

# Swimmer's ear and differential diagnoses

**Swimmer's ear (acute diffuse otitis externa) is the most common form of otitis externa.**

**Most infections can be resolved promptly with simple ear toileting techniques and local application of antibiotic drops and ointments in conjunction with water proofing.**

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Severe acute pain of the ear (otalgia) is a common clinical presentation in both general and specialist practice. It is most often related to infection of the external ear canal skin (otitis externa) as a result of impairment of the natural local defences of the ear canal. Acute diffuse bacterial infection is the most common cause of otitis externa and is known as swimmer's ear. Otitis externa can be effectively treated with ear toileting and local application of antibiotic ear drops. Occasionally, severe acute pain accompanied by pain or bleeding represents the presentation of a destructive process within the temporal bone such as skull base osteomyelitis, osteoradionecrosis or cancer.

### The normal ear

The external ear canal is supported by bone in its medial part and by cartilage in its outer parts and

is closed at the medial end by the tympanic membrane. The entire canal is lined by tightly bound squamous epithelium. The lining in the cartilaginous part of the canal is thicker than that of the bony portion. This skin contains hair follicles and specialised sebaceous glands responsible for wax secretion. The keratinised epithelium of the drum and the external canal has a unique migratory property that is responsible for the self-cleansing nature of the external ear (Figure 1). Over a period of months the epithelium migrates in a radial pattern to the periphery of the drum, then along the external canal surfaces, becoming mixed with the antibacterial secretion of ceruminous glands. It is then discarded as common ear wax (cerumen) along with any impacted debris. The oily secretion forms an acidic water proofing layer that contains immunoglobulins and lysozymes.

### IN SUMMARY

- Acute diffuse otitis externa or swimmer's ear is a common problem in general and specialist practice.
- Underlying causes of acute diffuse otitis externa are most often bacterial or fungal infections of the external canal following water exposure.
- Most infections can be resolved promptly with simple ear toileting techniques and local application of antibiotic drops and ointments in conjunction with water proofing.
- Ear swabs are reserved for patients with recurrent otitis externa, those who are treatment resistant or at-risk patients (those who have diabetes, are immunocompromised or have had previous ear surgery or irradiation).
- At-risk patients and those with increasing pain, bleeding or failure to respond to simple treatment require referral for specialist assessment.
- Although cancer of the ear canal is rare, the symptoms are similar to those of otitis externa. A high degree of awareness is therefore required, particularly in patients who respond poorly to treatment for otitis externa.

This antibacterial and antifungal waterproofing layer, in addition to the migratory properties of the surface epithelium, forms the primary defence against ear canal infections.

### Mechanisms of infection

Otitis externa is usually caused by a combination of factors. Trauma from scratching the ear canal, combined with maceration of keratin from excessive humidity or water logging, easily impairs the normal protective mechanisms. Entry of microorganisms into the underlying tissues leads to infection and inflammation. The healthy ear canal is occupied by a wide variety of commensal bacteria in addition to some fungi and yeasts. The most common infecting organisms are Gram-negative bacilli (*Pseudomonas aeruginosa*, *Proteus* spp.) and less common infecting organisms are Gram-positive cocci such as *Staphylococcus aureus* and streptococci, and sometimes yeasts such as *Candida* and fungi such as *Aspergillus niger*.

### Acute diffuse otitis externa

Acute diffuse inflammatory change involving the external ear canal skin (acute otitis externa) is by far the most common form of otitis externa seen in clinical practice. Most canal infections are caused by a combination of factors, for example, loss of waterproofing due to water exposure, humidity and underlying skin diseases (e.g. dermatitis, psoriasis, contact sensitivity). The infection is often

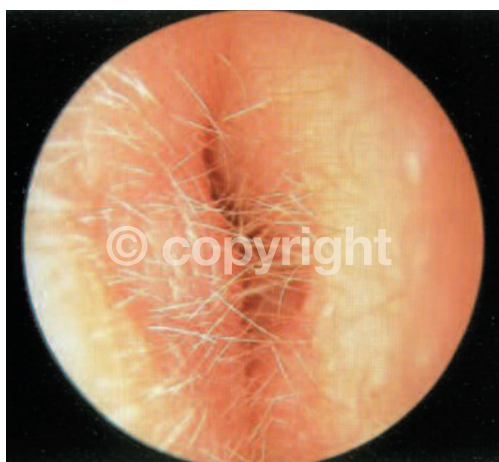


triggered by mild trauma, for example, by cleaning the irritated ear canal with a tissue, cotton bud, hair pin or bath towel. Recurrent cases might be associated with humidity by the use of a hearing aid, ear speaker or an occlusive ear muff.

In the early stages of infection, sparse watery discharge and irritation are the only symptoms of acute diffuse otitis externa. The ear canal skin is mildly inflamed with waterlogging of the surface epithelium, but the canal lumen remains patent (Figure 2a). As the inflammation progresses, the ear canal lumen becomes occluded, resulting in loss of hearing and there is a dramatic increase in

Figure 1. Epithelial migration. In this cadaver specimen, the keratin patches have been stained black with osmium tetroxide to emphasise the radial migratory pattern on the tympanic membrane.

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Figures 2a and b. Acute diffuse otitis media. a (left). Early stage of infection showing mildly inflamed ear canal with waterlogged and swollen epithelium. b (right). Severe stage of infection, with occlusion of the ear canal.

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continued



Figure 3. Fungal infection of the ear canal.

COURTESY OF DR BENEDICT PANIZZA, BRISBANE.

pain (Figure 2b). The ear canal appearance is of macerated 'wet blotting paper' keratin and oedema. Masses of black, brown or yellow fungal hyphae may be visible, giving a clue as to the underlying causative organism (Figure 3). At the extreme stages of infection, there is intense pain with total occlusion of the ear canal, trismus, cellulitis of the periauricular soft tissues and local lymphadenopathy. Examination of the ear at this stage is difficult, particularly in children. Any manipulation of the pinna or ear canal produces extreme pain. The

reason for this extreme pain is the tightly bound nature of the epithelial lining to the underlying cartilaginous and bony canal making even slight oedema cause a large increase in local tissue tension. Analgesia is helpful in the most acute stages of the infection, but it is not until the inflammation begins to subside that relief of the extreme pain is achieved.

### Principles of treatment for acute otitis externa

The treatment goal in ear canal infections is to restore protective mechanisms to their normal state. This process often takes two to three weeks to occur and can be achieved by instituting some basic principles of therapy, which include (Table 1):

- removal of accumulated debris
- treatment of the underlying infective agent with local antibiotic applications
- promoting water proofing of the ear canal skin.

The end point of treatment occurs with the complete resolution of all symptoms and a return to the normal self-cleansing properties of the canal skin signified by the production of wax. The resolution of symptoms generally occurs before the return of wax production. However, it is important to continue the treatment process during this asymptomatic period to prevent recurrence of the infection. Persisting or worsening symptoms are often due to failure to follow basic principles of therapy.

Instituting the principles of therapy in

the painful stages of otitis externa is often difficult, but with gentle patience and the appropriate equipment it is possible to toilet the ear canal and apply topical antibiotics, which will encourage resolution. The use of a headlight (voroscope), fine dental broach probe loaded with cotton and a pope otowick (Xomed, Jackson, Florida) are useful tools (Figure 4). Co-operation of the patient is mandatory to prevent inflicting any more discomfort than is necessary during the procedure. In the case of children a brief general anaesthetic may be required. The toileting process often has to be repeated a few times on alternate days until the oedema and canal occlusion resolve and the underlying tympanic membrane can be seen.

### Antibiotic drops and ointments

Several preparations of ear drops and ointments are available for treating otitis externa. Most have a combination of active ingredients consisting of antibacterial and antifungal agents in addition to a corticosteroid. They are presented as either water-based drops or oil-based drops and ointments as shown in Table 2. Examples of water-based drops include dexamethasone, framycetin plus gramicidin (Otodex, Sofradex), framycetin (Soframycin Ear), chloramphenicol (Chloromycetin Ear Drops), ciprofloxacin (Ciloxan Ear Drops) and ciprofloxacin plus hydrocortisone (Ciproxin HC Ear Drops). Examples of oil-based drops and ointments include clioquinol plus flumethasone (Locacorten-Vioform Ear

**Table 1. Principles of treatment for swimmer's ear**

- Diagnosis
- Ear toileting
- Local antibiotic therapy (drops and ointments)
- Water protection
- Adequate follow up
- Prevent recurrence
- Specialist referral for patients at high risk, including those who:
  - have persistent, increasing or severe pain
  - have bleeding
  - have diabetes
  - are immunosuppressed
  - have had radiotherapy

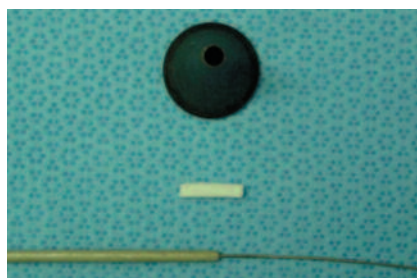


Figure 4. Equipment useful for toileting the ear and applying topical antibiotics. a (left). An ear speculum, an otowick and a broach probe. b (right). A head light.

**Table 2. Commonly available antibiotic ear drops and ointments**

Preparation	Active ingredients			Base		Ototoxic
	Antibacterial	Antifungal	Corticosteroid	Water	Oil	
Sofradex (drops and ointment)	Yes	No	Yes	Yes	No	Yes
Otodex	Yes	No	Yes	Yes	No	Yes
Soframycin Ear (drops and ointment)	Yes	No	No	Yes	No	Yes
Chloromycetin Ear Drops	Yes	No	No	Yes	No	Maybe
Ciproxin HC Ear Drops	Yes	No	Yes	Yes	No	Maybe
Ciloxan Ear Drops	Yes	No	No	Yes	No	No
Prednisolone	No	No	Yes	Yes	No	No
Locacorten-Vioform Ear Drops	No	Yes	Yes	No	Yes	Maybe
Kenacomb Otic (drops and ointment)	Yes	Yes	Yes	No	Yes	Yes
Otocomb Otic (drops and ointment)	Yes	Yes	Yes	No	Yes	Yes

Drops) and gramicidin, neomycin, nystatin plus triamcinolone acetonide (Kenacomb Otic, Otocomb Otic).

The choice between an oil- or water-based treatment is important. Although treatment with a water-based drop is easier, prolonged treatment tends to further waterlog the already oedematous and macerated canal skin, promoting fungal overgrowth and treatment failure. A recommendation is to commence therapy with a water-based drop (e.g. Sofradex or Soframycin Ear), applied with the assistance of a pope otowick, for a few days. Once the acute pain has subsided, the canal should be thoroughly toileted, then a change to an oil-based treatment (e.g. Locacorten-Vioform Ear Drops, Kenacomb Otic) is indicated. The oil-based treatment can be instilled as a drop (warmed to render it soothing and less viscous) or painted on with a cotton mounted broach probe. Filling the canal with ointment (e.g. Kenacomb Otic ointment) using a 2 mL syringe and blunt

plastic catheter (Jelco 16 gauge) is a particularly useful technique as the ointment tends to linger for a week or two and obviates the patient in complying with the application of any further drops.

### Swab cultures

Despite knowledge of the microbiology of otitis externa, the use of culture swabs in the discharging ear seems to be of little practical relevance in treatment. Cultures often produce mixed results or an organism that represents a commensal, therefore interpreting the swab result is difficult.

In the author's experience, adherence to the general principles of therapy is more important in producing rapid resolution of infection than the specific choice of antimicrobial agent. However, a swab culture may be useful in cases of treatment failure and in diabetic or immunocompromised patients. The culture will often demonstrate a fungal cause and an appropriate antifungal agent can be instituted.

### Water protection and prevention

Protection of the external ear canal from water exposure during swimming and showering remains the main preventative treatment for otitis externa. The most effective way of achieving this is to place in the conchal bowl a cotton wool ball (about the size of a small finger tip) that has been heavily impregnated with Vaseline (Figure 5). This method has the



Figure 5. Protecting the ear canal from water with a Vaseline-impregnated cotton wool ball.

**Table 3. Differential diagnoses of swimmer's ear****Eczematous otitis externa**

Dermatitis  
Contact sensitivity

**Localised otitis externa**

Perichondritis  
Furunculosis  
Myringitis

**Chronic otitis media with cholesteatoma****Otitis media with perforation****Destructive temporal bone conditions**

Osteoradionecrosis  
'Malignant' otitis externa  
Cancer of the external ear canal

advantages of using a commonly available and inexpensive product and being effective and suitable for adults and children. A new plug can be used each time, reducing the chance of contamination and reinfection. Commercial silicon ear plugs can also be used, but they may need to be smeared with Vaseline to make them water tight and may abrade the ear canal or transfer infection. The use of acetic acid and isopropyl alcohol drops (Aquaear) or glycerol and isopropyl alcohol drops (Ear Clear Dry & Clear) as drying agents or a hair dryer on low setting are also useful preventative measures. The sensation of stinging indicates the onset of infection, therefore, a change to a more intensive antibiotic drop and protection against water exposure is indicated.

Ear canal wax is the natural waterproofing of the ear canal, and gives excellent protection from otitis externa; however, in cases of extreme production or when removal becomes necessary, gentle mechanical ear toileting using a headlight and cotton loaded broach probe is the preferred technique. Syringing, although a well known traditional



Figure 6. Chronic otitis externa due to contact dermatitis.

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technique, is probably best avoided in patients with a history of otitis externa. Wax dissolving drops (e.g. Waxsol, Cerumol Ear Drops) can also be useful for wax clearance, but prolonged use for more than two or three days is associated with a chemical irritation of the canal skin.

**Differential diagnoses**

Swimmer's ear is an acute diffuse bacterial otitis externa. It needs to be differentiated from other forms of otitis externa and conditions affecting the external and middle ear (Table 3).

**Eczematous otitis externa**

Chronic skin disease (e.g. eczema, dermatitis, psoriasis or contact sensitisation) can also involve the canal skin. These skin conditions impair the protective mechanisms by removing the waxy waterproof layer, predisposing to infections. They also allow dehydration of the skin leading to annoying itchiness. The almost irresistible desire to scratch the ear canal further assists the entry of organisms.

**Dermatitis**

Psoriasis and eczema are common predisposing factors to acute diffuse otitis externa. Dermatitis is often responsible for the annoying itch that patients experi-

ence once an acute infection has been successfully treated. Patients find it almost irresistible to scratch the canal with a hair pin or cotton bud, causing mild trauma that starts the whole cycle again. In acute dermatitis, the conchal bowl is inflamed, fissured and weeping. Dermatitis can be seen affecting the pinna, periauricular areas and other parts of the body. The condition is commonly bilateral. The annoying itch and irritation can be effectively treated with intermittent ear drops or ointments containing a corticosteroid (e.g. Kenacomb Otic ointment), or simple warm vegetable oil, which can prevent dehydration of the canal skin and promote the normal mechanisms of protection.

**Contact sensitivity**

Contact sensitivity to hair sprays, hair care products, soaps and detergents are relatively common. Continual exposure of skin on the external ear canal to such products can result in sensitisation reactions, presenting as chronic otitis externa (Figure 6). The diagnosis is suggested by the history of chemical contact and the improvement with discontinuation of the offending product. Patch testing can be helpful in identifying the offending product if there are multiple suspected sensitising agents involved. Sensitisation to therapeutically applied ear drops, mainly those containing antibiotics (in particular neomycin), also occurs. It is important to recognise the possibility of drop-related sensitisation as it often occurs in patients treated for acute otitis externa, in whom symptoms continue despite what seems to be adequate treatment. Once recognised, instituting the principles of treatment with an alternative preparation results in rapid resolution.

**Localised otitis externa**

Localised forms of otitis externa also occur. The inflammation can involve just part of the hair bearing canal skin (furunculosis), the cartilaginous pinna (perichondritis) or the external surface

continued



Figure 7. Furunculosis.



Figure 8. Perichondritis.



Figure 9. Myringitis.

FIGURES 7, 8 AND 9. © PROFESSOR EMERITUS MICHAEL HAWKE, UNIVERSITY OF TORONTO, CANADA. SOURCE: BENJAMIN B. BINGHAM B, HAWKE M, STAMMBERGER H. 'A COLOUR ATLAS OF OTORHINOLARYNGOLOGY', LONDON: MARTIN DUNITZ, 1995.

of the ear drum (myringitis). In all these conditions discharge accompanied by irritation and pain are the common presenting symptoms.

#### Furunculosis

Furunculosis involves the hair bearing skin of the cartilaginous external canal. There may be a small amount of purulent discharge from the lesion, but the hallmark of this condition is the disproportionate amount of pain to the size of the inflammatory lesion, which is usually the size of a pimple (Figure 7). The reason for the extreme pain is the tight and adherent nature of the canal skin to the underlying perichondrium; therefore, even a small degree of inflammation and oedema adjacent to the perichondrium results in a great amount of tissue tension. Severe pain is produced on palpation of the lesion, with movement such as chewing or smiling and with manipulation of the area for examination or ear toileting. The underlying infective organism is *S. aureus* and the primary treatment is high doses of oral flucloxacillin for 14 days. Occasionally, lancing of an area of abscess formation is required.

#### Perichondritis

Perichondritis involves the cartilaginous part of the pinna. The upper pinna becomes inflamed, thickset and extremely

tender to manipulation (Figure 8). The noncartilaginous lobule is usually spared. Multiple earring piercings, which involve the upper part of pinna, breach the perichondrium and predispose patients to perichondritis. The underlying infective organisms are *Pseudomonas* spp. or occasionally *S. aureus*.

Patients with early perichondritis can be treated with oral ciprofloxacin and not be admitted to hospital, but the condition can be surprisingly debilitating. Patients with established perichondritis need to be treated in hospital with intravenous antipseudomonal antibiotics. Prolonged infection leads to abscess formation, extensive cartilage necrosis and cauliflower ear deformity. An autoimmune form of perichondritis can occur (relapsing perichondritis), but this is extremely rare and usually part of a systemic illness occurring in combination with perichondritis of the nasal, laryngeal and tracheal cartilages.

#### Myringitis

Myringitis is limited to the external surface of the tympanic membrane. It presents with discharge and a mild hearing loss. Examination shows a thickened inflamed tympanic membrane, often with large amounts of granulation tissue obscuring the normal drum landmarks (Figure 9). The surrounding external canal skin is normal. The cause is unknown but

presumed to be infective in origin. The condition is difficult to treat and can persist for years. Occasionally, healing of the inflamed deep canal occurs with blunting of the drum margins and foreshortening of the external canal resulting in a marked hearing loss. This may require surgery to excise the fibrous tissue and grafting of the deep canal and drum to improve hearing. Acute myringitis can sometimes be treated successfully with the use of local mild chemical cauterity and prolonged application of corticosteroid and antibiotic drops.

A bullous form of myringitis also occurs, in which large haemorrhagic oedematous blebs form on the outer tympanic membrane surface and deep canal. The condition is extremely painful, with relief occurring after rupture of the bullae, resulting in a small amount of watery blood-stained discharge. The course of the illness is self-limiting, lasting approximately two weeks. *Mycoplasma pneumoniae* has been cultured from the vesicle fluid, but it is not known if treatment with erythromycin shortens the duration of the pain.

#### Chronic otitis media with cholesteatoma

Mastoidectomy surgery is the usual form of treatment for patients with chronic otitis media with cholesteatoma. It involves removing part of the bony and

**Table 4. Differential diagnoses for the discharging painful ear**

History and examination	Otitis externa	Acute otitis media with perforation	Chronic otitis media
Pain	Present, may be severe	Present, relieved by perforation	Minimal
Itch	Prominent	Absent	Minimal
Fever	Late	Early	Rare
Discharge	Sparse	Mucopurulent	Intermittent mucopus
Precipitation factors	Water exposure, humidity, cleaning canal	Upper respiratory tract infection	Water exposure, upper respiratory tract infection
Examination of the ear canal	Oedema, tender, appearance of macerated 'wet blotting paper'	Pulsatile mucoid discharge	Debris, muco pus
Examination of the ear drum	Obscured with debris	Red, perforation with pulsatile discharge	Perforation
Underlying infective organisms	<i>Pseudomonas aeruginosa</i> , <i>Staphylococcus aureus</i> , yeasts, fungi	<i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> , <i>S. aureus</i>	<i>P. aeruginosa</i> , Gram-negative bacteria, <i>S. aureus</i>

cartilaginous external ear canal and changing the configurations of the middle ear cleft, forming a mastoid cavity and a widened external canal. Despite radically altering the configurations of the external and middle ear, many mastoid cavities are trouble free and self-cleansing. However, some cavities are susceptible to otitis externa, usually following water exposure. Annual toileting of the debris build up is the best way of preventing infections. However, if acute diffuse otitis externa supervenes, toileting of the cavity and adherence to the general principles of treatment for acute otitis externa will result in the rapid resolution of symptoms.

### Otitis media with perforation

A common problem with the discharging ear is to distinguish the cause of the infection of the external ear canal, which could be due to otitis media associated with a perforation of the underlying tympanic membrane or the presence of a grommet. This is an important distinction as the aetiology and microbiology of discharge from infections of the middle ear differs considerably from that of the otitis

externa (Table 4), and consequently different treatment principles need to be applied. In otitis externa, the use of potentially ototoxic ear drops is safe as the intact tympanic membrane will prevent absorption to the inner ear. However, in the presence of a perforation or grommet there is the potential for ototoxic ear drops to be absorbed via the middle ear into the inner ear causing irreversible hearing loss and vestibular problems. This potential side effect needs to be balanced against the demonstrated efficacy of the most commonly available topical antibiotic ear drop, Sofradex. This is a highly effective treatment for otitis media with perforation, clearing the discharge in most cases within a few days. However, because of its ototoxic potential it should be used with careful supervision and only for a limited period of time (three to four days). If the discharge persists beyond this period then referral of the patient to an ENT specialist is required. Although Sofradex topical antibiotic therapy has been used in the opened tympanic cavity and discharging grommet situation for many years with great efficacy, the few

documented cases of ototoxicity in this situation have suggested greater caution is required with its use.

Ciloxan Ear Drops (ciprofloxacin) is a fluorinated quinolone antibiotic drop, is not ototoxic and can be used in the external ear for otitis externa in patients with an intact drum as well as in those with an opened tympanic cavity (discharge perforations or grommets). Ciproxin HC (ciprofloxacin plus hydrocortisone) has been available in Australia since 2002 and is only indicated for otitis externa in the closed middle ear.

### Destructive temporal bone conditions

Rarely, severe acute pain accompanied by pain or bleeding indicates a destructive process within the temporal bone, such as osteoradionecrosis, malignant otitis externa or cancer.

### Radiation-induced otitis externa (osteoradionecrosis)

Radiation therapy involving the external canal and temporal bone results in a variety of changes that present with discharge and pain. During the course of

continued



Figure 10. Squamous carcinoma of the external ear canal.

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radiation therapy there is often an acute reaction, resulting in diffuse otitis externa. This tends to settle down with cessation of the radiation course, but symptom resolution can be hastened by applying the usual principles of therapy for acute otitis externa. The long-term result of radiotherapy is an alteration in the migratory properties of the external canal skin, resulting in build-up of epithelial debris. At the severe end of the spectrum there is extensive death of the skin and underlying bone, resulting in sequestrum formation. Patients present with continuous offensive discharge pain and occasional bleeding. There can be great disruption to the patient's life and there is concern about cancer recurrence in the

region because of the bleeding.

Treatment consists of repeated ear toileting, debridement of the sequestrum and consideration of obliteration of the middle ear cleft and external ear with vascularised tissue. All patients with osteoradionecrosis require speciality referral for assessment and management.

### 'Malignant' otitis externa

'Malignant' or necrotising otitis externa is osteomyelitis of the skull base. It occurs in elderly patients with diabetes or immunocompromised patients and is associated with a high degree of morbidity. The presentation is purulent, sometimes with a bloody discharge accompanied with intense pain. The external canal is filled with granulation tissue. The occurrence of facial nerve or lower cranial nerve palsies is a poor prognostic sign. A diagnosis is made on nuclear imaging of the skull base showing intense uptake in the region of the temporal bone. The underlying infective organisms are *P. aeruginosa* or invasive fungi such as *Aspergillus*, and treatment involves prolonged intravenous antibiotics.

### Carcinoma of the external ear canal

Cancers arising from the skin or glandular elements of the external canal are extremely rare. Although bleeding is a hallmark sign, cancer can present with symptoms identical to chronic diffuse otitis externa (Figure 10). Examination of the ear canal

shows oedema, swelling and ulceration with granulation tissue. Palpation of these ulcerated areas often results in bleeding. A high index of awareness is required to diagnose cancers in this region at an early stage because cancers in this region are rare and the canal appearance is similar to that of severe otitis externa. Patients with a suspicious lesion should be referred for urgent specialist assessment and biopsy.

### Conclusion

Otitis externa is a common problem in clinical practice. Most cases can be diagnosed after taking a full history and examination. Treatment based on simple principles and knowledge of the normal physiology of the ear canal usually produces satisfying results. However, patients who have persistent discharge, worsening pain or bleeding or who fail to respond to adequate therapy require specialist referral for assessment. A high index of suspicion is required to diagnose patients with more serious and sometimes life-threatening conditions of the temporal bone and skull base, who also present with discharge. **MT**

DECLARATION OF INTEREST: None.