5 days.

Glaucoma is diagnosed by **tonometry**, a screening test that measures intraocular pressure by determining the resistance of the eyeball to indentation by an applied force. A slit lamp examination (SLE) with a high-intensity beam is used to assess the external surface and internal segments of the eye after administration of a local anesthetic. Devices such as a **tonometer**, which measures intraocular pressure, and a **gonioscope**, which visualizes the anterior chamber angle, expand the scope of the examination. Several methods of tonometry are available, but the one that is considered most accurate is **applanation tonometry**. (See Figure 15–7.) Numbing drops are used and the test is pain free. Treatment for glaucoma includes medications that cause the pupils to constrict (**miotics**), which permits aqueous humor to

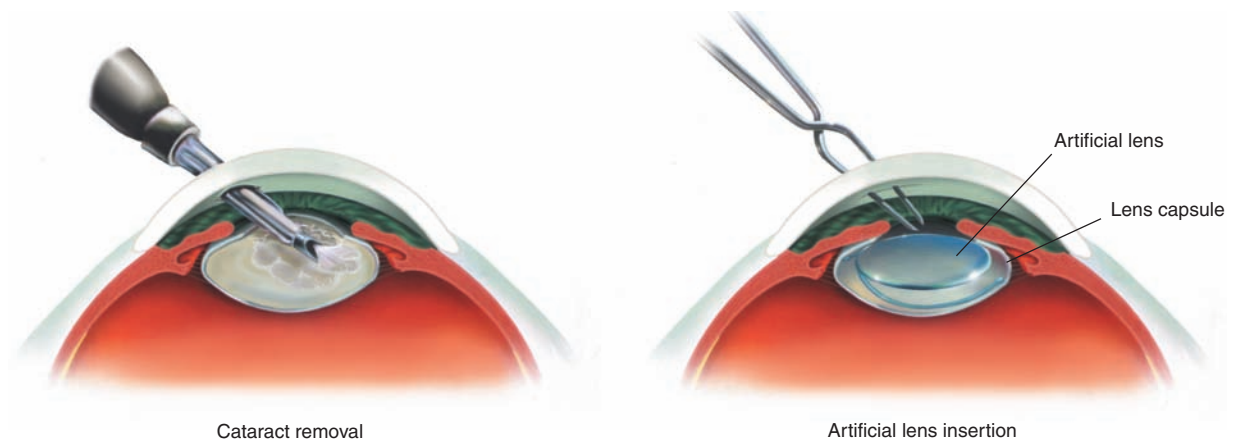


Figure 15-5. Phacoemulsification.

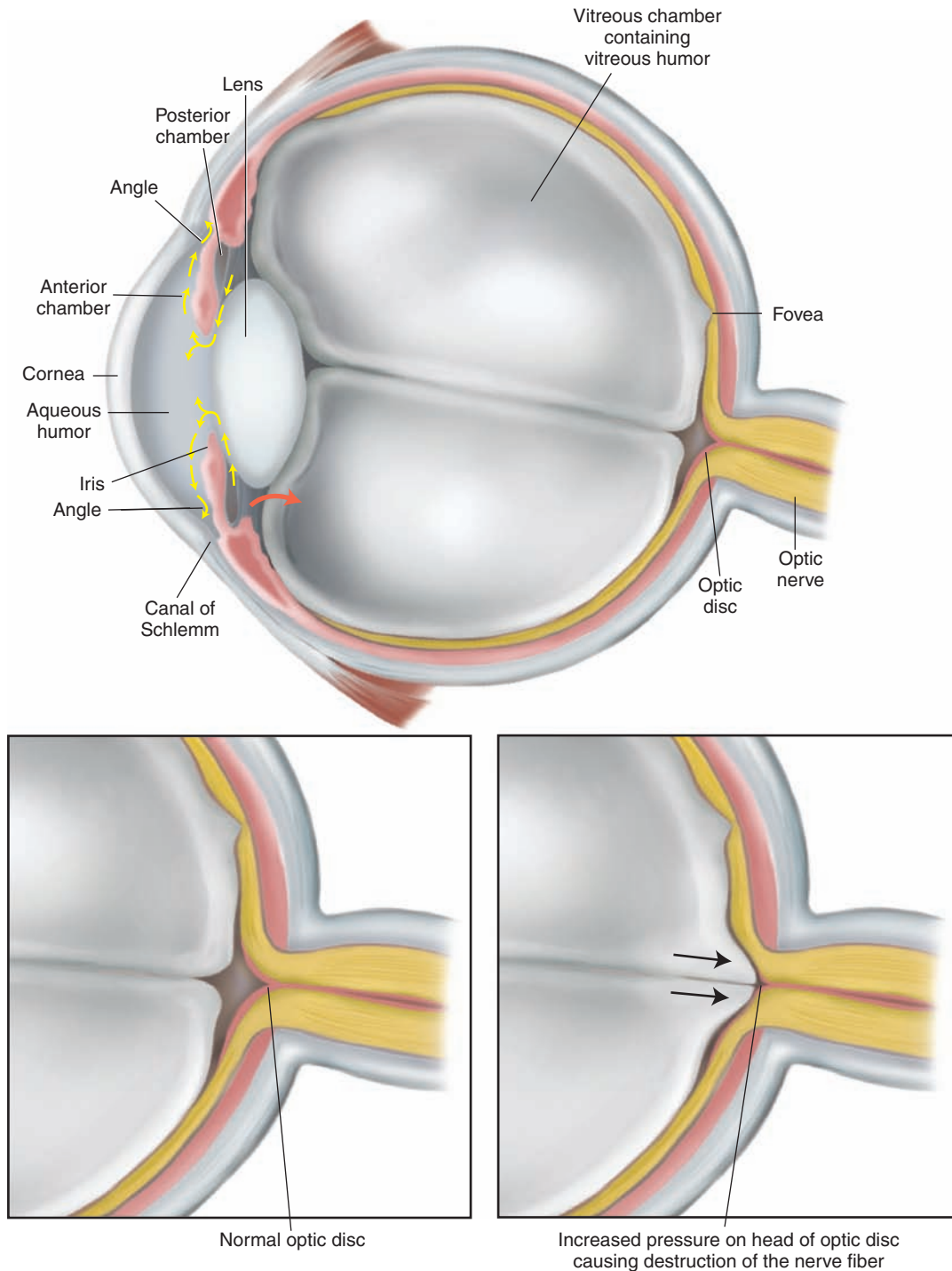


Figure 15-6. Glaucoma. Eye showing normal flow of aqueous humor (yellow arrows) and abnormal flow of aqueous humor (red arrow) causing destruction of optic nerve.

escape from the eye, thereby relieving pressure. If miotics are ineffective, surgery may be necessary.

Strabismus

Strabismus, also called *heterotropia* or *tropia*, is a condition in which one eye is misaligned with the other and the eyes do not focus simultaneously

when viewing an object. This misalignment may be in any direction—inward (**esotropia**), outward (**exotropia**), up, down, or a combination. The deviation may be a constant condition or may arise intermittently with stress, exhaustion, or illness. (See Figure 15–8.) In normal vision, each eye views an image from a somewhat different vantage point,



Figure 15-7. Applanation tonometry using a slit lamp to measure intraocular pressure (courtesy of Richard H. Koop, MD).

thus transmitting a slightly different image to the brain. The result is binocular perception of depth or three-dimensional space, a phenomenon known as **stereopsis**. Strabismus commonly causes a loss of stereopsis. In children, strabismus is commonly, but not always, associated with “lazy-eye syndrome” (**amblyopia**). Vision is suppressed in the “lazy” eye so that the child uses only the “good” eye for vision. The vision pathway fails to develop in the “lazy” eye.

There is a critical period during which amblyopia must be corrected, usually before age 6. If not detected and treated early in life, amblyopia can cause a permanent loss of vision in the affected eye, with associated loss of stereopsis. Treatment for strabismus depends on the cause. It commonly consists of covering the normal eye, forcing the child to use the deviated, or lazy, eye. Eye exercises and corrective lenses may be prescribed, or surgical correction may be necessary.

Macular Degeneration

Macular degeneration is a deterioration of the macula, the most sensitive portion of the retina. The macula is responsible for central, or “straight-ahead,” vision required for reading, driving, detail work, and recognizing faces. (See Figure 15-9.) Although deterioration of the macula is associated with toxic effects of some drugs, the most common type is **age-related macular degeneration (ARMD, AMD)**. ARMD is a leading cause of visual loss in the United States. The disease is unpredictable and progresses differently in each individual.

So far, two forms of ARMD have been identified: wet and dry. The less common, but more severe, form is **wet**, or **neovascular ARMD**. It affects about 10% of those afflicted with the disease. Small blood vessels form under the macula. Blood and other fluids leak from these vessels and destroy the visual cells, leading to severe loss of central vision and permanent visual impairment. If identified in its early stages, laser surgery can be employed to destroy the newly forming vessels. This treatment is called **laser photocoagulation**. It is successful in about one half of the patients with wet ARMD. However, the effects of the procedure commonly do not last and new vessels begin to form.

The more common form of the macular degeneration is **dry ARMD**. Small yellowish deposits called **drusen** develop on the macula and interfere with central vision. Drusen are dried retinal pigment epithelial cells that form granules on the macula. Although some vision is lost, this form of the disease rarely leads to total blindness. Patients with dry ARMD are encouraged to see their ophthalmologist frequently and perform a simple at-home test that identifies visual changes that may indicate the development of the more serious neovascular ARMD.

Ear Disorders

Common signs and symptoms of ear disorders include hearing loss, earache, vertigo, and tinnitus. Hearing tests are important in diagnosing hearing loss as well as aiding in localizing the source and nature of the hearing deficiency. In addition, many infections of the nose and throat refer pain (**synalgia**)

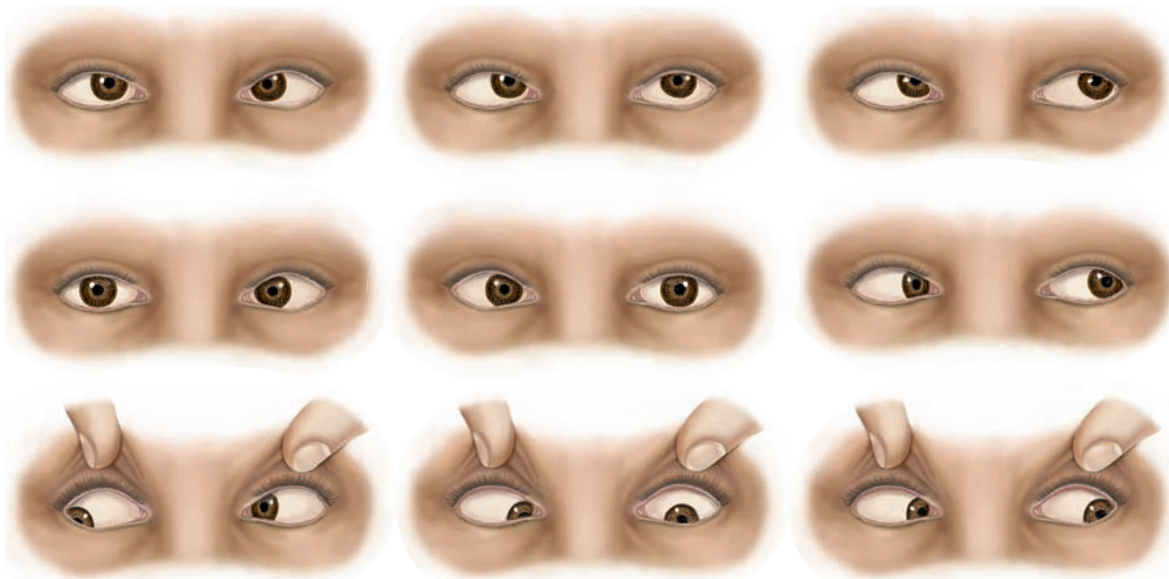
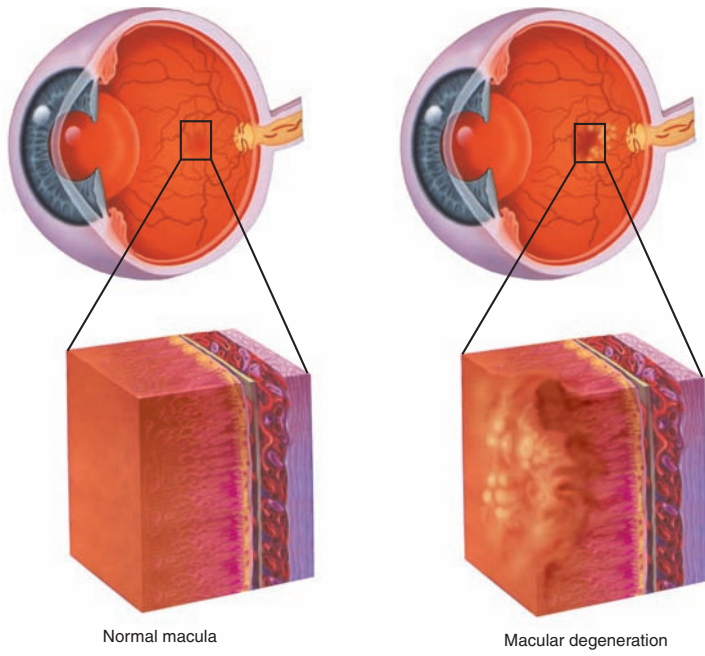


Figure 15-8. Types of strabismus.

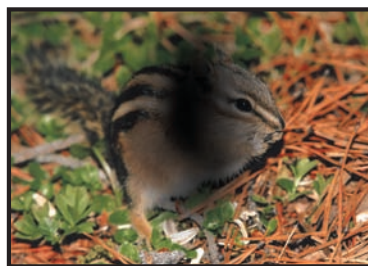


Normal macula

Macular degeneration



Normal vision



Central vision loss

Figure 15-9. Macular degeneration.

to the ear. Therefore, an examination of the nose and throat is usually essential in identifying the cause of ear pain. Common ear disorders include otitis media and otosclerosis.

Otitis Media

Otitis media (OM) is an inflammation of the middle ear. This infection may be caused by a virus or bacterium. However, the most common culprit is *Streptococcus pneumoniae*. Otitis media is found most commonly in infants and young children, especially in the presence of an upper respiratory infection (URI). Symptoms may include earache and draining of pus from the ear (**otopyorrhea**). In its most severe form, otitis media may lead to infection of the mastoid process (**mastoiditis**) or inflammation of brain tissue near the middle ear (**otoencephalitis**). Recurrent episodes of otitis media may cause scarring of the tympanic membrane, leading to hearing loss. Treatment consists of bed rest, medications to relieve pain (**analgesics**), and antibiotics. Occasionally, an incision of the eardrum (**myringotomy, tympanotomy**) may be necessary to relieve pressure and promote drainage.

The usual treatment for children with recurrent infection is the use of **pressure-equalizing tubes**

(**PE tubes**) that are passed through the tympanic membrane. These tubes help drain fluid from the middle ear. (See Figure 15-10.)

Otosclerosis

Otosclerosis is a disorder characterized by an abnormal hardening (**ankylosis**) of bones of the middle ear that causes hearing loss. The ossicle most commonly affected is the stapes, the bone that attaches to the oval window of the cochlea. The formation of a spongy growth at the footplate of the stapes decreases its ability to move the oval window, resulting in hearing loss. Occasionally, the patient perceives a ringing sound (**tinnitus**) within the ear, along with dizziness and a progressive loss of hearing, especially of low tones. Development of otosclerosis is typically closely tied to genetic factors; if one or both parents have the disorder, the child is at high risk for developing the disease. Surgical correction involves removing part of the stapes (**stapedectomy** or, more commonly, **stapedotomy**) and implanting a prosthetic device that allows sound waves to pass to the inner ear. The procedure requires only a local anesthetic and usually lasts only 45 minutes. Hearing is immediately restored.

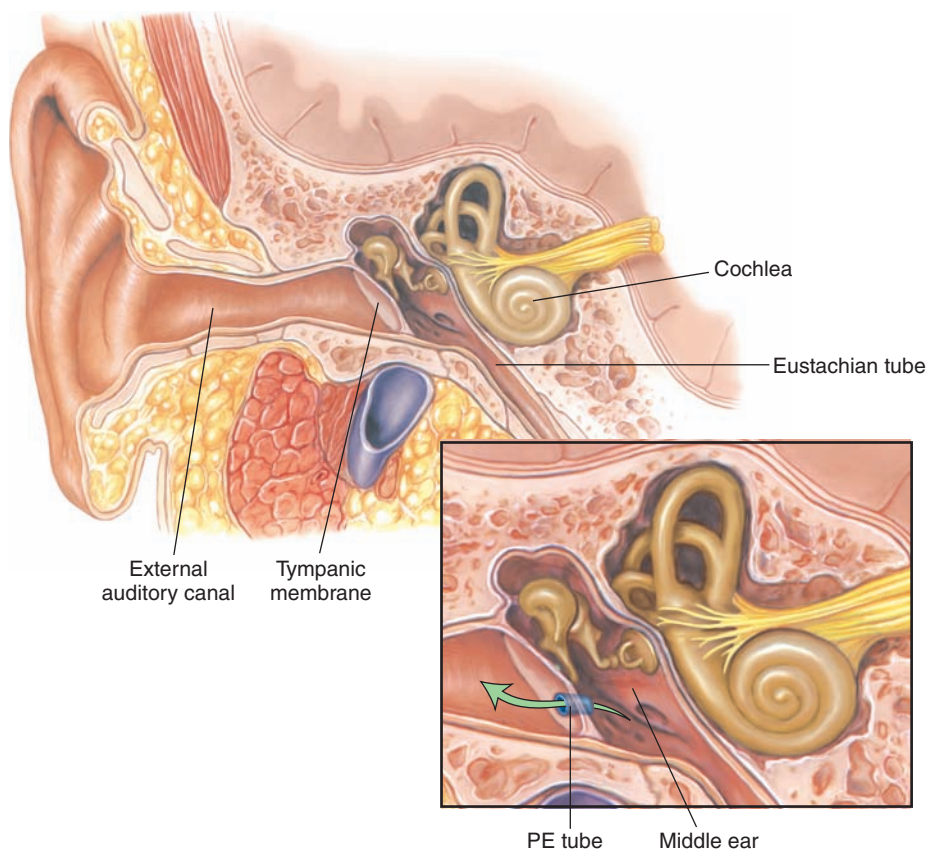


Figure 15-10. Placement of pressure-equalizing (PE) tube.

Oncology

Two major **neoplastic diseases** account for more than 90% of all primary intraocular diseases: **retinoblastoma**, found primarily in children, and **melanoma**, found primarily in adults. Most retinoblastomas tend to be familial. The cell involved is the retinal neuron. Vision is impaired and, in about 30% of patients, the disease is found in both eyes (**bilateral**). Melanoma may occur in the orbit, the bony cavity of the eyeball, the iris, or the ciliary body, but it arises most commonly in the pigmented cells of the choroid. The disease is usually asymptomatic until there is a hemorrhage into the anterior chamber. Any discrete, fleshy mass on the iris should be examined by an ophthalmologist. If malignancy occurs in the choroid, it usually appears as a brown or gray mushroom-shaped lesion.

Treatment for retinoblastoma usually involves the removal of the affected eye(s) (**enucleation**), followed by radiation. In melanoma where the lesion is on the iris, an iridectomy is performed. For melanoma of the choroid, enucleation is necessary. Many eye tumors are noninvasive and are not necessarily life threatening.

Both malignant and nonmalignant tumors can arise in the external ear, the canal, or the middle ear. Malignant tumors of the ear include basal cell carcinoma and squamous cell tumors. The most common ear malignancy is basal cell carcinoma, which usually occurs on the top of the pinna as the result of sun exposure. It is found more commonly in elderly patients or those with fair skin. Small, craterlike ulcers form as the disease progresses. Basal cell carcinoma does not readily metastasize; however, failure to treat it in a timely manner may result in the need for extensive surgery to remove the tumor. Squamous cell carcinoma, on the other hand, is much more invasive. However, it is a very rare type of ear tumor. In appearance, it closely resembles basal cell carcinoma, and biopsy is required to make a definitive diagnosis. Squamous cell carcinoma grows more slowly than basal cell carcinoma; however, because of its tendency to metastasize to the surrounding nodes and the nodes of the neck, it must be removed. Surgery combined with radiation therapy is the most effective treatment for squamous cell carcinoma.

Diagnostic, Symptomatic, and Related Terms

This section introduces diagnostic, symptomatic, and related terms and their meanings. Word analyses for selected terms are also provided.

| Term | Definition |
|---|--|
| Eye | |
| achromatopsia ă-krō-mă-TŌP-sě-ă <i>a-</i> : without, not <i>chromat</i> : color <i>-opsia</i> : vision | Severe congenital deficiency in color perception; also called <i>complete color blindness</i> |
| chalazion kă-LĀ-zē-ōn | Small, hard tumor developing on the eyelid, somewhat similar to a sebaceous cyst |
| conjunctivitis kōn-jŭnk-tī-VĪ-tīs <i>conjunctiv</i> : conjunctiva <i>-itis</i> : inflammation | Inflammation of the conjunctiva with vascular congestion, producing a red or pink eye; may be secondary to viral, bacterial, or fungal infections or allergy |
| convergence kōn-VĒR-jěnts | Medial movement of the two eyeballs so that they are both directed at the object being viewed |
| diopter (D) dī-ŌP-těr | Measurement of refractive error <i>When the D value is negative, it signifies an eye with myopia. When the D value is positive, it signifies an eye with hyperopia.</i> |

Diagnostic, Symptomatic, and Related Terms—cont'd

| Term | Definition |
|---|--|
| ectropion ĕk-TRŌ-pĕ-ŏn | Eversion, or outward turning, of the edge of the lower eyelid |
| emmetropia (Em) ĕm-ĕ-TRŌ-pĕ-ă | State of normal vision <i>In emmetropia, when the eye is at rest, the image is focused directly on the retina.</i> |
| entropion ĕn-TRŌ-pĕ-ŏn | Inversion or inward turning of the edge of the lower eyelid |
| epiphora ĕ-PĪF-ŏ-ră | Abnormal overflow of tears <i>Epiphora is sometimes caused by obstruction of the tear ducts.</i> |
| exophthalmos ĕks-ŏf-THĀL-mŏs | Protrusion of one or both eyeballs <i>Common causes of exophthalmos include hyperactive thyroid, trauma, and tumor.</i> |
| hordeolum hor-DE-ŏ-lŭm | Localized, circumscribed, inflammatory swelling of one of the several sebaceous glands of the eyelid, generally caused by a bacterial infection; also called <i>stye</i> |
| metamorphopsia mĕt-ă-mor-FŌP-sĕ-ă <i>meta-</i> : change; beyond <i>morph</i> : form, shape, structure <i>-opsia</i> : vision | Visual distortion of objects <i>Metamorphopsia is commonly associated with errors of refraction, retinal disease, choroiditis, detachment of the retina, and tumors of the retina or choroid.</i> |
| nyctalopia nĭk-tă-LŌ-pĕ-ă <i>nyctal</i> : night <i>-opia</i> : vision | Impaired vision in dim light; also called <i>night blindness</i> <i>Common causes of nyctalopia include cataracts, vitamin A deficiency, certain medications, and hereditary causes.</i> |
| nystagmus nĭs-TĀG-mŭs | Involuntary eye movements that appear jerky and may reduce vision or be associated with other, more serious conditions that limit vision |
| papilledema păp-ĭl-ĕ-DE-mă | Edema and hyperemia of the optic disc usually associated with increased intracranial pressure; also called <i>choked disc</i> |
| photophobia fŏ-tŏ-FŌ-bĕ-ă <i>phot/o</i> : light <i>-phobia</i> : fear | Unusual intolerance and sensitivity to light <i>Photophobia commonly occurs in such diseases as meningitis, inflammation of the eyes, measles, and rubella.</i> |
| presbyopia prĕz-bĕ-Ō-pĕ-ă <i>presby</i> : old age <i>-opia</i> : vision | Loss of accommodation of the crystalline lens associated with the aging process <i>During the aging process, proteins in the lens become harder and less elastic and muscle fibers surrounding the lens lose strength. These changes cause a decreased ability to focus, especially at close range.</i> |
| retinopathy rĕt-ĭn-ŌP-ă-thĕ <i>retin/o</i> : retina <i>-pathy</i> : disease | Any disorder of retinal blood vessels |
| diabetic dĭ-ă-BĒT-ĭk | Disorder that occurs in patients with diabetes and is manifested by small hemorrhages, edema, and formation of new vessels on the retina, leading to scarring and eventual loss of vision |

(continued)

Diagnostic, Symptomatic, and Related Terms—cont'd

| Term | Definition |
|--|---|
| trachoma trā-KŌ-mă | Chronic, contagious form of conjunctivitis common in the southwestern United States that typically leads to blindness |
| visual field | Area within which objects may be seen when the eye is in a fixed position |
| Ear | |
| anacusis ăn-ă-KŪ-sīs <i>an-</i> : without, not <i>-acosis</i> : hearing | Complete deafness; also called <i>anacusia</i> <i>Anacusis may be unilateral or bilateral. Anacusis should not be confused with hearing loss. Hearing loss refers to impairment in hearing and the individual may be able to respond to auditory stimuli including speech.</i> |
| conduction impairment kŏn-DŪK-shŭn | Blocking of sound waves as they pass through the external and middle ear (conduction pathway) |
| labyrinthitis lăb-ĭ-rĭn-THĪ-tīs <i>labyrinth</i> : labyrinth (inner ear) <i>-itis</i> : inflammation | Inflammation of the inner ear that usually results from an acute febrile process <i>Labyrinthitis may lead to progressive vertigo.</i> |
| Ménière disease mĕn-ĕ-ĀR | Disorder of the labyrinth that leads to progressive loss of hearing <i>Ménière disease is characterized by vertigo, sensorineural hearing loss, and tinnitus.</i> |
| noise-induced hearing loss (NIHL) | Condition caused by the destruction of hair cells, the organs responsible for hearing, caused by sounds that are “too long, too loud, or too close” <i>Target shooting, leaf blowing, motorcycle engines, rock concerts, woodworking, and other such environmental noises all produce sounds that may, over time, cause NIHL.</i> |
| otitis externa ō-TĪ-tīs ěks-TĚR-nă <i>ot</i> : ear <i>-itis</i> : inflammation | Infection of the external auditory canal <i>Common causes of otitis externa include exposure to water when swimming (swimmer’s ear), bacterial or fungal infections, seborrhea, eczema, and chronic conditions such as allergies.</i> |
| presbycusis prĕz-bĕ-ă-KŪ-sīs <i>presby</i> : old age <i>-acosis</i> : hearing | Impairment of hearing resulting from old age; also called <i>presbycusia</i> <i>In presbycusis, patients are generally able to hear low tones but lose the ability to hear higher tones. This condition usually affects speech perception, especially in the presence of background noise, as in a restaurant or a large crowd. This type of hearing loss is irreversible.</i> |
| pressure-equalizing (PE) tubes | Tubes that are inserted through the tympanic membrane, commonly to treat chronic otitis media; also called <i>tympanostomy tubes</i> or <i>ventilation tubes</i> <i>PE tubes remain in the ear several months, and then fall out on their own or are removed surgically. (See Figure 15-10.)</i> |

Diagnostic, Symptomatic, and Related Terms—cont'd

| Term | Definition |
|------------------------------|---|
| tinnitus tĭn-Ī-tŭs | Perception of ringing, hissing, or other sounds in the ears or head when no external sound is present <i>Tinnitus may be caused by a blow to the head, ingestion of large doses of aspirin, anemia, noise exposure, stress, impacted wax, hypertension, and certain types of medications and tumors.</i> |
| vertigo VĒR-tĭ-gō | Hallucination of movement, or a feeling of spinning or dizziness <i>Vertigo may be caused by a variety of disorders, including Ménière disease and labyrinthitis.</i> |



It is time to review pathological, diagnostic, symptomatic, and related terms by completing Learning Activity 15–4.

Diagnostic and Therapeutic Procedures

This section introduces procedures used to diagnose and treat eye and ear disorders. Descriptions are provided as well as pronunciations and word analyses for selected terms.

| Procedure | Description |
|--|--|
| Diagnostic Procedures | |
| Clinical | |
| audiometry aw-dē-ŌM-ĕ-trē <i>audi/o:</i> hearing <i>-metry:</i> act of measuring | Measurement of hearing acuity at various sound wave frequencies <i>In audiometry, pure tones of controlled intensity are delivered through ear-phones to one ear at a time while the patient indicates if the tone was heard. The minimum intensity (volume) required to hear each tone is graphed.</i> |
| caloric stimulation test | Test that uses different water temperatures to assess the vestibular portion of the nerve of the inner ear (acoustic nerve) to determine if nerve damage is the cause of vertigo <i>In the caloric stimulation test, cold and warm water are separately introduced into each ear while electrodes placed around the eye record nystagmus. Eyes move in a predictable pattern when the water is introduced, except with acoustic nerve damage.</i> |
| electronystagmography (ENG) ē-lĕk-trō-nĭs-tăg-MŌG-ră-fē | Method of assessing and recording eye movements by measuring the electrical activity of the extraocular muscles <i>In ENG, electrodes are placed above, below, and to the side of each eye. A ground electrode is placed on the forehead. The electrodes record eye movement relative to the position of the ground electrode.</i> |
| ophthalmodynamometry ôf-thăl-mō-dĭ-nă-MŌM-ĕ-trē | Measurement of the blood pressure of the retinal vessels <i>Ophthalmodynamometry is a screening test used to determine reduction of blood flow in the carotid artery.</i> |
| tonometry tōn-ŌM-ĕ-trē <i>ton/o:</i> tension <i>-metry:</i> act of measuring | Evaluation of intraocular pressure by measuring the resistance of the eye-ball to indentation by an applied force <i>Tonometry is used to detect glaucoma. Several kinds of tonometers can be used. The applanation method of tonometry uses a sensor to depress the cornea and is considered the most accurate method of tonometry. (See Figure 15-7.)</i> |

(continued)

Diagnostic and Therapeutic Procedures—cont'd

| Procedure | Description |
|---|--|
| visual acuity (VA) test ă-KŪ-ĭ-tē | Part of an eye examination that determines the smallest letters that can be read on a standardized chart at a distance of 20 feet <i>Visual acuity (VA) is expressed as a fraction. The top number refers to the distance from the chart and the bottom number indicates the distance at which a person with normal eyesight could read the same line. For example 20/40 indicates that the patient correctly read letters at 20 feet that could be read by a person with normal vision at 40 feet.</i> |
| Endoscopic | |
| gonioscopy gō-nē-ŌS-kō-pē <i>goni/o:</i> angle <i>-scopy:</i> visual examination | Examination of the angle of the anterior chamber of the eye to determine ocular motility and rotation and diagnose and manage glaucoma |
| ophthalmoscopy ǒf-thāl-MŌS-kō-pē <i>ophthalm/o:</i> eye <i>-scopy:</i> visual examination | Visual examination of the interior of the eye using a hand-held instrument called an <i>ophthalmoscope</i> , which has various adjustable lenses for magnification and a light source to illuminate the interior of the eye <i>Ophthalmoscopy is used to detect eye disorders as well as other disorders that cause changes in the eye.</i> |
| otoscopy ǒ-TŌS-kō-pē <i>ot/o:</i> ear <i>-scopy:</i> visual examination | Visual examination of the external auditory canal and the tympanic membrane using an otoscope |
| pneumatic nū-MĀT-ĭk | Procedure that assesses the ability of the tympanic membrane to move in response to a change in air pressure <i>In pneumatic otoscopy, a tight seal is created in the ear canal and then a very slight positive pressure and then a negative pressure is applied by squeezing and releasing a rubber bulb attached to the pneumatic otoscope. The fluctuation in air pressure causes movement of a normal tympanic membrane.</i> |
| retinoscopy rēt-ĭn-ŌS-kō-pē <i>retin/o:</i> retina <i>-scopy:</i> visual examination | Evaluation of refractive errors of the eye by projecting a light into the eyes and determining the movement of reflected light rays <i>Retinoscopy is especially important in determining errors of refraction in babies and small children who cannot be refracted by traditional methods.</i> |
| Radiographic | |
| dacryocystography dāk-rē-ō-sĭs-TŌG-ră-fē <i>dacryocyst/o:</i> lacrimal sac <i>-graphy:</i> process of recording | Radiographic imaging procedures of the nasolacrimal (tear) glands and ducts <i>Dacryocystography is performed for excessive tearing (epiphora) to determine the cause of hypersecretion of the lacrimal gland or obstruction in the lacrimal passages.</i> |
| fluorescein angiography floo-RĒS-ēn ăn-jē-ŌG-ră-fē <i>angio:</i> vessel (usually blood or lymph) <i>-graphy:</i> process of recording | Assesses blood vessels and their leakage in and beneath the retina after injection of fluorescein dye. The dye circulates while photographs of the vessels within the eye are obtained. <i>Fluorescein angiography facilitates the in vivo study of the retinal blood flow circulation and is particularly useful in the management of diabetic retinopathy and macular degeneration, two leading causes of blindness.</i> |

Diagnostic and Therapeutic Procedures—cont'd

| Procedure | Description |
|--|---|
| <i>Therapeutic Procedures</i> | |
| Clinical | |
| orthoptic training or-THŌP-tīk TRĀ-nīng <i>orth</i> : straight <i>opt</i> : eye, vision <i>-ic</i> : pertaining to | Exercises intended to improve eye movements or visual tracking that use training glasses, prism glasses, or tinted or colored lenses |
| Surgical | |
| blepharoplasty BLĒF-ā-rō-plās-tē <i>blephar/o</i> : eyelid <i>-plasty</i> : surgical repair | Cosmetic surgery that removes fatty tissue above and below the eyes that commonly form as a result of the aging process or excessive exposure to the sun |
| cochlear implant KŌK-lē-ār ĪM-plānt <i>cochle</i> : cochlea <i>-ar</i> : pertaining to | Artificial hearing device that produces useful hearing sensations by electrically stimulating nerves inside the inner ear; also called <i>bionic ear</i> |
| cyclodialysis sī-klō-dī-ĀL-ī-sīs <i>cycl/o</i> : ciliary body of eye; circular, cycle <i>dia</i> : through, across <i>-lysis</i> : separation; destruction; loosening | Formation of an opening between the anterior chamber and the supra-choroidal space for the draining of aqueous humor in glaucoma |
| enucleation ē-nū-klē-Ā-shŭn | Removal of the eyeball from the orbit <i>Enucleation is performed to treat cancer of the eye when the tumor is large and fills most of the structure.</i> |
| evisceration ē-vīs-ēr-Ā-shŭn | Removal of the contents of the eye while leaving the sclera and cornea intact <i>Evisceration is performed when the blind eye is painful or unsightly. The eye muscles are left intact, and a thin prosthesis called a cover shell is fitted over the sclera and cornea.</i> |
| mastoid antrotomy MĀS-toyd ān-TRŌT-ō-mē | Surgical opening of a cavity within the mastoid process |
| otoplasty Ō-tō-plās-tē <i>ot/o</i> : ear <i>-plasty</i> : surgical repair | Corrective surgery for a deformed or excessively large or small pinna <i>Otoplasty is also performed to rebuild new ears for those who lost them through burns or other trauma or were born without them.</i> |
| phacoemulsification fā-kō-ē-mŭl-sī-fī- KĀ-shŭn | Method of treating cataracts by using ultrasonic waves to disintegrate a cloudy lens, which is then aspirated and removed |

(continued)

| Diagnostic and Therapeutic Procedures—cont'd | |
|---|--|
| Procedure | Description |
| radial keratotomy (RK) kĕr-ă-TŌT-ō-mĕ <i>kerat/o</i> : horny tissue; hard; cornea <i>-tomy</i> : incision | Incision of the cornea for treatment of nearsightedness or astigmatism. <i>In RK, hairline radial incisions are made on the outer portion of the cornea that allow the cornea to be flatten, to correct nearsightedness, or to reshape an irregular curvature of the cornea in astigmatism.</i> |
| sclerostomy sklĕ-RŌS-tō-mĕ <i>scler/o</i> : hardening; sclera (white of eye) <i>-stomy</i> : forming an opening (mouth) | Surgical formation of an opening in the sclera <i>Sclerostomy is commonly performed in conjunction with surgery for glaucoma.</i> |
| tuning fork test Rinne Weber | Method use to evaluate sound conduction using a vibrating tuning fork Tuning fork test that evaluates bone conduction (BC) versus air conduction (AC) of sound <i>In the Rinne test, the base of a vibrating fork is placed against the mastoid bone (bone conduction) and in front of the auditory meatus (air conduction). If the sound is louder when the tuning fork is next to the ear, hearing in that ear is normal. If the sound is louder when the tuning fork touches the mastoid process, it is an indication of conductive hearing loss.</i> Tuning fork test that evaluates bone conduction of sound in both ears at the same time <i>In the Weber test, the vibrating tuning fork is placed on the center of the forehead. If sound perception is equal in both ears, hearing is normal.</i> |
| tympanoplasty tĭm-păn-ō-PLĀS-tĕ <i>tympan/o</i> : tympanic membrane (eardrum) <i>-plasty</i> : surgical repair | Reconstruction of the eardrum, commonly due to perforation; also called <i>myringoplasty</i> |

Pharmacology

Disorders of the eyes and ears are commonly treated with instillation of drops onto the surface of the eye or into the cavity of the ear. The eyes and ears are typically irrigated with liquid solution to remove foreign objects and to provide topical application of medications. Pharmacological agents used to treat eye disorders include antibiotics for bacterial eye infections, beta blockers and carbonic

anhydrase inhibitors for glaucoma, and ophthalmic decongestants and moisturizers for irritated eyes. Mydriatics and miotics are used not only to treat eye disorders but also to dilate (mydriatics) and contract (miotics) the pupil during eye examinations. Ear medications include antiemetics to relieve nausea associated with inner ear infections, products to loosen and remove wax buildup in the ear canal, and local anesthetics to relieve pain associated with ear infections. (See Table 15–1.)

Table 15-1 **Drugs Used to Treat Sensory Disorders**

This table lists common drug classifications used to treat eye and ear disorders, their therapeutic actions, and selected generic and trade names.

| Classification | Therapeutic Action | Generic and Trade Names |
|---------------------------------|--|---|
| Eye | | |
| antibiotics, ophthalmic | Inhibit growth of microorganisms that infect the eye. <i>Ophthalmic antibiotics are dispensed as topical ointments and solutions to treat various bacterial eye infections such as conjunctivitis (pinkeye).</i> | erythromycin base ě-rĭth-rō-MĪ-sĭn |
| antiglaucoma agents | Decrease aqueous humor production by constricting the pupil to open the angle between the iris and cornea. | timolol TĪ-mō-lōl Betimol acetazolamide ās-ět-ā-ZŌL-ā-mĭd Diamox |
| mydriatics | Drugs that disrupt parasympathetic nerve supply to the eye or stimulate the sympathetic nervous system, causing the pupil to dilate. <i>Mydriatics are commonly used to dilate the pupil to treat inflammatory conditions or in preparation for internal examinations of the eye.</i> | atropine sulfate ĀT-rō-pēn SŪL-fāt |
| ophthalmic decongestants | Constrict the small arterioles of the eye, decreasing redness and relieving conjunctival congestion. <i>Ophthalmic decongestants are over-the-counter products that temporarily relieve the itching and minor irritation commonly associated with allergy.</i> | tetrahydrozoline tět-rā-hĭ-DRŌZ-ō-lēn Murine, Visine |
| ophthalmic moisturizers | Soothe dry eyes due to environmental irritants and allergens <i>Ophthalmic moisturizers are administered topically and may also be used to facilitate ophthalmoscopic examination in gonioscopy and ophthalmoscopy.</i> | buffered isotonic solutions BŮ-fērd ĩ-sō-TŌN-ĭk sō-LŪ-shŭnz Akwa Tears, Moisture Eyes |
| Ear | | |
| antiemetics | Treat and prevent nausea, vomiting, dizziness, and vertigo by reducing the sensitivity of the inner ear to motion or inhibiting stimuli from reaching the part of the brain that triggers nausea and vomiting <i>Antiemetics are commonly used to treat vertigo.</i> | meclizine MĚK-lĭ-zēn Antrizine, Bonine, Meni-D |

(continued)

Table 15-1 Drugs Used to Treat Sensory Disorders—cont'd

| Classification | Therapeutic Action | Generic and Trade Names |
|------------------------|--|--|
| otic analgesics | Provide temporary relief from pain and inflammation associated with otic disorders <i>Otic analgesics may be prescribed for otitis media, otitis externa, and swimmer's ear. Some otic analgesics are also wax emulsifiers.</i> | antipyrine and benzocaine ăn-tī-PĪ-rĕn, BĒN-zō-kān Allergan Ear Drops, A/B Otic |
| wax emulsifiers | Loosen and help remove impacted cerumen (ear wax) <i>Excessive wax may be washed out, vacuumed out, or removed using special instruments.</i> | carbamide peroxide KĂR-bă-mĭd pĕr-ÖK-sĭd Debrox Drops, Murine Ear Drops |

Abbreviations

This section introduces abbreviations related to the eye and ear along with their meanings.

| Abbreviation | Meaning | Abbreviation | Meaning |
|------------------|---|---------------|--|
| Eye | | | |
| Acc | accommodation | OD | right eye |
| ARMD, AMD | age-related macular degeneration | O.D. | Doctor of Optometry |
| Ast | astigmatism | OS | left eye |
| CK | conductive keratoplasty; creatine kinase (cardiac enzyme) | OU | both eyes |
| CT | computed tomography | PERRLA | pupils equal, round, and reactive to light and accommodation |
| D | diopter (lens strength) | RK | radial keratotomy |
| Em | emmetropia | SICS | small incision cataract surgery |
| EOM | extraocular movement | SLE | slit lamp examination; systemic lupus erythematosus |
| IOL | intraocular lens | ST | esotropia |
| IOP | intraocular pressure | VA | visual acuity |
| LASIK | laser-assisted <i>in situ</i> keratomileusis | VF | visual field |
| mix astig | mixed astigmatism | XT | exotropia |
| Myop | myopia (nearsightedness) | | |
| Ear | | | |
| AC | air conduction | AS | left ear |
| AD | right ear | AU | both ears |

| Abbreviations—cont'd | | | |
|-----------------------------|----------------------------|---------------------|--|
| Abbreviation | Meaning | Abbreviation | Meaning |
| BC | bone conduction | OM | otitis media |
| ENT | ears, nose, and throat | PE | physical examination; pulmonary embolism; pressure-equalizing (tube) |
| NIHL | noise-induced hearing loss | URI | upper respiratory infection |



It is time to review procedures, pharmacology, and abbreviations by completing Learning Activity 15–5.

LEARNING ACTIVITIES

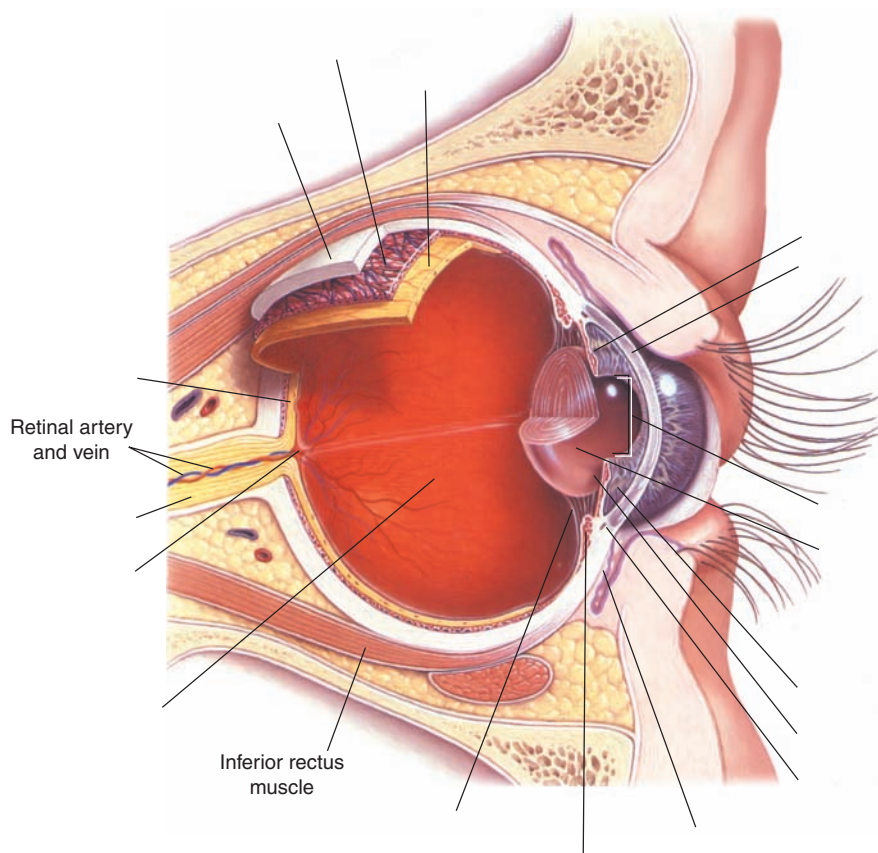
The following activities provide review of the eye and ear terms introduced in this chapter. Complete each activity and review your answers to evaluate your understanding of the chapter.

Learning Activity 15-1

Identifying Eye Structures

Label the following illustration using the terms listed below.

| | | | | |
|-------------------------|--------------------|--------------------------|---------------|-----------------------------|
| <i>anterior chamber</i> | <i>conjunctiva</i> | <i>lens</i> | <i>pupil</i> | <i>suspensory ligaments</i> |
| <i>canal of Schlemm</i> | <i>cornea</i> | <i>optic disc</i> | <i>retina</i> | <i>vitreous chamber</i> |
| <i>choroid</i> | <i>fovea</i> | <i>optic nerve</i> | <i>sclera</i> | |
| <i>ciliary body</i> | <i>iris</i> | <i>posterior chamber</i> | | |



Check your answers by referring to Figure 15-1 on page 467. Review material that you did not answer correctly.

Learning Activity 15-2

Identifying Ear Structures

Label the following illustration using the terms listed below.

auricle

incus

stapes

cochlea

malleus

tympanic membrane

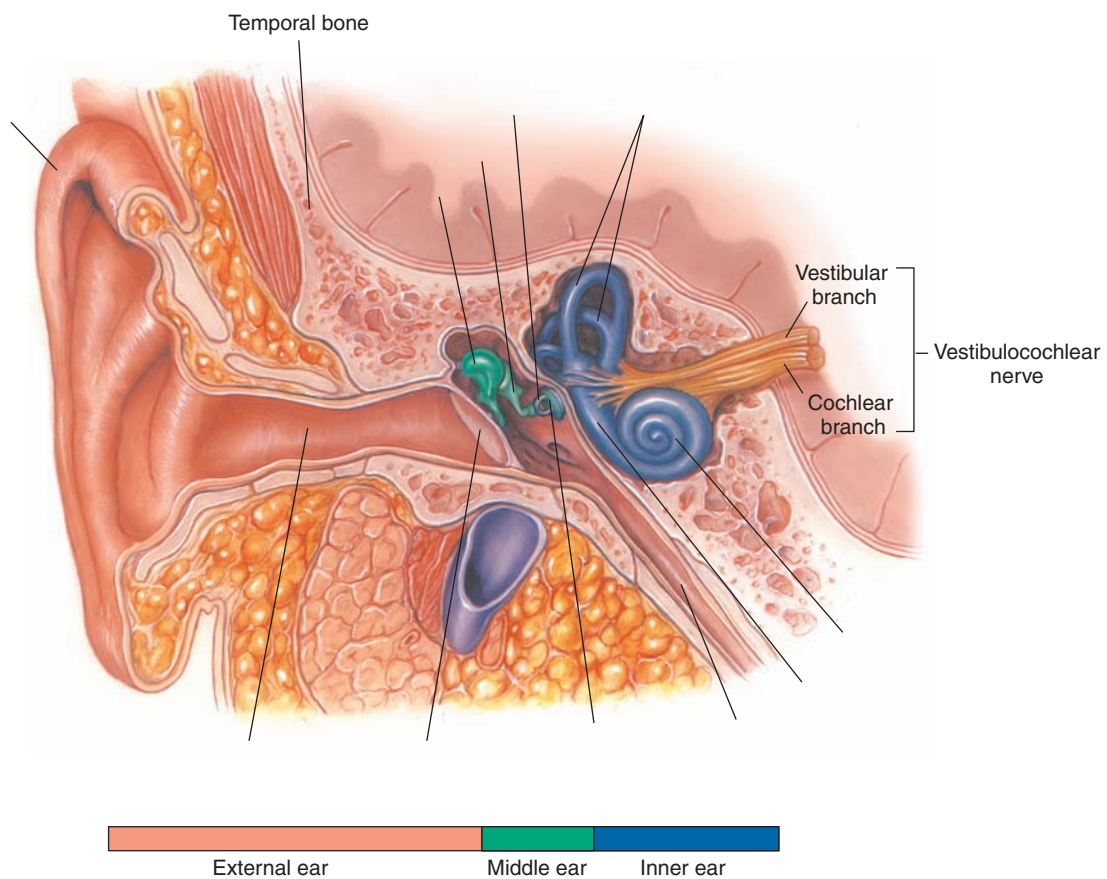
eustachian tube

oval window

vestibule

external auditory canal

semicircular canals



Check your answers by referring to Figure 15-3 on page 469. Review material that you did not answer correctly.



[DavisPlus.fadavis.com](https://www.davisplus.fadavis.com)

Enhance your study and reinforcement of word elements with the power of DavisPlus. Visit www.davisplus.fadavis.com/gylys/systems for this chapter's flash-card activity. We recommend you complete the flash-card activity before completing Activity 15-3 below.

Learning Activity 15-3

Building Medical Words

Use *ophthalm/o* (eye) to build words that mean:

1. paralysis of the eye _____
2. study of the eye _____

Use *pupill/o* (pupil) to build a word that means:

3. examination of the pupil _____

Use *kerat/o* (cornea) to build words that mean:

4. softening of the cornea _____
5. instrument for measuring the cornea _____

Use *scler/o* (sclera) to build words that mean:

6. inflammation of the sclera _____
7. softening of the sclera _____

Use *irid/o* (iris) to build words that mean:

8. paralysis of the iris _____
9. herniation of the iris _____

Use *retin/o* (retina) to build words that mean:

10. disease of the retina _____
11. inflammation of the retina _____

Use *blephar/o* (eyelid) to build words that mean:

12. paralysis of the eyelid _____
13. prolapse of the eyelid _____

Use *ot/o* (ear) to build a word that means:

14. flow of pus from the ear _____

Use *audi/o* (hearing) to build a word that means:

15. instrument for measuring hearing _____

Use *myring/o* (tympanic membrane [eardrum]) to build a word that means:

16. instrument for cutting the eardrum _____

Use the suffix *-opia* (vision) to build words that mean:

17. dim or dull vision _____
18. excessive (far-sighted) vision _____

Use the suffix *-acusis* (hearing) to build words that mean:

19. without hearing _____

20. excessive (sensitivity to) hearing _____

Build surgical words that mean:

21. removal of the stapes _____

22. incision of the labyrinth _____

23. removal of the mastoid process _____

24. surgical repair of the eardrum _____

25. incision of the cornea _____



Check your answers in Appendix A. Review material that you did not answer correctly.

Correct Answers _____ $\times 4 =$ _____ % Score

Learning Activity 15-4

Matching Pathological, Diagnostic, Symptomatic, and Related Terms

Match the following terms with the definitions in the numbered list.

| | | | | |
|----------------------|--------------------|------------------------|-----------------------|---------------------|
| <i>achromatopsia</i> | <i>chalazion</i> | <i>exotropia</i> | <i>nyctalopia</i> | <i>tinnitus</i> |
| <i>amblyopia</i> | <i>diopter</i> | <i>gonioscope</i> | <i>otitis externa</i> | <i>tonometer</i> |
| <i>anacusis</i> | <i>enucleation</i> | <i>Mènière disease</i> | <i>retinoblastoma</i> | <i>vertigo</i> |
| <i>cataract</i> | <i>epiphora</i> | <i>neovascular</i> | <i>strabismus</i> | <i>visual field</i> |

1. _____ opacity that forms on the lens and impairs vision
2. _____ complete color blindness
3. _____ inability to see well in dim light
4. _____ instrument for examining the angle of the anterior chamber of the eye
5. _____ complete deafness
6. _____ infection of the external auditory canal
7. _____ measurement of refractive errors
8. _____ instrument that measures the internal pressure of the eye
9. _____ area in which objects are seen when the eye is in a fixed position
10. _____ abnormal overflow of tears
11. _____ a condition in which one eye is misaligned with the other eye; also called *heterotropia*
12. _____ disorder of the labyrinth that leads to progressive hearing loss
13. _____ refers to the wet form of macular degeneration
14. _____ feeling of dizziness or spinning
15. _____ outward deviation of the eye
16. _____ removal of the eye
17. _____ tumor of the eyelid
18. _____ “lazy-eye” syndrome
19. _____ neoplastic disease of the eye found primarily in children
20. _____ perception of ringing in the ears with no external stimuli



Check your answers in Appendix A. Review any material that you did not answer correctly.

Correct Answers _____ × 5 = _____ % Score

Learning Activity 15-5

Matching Procedures, Pharmacology, and Abbreviations

Match the following terms with the definitions in the numbered list.

| | | | |
|---------------------------------|---------------------------------|--------------------------|---------------------------|
| <i>antiemetics</i> | <i>evisceration</i> | <i>ophthalmoscopy</i> | <i>ST</i> |
| <i>audiometry</i> | <i>fluorescein angiography</i> | <i>otic analgesics</i> | <i>tonometry</i> |
| <i>caloric stimulation test</i> | <i>gonioscopy</i> | <i>otoplasty</i> | <i>visual acuity test</i> |
| <i>cochlear implant</i> | <i>mydriatics</i> | <i>otoscopy</i> | <i>wax emulsifiers</i> |
| <i>enucleation</i> | <i>ophthalmic decongestants</i> | <i>radial keratotomy</i> | <i>XT</i> |

1. _____ test that uses different temperatures to assess the vestibular portion of the nerve
2. _____ visual examination of the interior of the eye
3. _____ artificial device that produces hearing sensations by electrically stimulating nerves inside the inner ear
4. _____ assesses blood vessels and retinal circulation using a colored dye while photographs are taken
5. _____ corrective surgery for large, small, or deformed ears
6. _____ agents that dilate the pupils and paralyze the eye muscles of accommodation
7. _____ measurement of the intraocular pressure for detecting glaucoma
8. _____ determines the smallest letters that can be read on a standardized chart
9. _____ removal of the contents of the eyeball, leaving the sclera and cornea
10. _____ treat and prevent nausea, vomiting, dizziness, and vertigo
11. _____ loosen and help remove impacted cerumen
12. _____ removal of the entire eyeball from its orbit
13. _____ esotropia
14. _____ constrict small arterioles of the eye to decrease redness and conjunctival congestion
15. _____ exotropia
16. _____ visual examination of the angle of the anterior chamber of the eye
17. _____ visual examination of the external auditory canal
18. _____ measurement of hearing acuity at various frequencies
19. _____ surgical treatment for nearsightedness that uses small incisions to flatten the cornea
20. _____ provide temporary relief from earache



Check your answers in Appendix A. Review any material that you did not answer correctly.

Correct Answers _____ $\times 5 =$ _____ % Score

MEDICAL RECORD ACTIVITIES

The two medical records included in the following activities use common clinical scenarios to show how medical terminology is used to document patient care. Complete the terminology and analysis sections for each activity to help you recognize and understand terms related to the special senses.

Medical Record Activity 15-1

Operative Report: Retained Foreign Bodies

Terminology

Terms listed below come from the *Operative Report: Retained Foreign Bodies* that follows. Use a medical dictionary such as *Taber's Cyclopedic Medical Dictionary*, the appendices of this book, or other resources to define each term. Then review the pronunciations for each term and practice by reading the medical record aloud.

| Term | Definition |
|---|------------|
| bilateral bī-LĀT-ēr-ăl | |
| cerumen sĕ-ROO-mĕn | |
| perforation pĕr-fō-RĀ-shŭn | |
| supine sŭ-PĪN | |
| tympanostomy tĭm-pă-NŌS-tō-mĕ | |



Listen and Learn Online! *will help you master the pronunciation of selected medical words from this medical record activity. Visit www.davisplus.com/gyls/systems to find instructions on completing the Listen and Learn Online! exercise for this section and to practice pronunciations.*

OPERATIVE REPORT: RETAINED FOREIGN BODIES

Physicians Day Surgery

1514 Ninth Avenue ■■ Sun City, USA 12345 ■■ (555) 936-1933

OPERATIVE REPORT

Date: 5/13/xx
Patient: Hirsch, Annie

Surgeon: Richard Roake, MD
Patient ID#: 33328

PREOPERATIVE DIAGNOSIS: Foreign body, ears.

POSTOPERATIVE DIAGNOSIS: Foreign body, ears.

OPERATIVE INDICATIONS: Patient is a 9-year-old girl who presents with bilateral retained tympanostomy tubes. The tubes had been placed for more than 2-1/2 years.

ANESTHESIA: General.

COMPLICATIONS: None.

OPERATIVE FINDINGS: Retained tympanostomy tubes, bilateral.

PROCEDURE: Removal of foreign bodies from ears with placement of paper patches.

INFORMED CONSENT: The risks and alternatives were explained to the mother, and she consented to the surgery.

In the supine position under satisfactory general anesthesia via mask, the patient was draped in a routine fashion.

The operating microscope was used to inspect the right ear. A previously placed tympanostomy tube was found to be in position and was surrounded with hard cerumen. The cerumen and the tube were removed, resulting in a very large perforation. The edges of the perforation were freshened sharply with a pick, and a paper patch was applied.

Patient tolerated the surgery very well, and was sent to recovery in stable condition.

Richard Roake, MD
Richard Roake, MD

rk:bg

D: 5-14-20xx
T: 5-14-20xx

Analysis

Review the medical record *Operative Report: Retained Foreign Bodies* to answer the following questions.

1. Did the surgery involve one or both ears?

2. What was the nature of the foreign body in the patient's ears?

3. What ear structure was involved?

4. What instrument was used to locate the tubes?

5. What was the material in which the tubes were embedded?

6. What occurred when the cerumen and tubes were removed?

7. How was the perforation treated?

Medical Record Activity 15-2

Operative Report: Phacoemulsification and Lens Implant

Terminology

Terms listed below come from *Operative report: Phacoemulsification and lens implant* that follows. Use a medical dictionary such as *Taber's Cyclopedic Medical Dictionary*, the appendices of this book, or other resources to define each term. Then review the pronunciations for each term and practice by reading the medical record aloud.

| Term | Definition |
|--|------------|
| anesthesia än-ēs-TĤĤ-zē-ă | |
| blepharostat BLĤF-ă-rō-stăt | |
| capsulorrhexis kăp-sū-lō-RĤK-sīs | |
| cataract KĀT-ă-răkt | |
| conjunctival kōn-jŭnk-TĪ-văl | |
| dioptr dī-ŌP-tĕr | |
| intravenous ĭn-tră-VĤ-nŭs | |
| keratome KĤR-ă-tōm | |
| peritomy pĕr-ĪT-ō-mĕ | |
| phacoemulsification fă-kō-ē-mŭl-sĭ-fĭ- KĀ-shŭn | |
| posterior chamber pōs-TĤR-ē-or CHĀM-bĕr | |
| retrobulbar block rĕt-rō-BŬL-băr | |
| sutures SŪ-chŭrz | |
| TobraDex TŌ-bră-dĕks | |



Listen and Learn Online! *will help you master the pronunciation of selected medical words from this medical record activity. Visit www.davisplus.com/gyls/systems to find instructions on completing the Listen and Learn Online! exercise for this section and to practice pronunciations.*