

CHAPTER 1

DISEASES OF THE PINNA

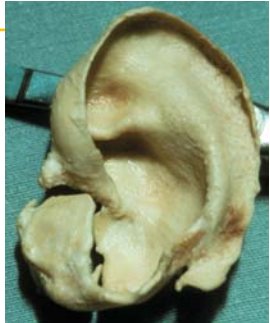
FIGURE 1-1

Normal pinna. In the human, the pinna plays a rudimentary function in the amplification and localization of sound, in addition to providing protection by shielding the external canal from direct trauma. Because the pinna is attached to the side of the head in a relatively exposed position, it is traumatized easily.



FIGURE 1-2

The auricular cartilage. The shape of the pinna is determined by the underlying auricular cartilage. The auricular cartilage of the pinna is contiguous with the cartilage of the outer (cartilaginous) portion of the external auditory canal.



CONGENITAL MALFORMATIONS OF THE EAR

FIGURE 1-3

Darwin's tubercle. Darwin's tubercle is a small cartilaginous protuberance that is most commonly located along the concave edge of the posterosuperior margin of the helix and projects anteriorly. Darwin's tubercles are inherited by means of an autosomal dominant gene that has a variable expressivity. This atavistic remnant represents the apex of the anthropoid ear, suggesting a common ancestry between humanity and apes, and for this reason it is called "Darwin's" tubercle.



**FIGURE 1-4**

Partial meatal atresia. Absence or partial maldevelopment of the pinna is frequently associated with abnormalities of the external auditory canal and underlying middle ear; the inner ear in these patients is usually normal. In the case shown here, the anterior half of the conchal bowl is not fully developed, giving the ear a feline appearance. The external canal consists of only a small conchal pit that ends blindly a short distance medially. This failure in the development of the external auditory meatus is associated with deformity of the middle ear and ossicles.

**FIGURE 1-5**

Complete meatal atresia. In this patient, there is no opening for the external canal (complete meatal atresia).

FIGURE 1-6

Microtia. The term “microtia” is used when there is gross hypoplasia of the pinna with a blind or absent external auditory canal. Microtia encompasses a wide spectrum of severe malformations, ranging from a mere nubbin of tissue with no recognizable features on the side of the head to an incompletely formed auricular appendage. Microtia is typically bilateral, although the degree of the deformity may be different on the two sides. Children born with microtia should have their hearing tested soon after birth and, if hearing loss is present, be fitted with a hearing aid as quickly as possible.

**FIGURE 1-7**

Outstanding ears (posterior view). Outstanding, or protruding ears are the most common cosmetic deformity of the pinna. They are inherited by means of an autosomal dominant gene that has complete penetrance but a variable expressivity. Although outstanding ears are asymptomatic, children with such ears often experience intense emotional discomfort, and otoplasty is recommended for cosmetic reasons.

**FIGURE 1-8**

Outstanding ears (posterior view). The angle between the auricle and the side of the head is greater than normal, and the auricle protrudes anteriorly.





FIGURE 1-9

Outstanding ears (lateral view). There may be a poorly formed antihelical fold or excessive tissue, usually in the conchal or triangular fossae, giving the ear a cupped appearance.



FIGURE 1-10

Preauricular tag. Preauricular tags are tiny, raised nubbins of skin located along the anterior border of the ear in front of the tragus. They are soft, mobile, and filled with soft tissue.



FIGURE 1-11

Accessory auricle. The pinna is formed in the embryo by the coalescence of six tiny hillocks, or tubercles, located on the dorsal end of the first (mandibular) and second (hyoid) branchial arches. Accessory auricles represent the remnant of one of the embryologic hillocks. They differ from preauricular tags in that they contain a small island of cartilage. Preauricular tags and accessory auricles are often excised for cosmetic reasons.

FIGURE 1-12

Preauricular pit. Defective closure of the first branchial cleft or a failure in the fusion of the primitive ear hillocks may result in the formation of a small pit, sinus, or fistula in front of the pinna. These deformities can vary from a small dimple (preauricular pit) to a larger sinus (preauricular sinus). Preauricular pits are shallow invaginations in the skin of the face located just in front of the anterior border of the anterior crus of the helix. A foul-smelling, cheesy discharge of desquamated keratin debris is often encountered.

**FIGURE 1-13**

Infected preauricular sinus. A preauricular sinus is deeper than a pit and is lined with a stratified, squamous, keratinizing epithelium. Gentle sounding with a small lacrimal duct probe can be used to establish the depth of the preauricular depression and distinguish a preauricular pit from a preauricular sinus. Preauricular pits and sinuses can become infected, and if they do, the infection frequently recurs.

**FIGURE 1-14**

Preauricular cyst. If the opening of a preauricular sinus becomes occluded, the sinus will be converted into a cyst. As the keratin squames of the skin lining the interior of the cyst shed into its lumen, the cyst will slowly enlarge. Preauricular sinuses and cysts may be closely related to the facial nerve, and for this reason, their removal should be left to an experienced surgeon.



**FIGURE 1-15**

Infected preauricular sinus. If pathogenic bacteria enter the opening of a preauricular sinus, the tract may become infected. When the tract of an infected preauricular sinus is patent, a milky, purulent material will be seen oozing onto the surface of the skin (see Figure 1-13). When the opening of the preauricular sinus is occluded, then an abscess may form. Pain, tenderness, and swelling in front of the anterior border of the helix suggests the presence of a preauricular abscess. Once a preauricular sinus has become infected, there is a strong likelihood of recurrent infection.

**FIGURE 1-16**

Hairy tragus. With age, coarse hairs appear on the tragus of some males. This is a secondary sexual characteristic that is called a “hairy tragus.”

**FIGURE 1-17**

Hairy pinna. Coarse hairs may appear on the lower portions of the helix of some individuals as they age. This type of ear is referred to as a “hairy pinna”. Hairy pinna occurs only in men and is a Y chromosome-linked trait.

FIGURE 1-18

Hypertrichosis lanuginosa acquisita. Hypertrichosis lanuginosa acquisita is an acquired condition characterized by the excessive growth of fine, villous hair. It has been associated with certain metabolic conditions (porphyria) and some medications (minoxidil).

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FIGURE 1-19

Idiopathic cystic chondromalacia (auricular pseudocyst). Benign idiopathic cystic chondromalacia is an idiopathic cystic degeneration of the auricular cartilage that presents clinically as an isolated, unilateral, asymptomatic, cystic swelling of the pinna. Aspiration produces a clear, uninfected, yellow, serous fluid.



FIGURE 1-20

Traumatic seroma. Acute or chronic friction that irritates the perichondrium of the auricular cartilage can induce a subperichondrial serous or serosanguinous effusion. A seroma should be aseptically aspirated to prevent devitalization and subsequent necrosis of the underlying cartilage.



**FIGURE 1-21****Aspirate from a traumatic seroma.**

Note the clear serosanguinous aspirate. After the fluid has been aspirated, the perichondrium should be gently compressed onto the cartilage by an inert (stainless steel or monofilament nylon) mattress suture using a button on either side of the pinna to maintain gentle pressure for 10 to 14 days to prevent reaccumulation of the fluid.

**FIGURE 1-22****Large subperichondrial hematoma.**

Hematomas of the auricle are usually the result of blunt trauma, such as those encountered during boxing, rugby, and other physical activities in which the skin of the pinna is exposed to twisting or shearing forces. The small blood vessels that lie between the perichondrium and the underlying auricular cartilage are easily ruptured by a shearing force. Once a vessel is torn, blood will leak into the subperichondrial plane (between the perichondrium and the cartilage), thereby elevating the perichondrium from the underlying cartilage. The subperichondrial hematoma shown here has formed a fluctuant purple bulge that balloons the skin over the lateral surface of the pinna and distorts its normal sharp contours.

FIGURE 1-23

Small subperichondrial hematoma. If the subperichondrial collection of blood is not removed, it will deprive the underlying cartilage of its critical nourishment, thereby producing an avascular necrosis of the involved cartilage. Simple aspiration of the hematoma is not sufficient, as it will almost always recur. A late sequela is the organization of the hematoma by the ingrowth of fibrous tissue and the development of a cauliflower ear.

**FIGURE 1-24**

Small subperichondrial hematoma post-drainage. The entire collection of blood should be aspirated under sterile conditions and the skin held down against the underlying cartilage by mattress sutures. Antibiotic coverage should be provided to prevent the development of acute perichondritis and subsequent cartilage necrosis.

**FIGURE 1-25**

Cauliflower ear. Repeated episodes of blunt trauma to the pinna (eg, after boxing, rugby, or football) can produce areas of subperichondrial separation or hemorrhage, which will cause necrosis and softening of the underlying auricular cartilage. The fibrosis that develops during the healing of these damaged areas usually results in both thickening and deformity of the lateral surface of the pinna. This type of post-traumatic deformity is called a “cauliflower ear.”



**FIGURE 1-26**

Ear mold pressure ulceration. Chronic pressure on the skin by a poorly fitting hearing-aid ear mold can cause a traumatic pressure ulcer.

**FIGURE 1-27**

Solar dermatitis (sunburn). Because of its exposed location, the superior portion of the pinna is exposed to the sun and therefore is highly susceptible to acute solar dermatitis (sunburn). Repeated exposure of the skin to solar radiation predisposes an individual to pre-malignant and malignant cutaneous changes.

**FIGURE 1-28**

Frostbite. The pinna, by virtue of its exposed location, presents a large surface area in relation to its blood supply and is consequently subject to damage from extreme cold. Exposure to very low temperatures causes a severe and prolonged vasoconstriction of the capillary walls, resulting in damage to these walls. The anesthesia that takes place in those areas of the skin exposed to the cold allows a significant amount of damage to occur “silently” without the individual’s knowledge.

The upper third of the pinna is most commonly affected by frostbite. Frostbite is usually characterized by a reddish or blue discoloration of the pinna, often accompanied by serum-filled blisters that resemble a second-degree burn.

FIGURE 1–29

Late calcification of the auricular cartilage following frostbite.

Delayed dystrophic calcification of the underlying auricular cartilage may develop years after the initial frostbite. When this occurs, the pinna is bony and hard to palpation. A radiograph of the pinna will reveal radiodense areas of calcification in the auricular cartilage.

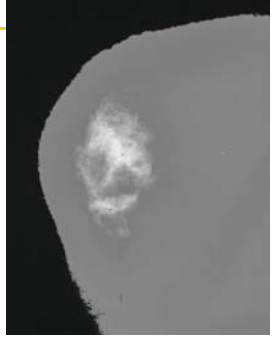


FIGURE 1–30

Early herpes zoster (shingles).

Herpes zoster is an acute localized cutaneous infection of a sensory dermatome by the *Varicella zoster* virus. It first appears as a series of pustules.



FIGURE 1–31

Late herpes zoster (shingles). Over time, the pustules rupture, and the lesions crust.



**FIGURE 1-32**

Herpes zoster of the tympanic membrane. Herpes zoster oticus is characterized by the appearance of vesicles on the skin of the pinna in the region of the conchal bowl, along the skin of the external auditory canal, and, occasionally, on the tympanic membrane.

**FIGURE 1-33**

Impetigo. The superficial layers of the epidermis may become infected with *Staphylococcus aureus* or *Streptococcus pyogenes*. Macerated and moist skin is particularly susceptible to bacterial infections. The initial lesion consists of an infected vesicle or pustule that ruptures and dries to produce typical yellowish crusts. Both the pustules and the crusts contain viable bacteria and are highly contagious.

Impetigo is surprisingly painless, and the most common symptom is the presence of crusty scabs and local itching. Treatment consists of the application of a topical cream containing an antibiotic that is effective against the causative organisms.

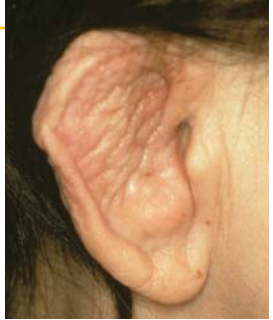
**FIGURE 1-34**

Acute perichondritis. Acute perichondritis of the auricle is a bacterial infection of the perichondrium and underlying cartilage that develops usually following trauma to the skin of the pinna. A painful, red, and swollen pinna following localized infection of the external ear, trauma, or surgery suggests the development of an acute perichondritis.

This type of acute bacterial infection is potentially serious because, if untreated, the underlying auricular cartilage will become infected and, ultimately, necrotic, with collapse of the pinna. Gram-negative bacteria, especially *Pseudomonas aeruginosa* and *Proteus*, are the usual causative organisms.

FIGURE 1-35

Relapsing perichondritis. Relapsing perichondritis is an autoimmune episodic recurrent inflammation of the cartilaginous structures of the body. Clinically, relapsing perichondritis is characterized by recurrent, always bilateral, auricular, nasal, and laryngeal chondritis. These patients have antibodies to Type II collagen.



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FIGURE 1-36

Erysipelas. Erysipelas is an acute, rapidly spreading, superficial cellulitis caused by group A β -hemolytic *Streptococcus*. It is characterized by a bright red, tender swelling that is well demarcated from the surrounding normal skin.



FIGURE 1-37

Creased lobule. The appearance of a crease running across the skin of the lobule is a minor deformity that does not appear until later life. Most commonly, the crease begins where the ear lobe attaches to the head and angles diagonally downwards and backwards to the edge of the lobule. This sign is associated with increasing age and also, independently, with an increased incidence of obstructive coronary artery disease.



**FIGURE 1-38**

Elongated earring hole. Over time, the continued wearing of a heavy earring may gradually elongate an earring hole.

**FIGURE 1-39**

Split lobule. If an earring is pulled through the lobule and the defect is not sutured, the lobule will remain split (bifid). These injuries usually occur when a large earring is accidentally grasped and pulled by an infant or child.

**FIGURE 1-40**

Infected earring tract. Localized infection within the epithelial-lined fistula tract of a pierced ear is usually the result of poor hygiene. There will be localized tenderness, erythema, swelling, and, occasionally, crusting. Pressure on the lobule will frequently expel a tiny drop of pus.

This type of infection can usually be avoided by good personal hygiene. If the infection does not respond to topical antibiotic therapy, the earring may need to be removed.

**FIGURE 1-41**

Contact dermatitis. Contact dermatitis of the external ear is relatively common and can frequently be confused with infectious dermatitis. One important differentiating feature is that patients with contact dermatitis complain primarily of itching rather than pain. Another important diagnostic clue is a track-like extension of the allergic inflammatory response below the ear as the discharge carries the allergen along.

The offending allergen may be a topical medication, such as neomycin, or one of the ingredients of topical ear drops, an ear mold, or an earring. Treatment consists of avoiding the offending allergen and applying a mild steroid-containing topical cream to the involved areas.

FIGURE 1-42

Metal contact dermatitis of the lobule. Cutaneous allergy (contact dermatitis) to metals, especially to nickel, may develop when the gold plating covering a poor-quality earring wears off and the underlying metal comes into direct contact with the underlying skin of the lobule. A localized area of contact dermatitis is frequently seen under an earring.

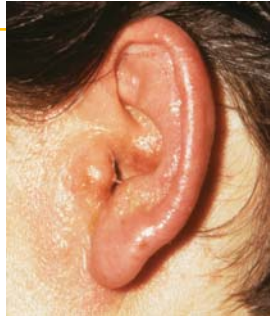


FIGURE 1-43

Hypertrophic scars. A simple hypertrophic scar should be differentiated from a keloid (Figure 1-44). Hypertrophic scars remain within the confines of the wound and flatten spontaneously over 1 or more years. In contrast, keloids persist and extend beyond the site of the original injury.



FIGURE 1-44

Keloids. Keloids are the result of an abnormality in a wound's healing process in which excessive bulk is produced at the site of a cutaneous injury, most commonly following a laceration, a surgical incision around the ear, or ear piercing. Keloids occur more commonly in blacks than in whites and develop most frequently in the second and third decades of life. In the case shown here, the keloid developed following ear piercing.



**FIGURE 1-45**

Post-traumatic epidermal inclusion cyst. Fragments of cutaneous epithelium can become trapped in the dermis of the lobule following ear piercing. If this happens, an epidermoid cyst will develop from the entrapped remnants.

**FIGURE 1-46**

Milia. Milia are small, multiple, white, keratin-filled cysts that arise from the infundibulum in the region of the sebaceous duct. Milia differ from epidermal cysts only in size.

**FIGURE 1-47**

Epidermal cysts. Epidermal cysts are slow-growing, round, firm, intradermal cysts that arise most commonly from the infundibula of hair follicles. The most common sites for the development of epidermal cysts are along the postauricular sulcus and the medial aspect of the lobule at its junction with the face.

**FIGURE 1-48**

Epidermal cyst showing cheesy debris. Clinically, these cysts appear as smooth, round, doughy masses that may have a tiny surface opening. The overlying skin is frequently yellowish-white because of the mass of pure white keratin contained within the cyst. Note the cheesy debris that is being expressed from this cyst.

FIGURE 1-49

Infected epidermal cyst. If an epidermal cyst becomes infected, the lining of the cyst may rupture, and the keratin squames within the cyst can spill out into the surrounding soft tissue.



FIGURE 1-50

Drainage of an infected epidermal cyst. An acute foreign body granulomatous reaction can develop in response to the keratin squames that infiltrate the tissue surrounding an infected epidermal cyst. Clinically, this can give rise to local tenderness. An incision into the cyst for drainage may be required, as seen here.



FIGURE 1-51

Neurodermatitis. Itching is the common feature in chronic infective dermatitis and may provoke the patient into repeated scratching of the involved area. The term “neurodermatitis” is used when the chronic dermatitis appears to be the result of trauma from repeated scratching,



The infecting organisms may be bacterial (most commonly *Staphylococcus aureus* or *Streptococcus*), fungal (most commonly *Candida albicans*), or, not infrequently, a mixture of both. These superficial infections respond well to topical antibiotic and/or antifungal therapy combined with good hygiene.

**FIGURE 1-52**

Neglect keratosis. In the elderly, neglected areas of skin may accumulate keratin debris over time. These raised, greasy, pigmented “lesions” resemble seborrheic keratosis at first glance. The diagnosis is, however, readily established, however, because these areas of neglect keratosis are easily removed by friction to reveal normal underlying skin.

**FIGURE 1-53**

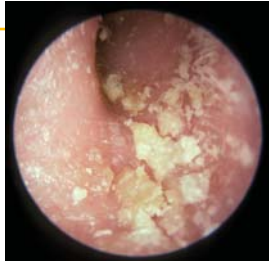
Seborrheic Keratosis. Seborrheic keratoses are benign, cutaneous tumors that appear as distinct, raised, pigmented, greasy lesions. The lesions appear to be “stuck on” to the surface of the skin, but a close examination of the surface of the keratosis will reveal keratotic plugs filling irregular crypts. Seborrheic keratoses vary in color from light yellow through brown to black.

**FIGURE 1-54**

Psoriasis. Psoriasis is a hereditary disorder of the skin that is characterized by an increased rate of epidermal cell replication. The chronic relapsing dermatosis shown here is characterized by sharply defined, dry, erythematous patches covered with adherent, silvery white scales. If the scales are removed by gentle scraping, fine, punctate bleeding points may be seen (the Auspitz sign). When psoriasis involves the external ear, the patient may also have typical lesions on the auricle.

FIGURE 1-55**Psoriasis of the external canal.**

Psoriasis may involve the external ear and the entrance to the external canal. The ear canal may be occluded by a toothpaste-like accumulation of desquamative keratin debris. If psoriasis is suspected in an otherwise asymptomatic patient with persistent accumulation of debris in the canal, the elbows and the scalp should be inspected, as these are the most common sites for psoriasis.

**FIGURE 1-56**

Gouty tophus. In advanced cases of gout, a collection of uric acid crystals may appear on the helix as a tophus. Gouty tophi present as painful, skin-covered nodules that occur most commonly on the helix. On palpation, the nodule is gritty, and yellow, crystal-like structures can occasionally be seen through the skin. Today, with modern medical treatment, gouty tophi are rarely encountered.



**FIGURE 1-57****Chondrodermatitis nodularis helicus chronica (Winkler's nodule).**

Chondrodermatitis nodularis helicus chronica is a discrete, firm, raised, and frequently tender, or even painful, nodule usually located on the apex of the helix of the ear. This lesion occurs primarily in middle-aged and elderly males, and is the result of solar damage to the skin covering the top of the pinna with resulting late solar elastosis. Repeated minor trauma and poor blood supply to the helical rim are responsible for degeneration of the skin, the underlying dermis, and the auricular cartilage. A central epidermal channel or pit (which develops for the purpose of transepidermal extrusion of the degenerated dermal collagen) is commonly seen.

**FIGURE 1-58**

Solar lentigo. Solar lentigines are multiple, brown, flat, irregular, uniformly pigmented cutaneous lesions that develop in skin that has been repeatedly exposed to the sun.

FIGURE 1-59

Solar keratosis. Solar keratoses are lesions, considered to be premalignant, that arise on areas of the skin that have been repeatedly exposed to the sun. These lesions occur most commonly in fair-skinned individuals after the third decade of life. Clinically, solar keratoses appear as dry, rough, adherent, and scaly lesions. Although a solar keratosis can develop over time into a squamous cell carcinoma, the tumor that develops is usually less malignant than the usual squamous cell carcinoma, which arises de novo.

**FIGURE 1-60**

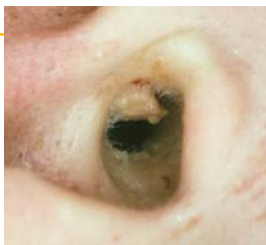
Cutaneous horn (solar keratosis). Occasionally, solar keratoses produce a circumscribed, conical, hyperkeratotic excrescence, which is termed a “cutaneous horn.” Because solar keratoses are premalignant, they should be excised.

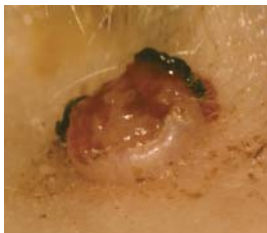
**FIGURE 1-61**

Pigmented nevus. Pigmented lesions occur frequently on the external ear. The presence of an enlarging or darkly pigmented lesion should always arouse the examiner’s suspicion that this may, in fact, represent a malignant melanoma. The lesion shown here is a benign pigmented nevus.

**FIGURE 1-62**

Verruca vulgaris. Verruca vulgaris (wart) is a benign localized area of epithelial hyperplasia caused by the human papilloma virus. Clinically, a verruca appears as a circumscribed, elevated papilloma that has a filiform or papillomatous hyperkeratotic surface.



**FIGURE 1-63**

Keratoacanthoma. Keratoacanthomas are benign, usually solitary, rapidly developing epithelial neoplasms that arise most frequently on the sun-exposed areas of fair-skinned, elderly individuals. The lesion consists of a firm, dome-shaped nodule that has skin-colored, rolled edges and a central crater filled with keratin debris. A keratoacanthomas usually begins as an erythematous papule that enlarges rapidly over 2 to 8 weeks to reach a maximum size of 1 to 2 cm; if left alone, it will involute spontaneously within 6 to 12 months, leaving behind a puckered and often unsightly scar.

Unfortunately, keratoacanthomas resemble squamous cell carcinomas both clinically and histologically. When the diagnosis is in doubt, and to avoid the scarring that accompanies spontaneous involution, an excisional biopsy is usually indicated.

**FIGURE 1-64**

Capillary hemangioma. A capillary hemangioma (strawberry birthmark) is a flat, bright red, soft, benign tumor consisting of numerous small, blood-filled capillaries. Most capillary hemangiomas resolve spontaneously during the first decade of life.

FIGURE 1-65

Arteriovenous malformation. An arteriovenous malformation presents as discoloration and distortion of the skin overlying the pinna. Palpation will reveal pulsations and auscultation an audible bruit.

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**FIGURE 1-66**

Basal cell carcinoma. The presence of persistent ulceration of the external ear should suggest the possibility of a malignancy. The patient shown here had been treated for many months for a chronic infection of the external ear when, in fact, she had an extensive basal cell carcinoma involving the conchal bowl. The diagnosis was established by biopsy. Fortunately, the tumor responded to radiotherapy.

**FIGURE 1-67**

Basal cell carcinoma. More commonly, the proliferation of basal cells creates a raised, indurated nodule with firm, pearly edges. A small central crust is frequently present, underneath which is a central ulcer.



**FIGURE 1-68**

Verrucous carcinoma. Verrucous carcinoma is a low-grade exophytic slowly growing squamous cell carcinoma that is wart-like in appearance.

**FIGURE 1-69**

Squamous cell carcinoma. Squamous cell carcinoma of the auricle occurs most frequently in persons of fair complexion who have experienced long exposure to sunlight. Clinically, a squamous cell carcinoma may appear as an indurated papule, plaque, or nodule that is frequently eroded, crusted, and ulcerated. Rapid growth in the size of the lesion, tenderness to palpation, crusting, and ulceration are all signs that should alert the physician to the presence of squamous cell carcinoma. On palpation, the lesion is hard and may be fixed to the underlying structures. There may also be spread to the regional lymph nodes.

Congenital abnormalities of the ear can be unilateral or bilateral and, of course, may be associated with congenital malformations elsewhere in the body. These deformities may be the result of a genetic defect, viral infection, or exposure to ototoxic drugs during the first trimester of pregnancy.

Severe congenital malformations of the pinna are often associated with an abnormality of the underlying middle or inner ear. As the external, middle, and inner ears differ in both their embryological origins and times of development, there is a wide variation in the types of abnormality that can be encountered.

Patients may be seen who have an absent auricle and external auditory canal and yet have only a minimal deformity of the middle ear and a normal inner ear. By contrast, some children have a normal or almost normal external ear but a severe congenital malformation of the underlying middle and inner ears.

A CT scan should be obtained to determine if the middle ear structures are sufficiently normal for middle ear reconstructive surgery to be successful.

Definitive treatment requires a complete excision of the entire sinus tract. Great care must be taken during the excision of a preauricular sinus because the sinus may extend quite deeply and be closely related to the branches of the facial nerve. Rarely, a preauricular fistula will be found as an abnormal communication between the skin of the face or neck and the external auditory canal (collaural fistula).

Preauricular sinuses are usually asymptomatic unless they become infected.

CHRONIC INFECTIVE DERMATITIS

Healthy skin usually provides an effective physical and chemical barrier against the numerous bacteria and fungi present in our environment. Under conditions of repeated trauma, moisture or maceration, the skin loses this effective barrier. The result may be an acute or chronic superficial infection of the epidermis by bacteria, fungi, or a mixture of both organisms. If the infection does not respond to the initial topical medication, a culture of the involved area should be taken for both bacteria and fungi and the medication adjusted accordingly. If the infection still does not respond, a biopsy may be needed to establish a diagnosis.