

CHRONIC OTITIS IN CATS

Clinical management of primary, predisposing and perpetuating factors

Bailey Brame and Christine Cain

The normal feline ear

Anatomic features and physical examination

With the exception of the Scottish Fold, domestic cats have upright pinnae, allowing for air circulation. This makes them less vulnerable to environmental factors that predispose to otitis, such as humidity and the effects of bathing or swimming. Despite the conformational difference in the Scottish Fold, an increase in otitis has not been reported in this breed.

It is normal for the feline ear to have a moderate amount of dark brown ceruminous debris present in the canal.¹ In the absence of other clinical signs, this is not suggestive of otitis externa. Cerumen may also be clear, white or yellow.

Unlike the dog, the bulla in the cat is divided into medial and lateral compartments by a thin, bony septum with a small opening between (Figure 1).² Under otoscopic guidance, it is feasible to access the lateral compartment; however, a bulla osteotomy is typically required to access the medial compartment. This affects treatment options for feline middle ear disease.

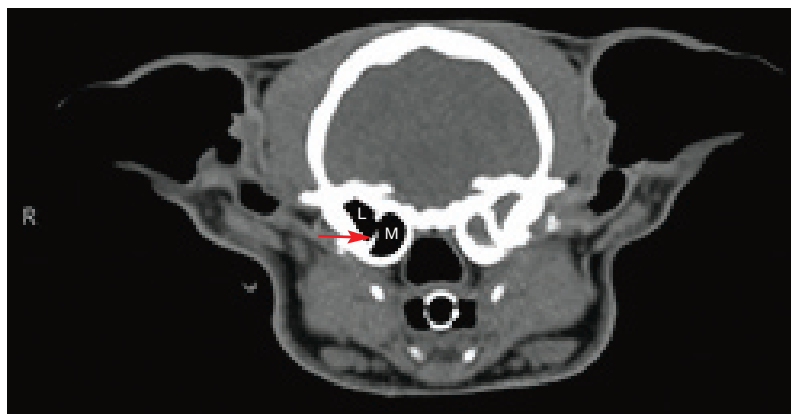


Figure 1 CT of a 6-year-old castrated male domestic shorthair cat with unilateral otitis media and otitis externa. Note the bony septum (arrow) that divides the medial (M) and lateral (L) compartments of the tympanic bulla. On the left side, there is fluid filling the bulla, and the bulla and septum are sclerotic secondary to chronic otitis media

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Practical relevance: Chronic otitis can be one of the most frustrating diseases to manage for a small animal practitioner. While it occurs less commonly in the cat than the dog, it is no less challenging. The purpose of this review is to discuss the common and uncommon causes of chronic otitis in the cat within the clinical framework used for diagnosis and treatment. The focus is on diseases that affect the ear canal, rather than those restricted to the pinnae.

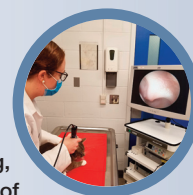
Clinical challenges: Otitis is multifactorial, which complicates management. A common clinical mistake is to focus solely on treating the infection present. Only by addressing all factors will a clinician successfully control chronic otitis. For the purposes of this review, the authors have adopted the established model of separating primary, predisposing and perpetuating causes of otitis. Primary factors are those that directly cause otitis (inflammation); predisposing factors are those that put the patient at risk for development of otitis; and perpetuating factors are those that result in ongoing clinical signs of otitis or that prevent clinical resolution.

Audience: This review is aimed at veterinarians who treat cats and particularly those with an interest in feline dermatology and otology.

Equipment: While many practitioners rely on a hand-held otoscope, a video-otoscope can be very helpful for the diagnosis and treatment of chronic otitis.

Evidence base: This review presents up-to-date information regarding the diagnosis and treatment of chronic otitis in cats, with emphasis on the most recent peer-reviewed literature.

Keywords: Chronic otitis; otitis externa; otitis media; *Otodectes cynotis*; inflammatory aural polyp



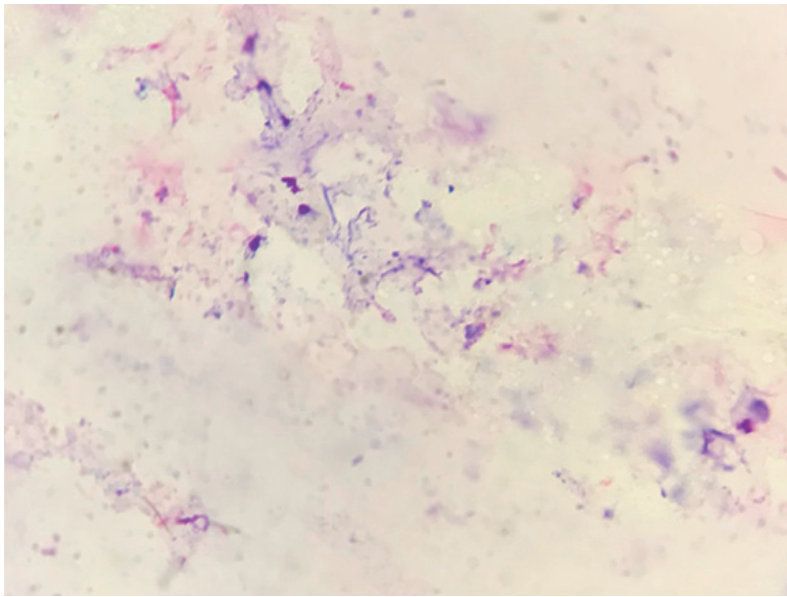


Figure 2 Cytology from a normal feline ear with mild staining artifact

Normal cytologic findings and flora

Feline ear cytology can be challenging to interpret because cats' cerumen can absorb stain, resulting in a stain artifact resembling bacterial cocci (Figure 2). Evaluating for pairs of cocci may help avoid misinterpretation.

Ginel et al evaluated cytologic samples from the external ear canal of healthy cats and cats with otitis externa to develop reference intervals for otic cytology.³ Cats were considered normal if they had two or fewer *Malassezia* organisms and four or fewer bacterial organisms per high-power field (HPF).³ The presence of cocci on cytology in healthy cats varies greatly by report, ranging from 2% to 71%,^{1,4} with a median density of 0.3 cocci per HPF in one study.⁴ The most commonly cultured bacteria from feral cats' ears in Grenada, West Indies were coagulase-negative *Staphylococcus* species, which made up 67% of isolates.⁵

Malassezia species, most commonly *Malassezia pachydermatis*, can be found on aural cytology and culture in normal cats.⁶⁻¹¹ The prevalence of *Malassezia* species on otic cytology reported in the literature ranges from 23% to 83%.^{1,4,6-8,12} In normal cats, the median density of *Malassezia* species on cytology ranges from 0.2 to 0.5 organisms per HPF.^{1,3} Among Belgian stray cats, 94% of those with *Malassezia* species on cytology had three or fewer organisms per HPF.¹²

Rod-shaped bacteria are rarely seen in healthy cats, so their presence suggests otic pathology.^{1,3} In one study, *Bacillus* species and *Pantoea* species accounted for 17% and 4% of bacterial isolates from the ears of feral cats, respectively.⁵

Keratinocytes and nucleated keratinocytes are a normal finding in feline otic cytology.^{1,12}

On ear cytology, cats' cerumen can absorb stain, resulting in a stain artifact resembling bacterial cocci. Evaluating for pairs of cocci may help avoid misinterpretation.



and were not increased in a group of cats with otitis externa.³ Low numbers of melanin clumps and saprophytes can also be seen in normal cats.¹² However, inflammatory cells are not a normal finding in the feline ear, and their presence suggests disease.³


Clinical presentation of, and diagnostic approach for, feline otitis

Owners often report head shaking, scratching or pawing at the ears, pain, excessive ceruminous debris and/or a foul odor. Less commonly, decreased appetite or lethargy are reported.

On physical examination, a cat with otitis externa may have excoriations, erythema, crusting and edema of the pinna or ear canal. The quantity and character of discharge is variable. The cat may exhibit pain on manipulation of the ear or opening the mouth, and a scratch response can be seen during evaluation of the ear. Aural hematoma is sometimes seen in cats secondary to otic pruritus.

On otoscopic examination, erythema and edema of the canal are typically present. The tympanic membrane can be thickened or opaque. If otitis media is present, fluid may be visible through the tympanum, or the tympanic membrane may bulge outward (see 'Otitis media' section later). Purulent debris can impede evaluation of the tympanum or horizontal canal.

Distribution (unilateral or bilateral) of otitis, lesion character and the presence of concurrent neurologic signs or systemic illness can aid in differentiating between causes (see Table 1). The overall diagnostic approach to otitis is summarized in the box on page 436.



Rod-shaped bacteria and inflammatory cells are not normal findings in the feline ear, and so their presence suggests disease.

Prevalence of feline otitis

The reported prevalence of otitis externa, media or interna varies greatly in the literature. Among cats presenting to general practice in a UK study, 2.8% were evaluated for otitis.¹⁴ Ten percent of cats presenting

to a dermatology service of a US veterinary teaching hospital were diagnosed with diseases of the ear canal.¹⁵ Among a population of Italian stray cats, 55% had otitis externa based on cytologic criteria.¹⁶

Table 1 Differentiation of diseases contributing to feline otitis (continued on page 436)

	Disease or etiology	History	Clinical features
Common	<i>Otodectes cynotis</i>	<ul style="list-style-type: none"> Most common cause of feline otitis externa Young cats No recent history of preventive treatment with efficacy against <i>O. cynotis</i> Older cats may be infested without clinical signs 	<ul style="list-style-type: none"> Bilateral Otic pruritus Excessive dark brown ceruminous debris with 'coffee ground' texture Mites may be present on the face and around the ears Secondary infection common
	Allergic skin disease	<ul style="list-style-type: none"> Chronic otitis that recurs after cytologic resolution Previous or concurrent pruritus or skin lesions consistent with feline allergy – eosinophilic granuloma complex, symmetrical alopecia, head and neck pruritus or miliary dermatitis Good response to glucocorticoids 	<ul style="list-style-type: none"> Bilateral Secondary infection common Excoriations of the pinnae and preauricular area
	Dermatophytosis	<ul style="list-style-type: none"> Young cats and geriatric cats Cats with systemic disease or immunosuppression Others in the household may be affected Persians may be over-represented Poor response to glucocorticoids 	<ul style="list-style-type: none"> Bilateral Alopecia, erythema, scale or crust, and variable pruritus Disease is not usually restricted to the ear canal Pinnae and head are commonly affected
Infrequent	Inflammatory aural polyps	<ul style="list-style-type: none"> Chronic Young cats and kittens Secondary infections may fail to respond to appropriate treatment Patients may also have previous or concurrent upper respiratory or ocular signs, vestibular signs or Horner's syndrome 	<ul style="list-style-type: none"> Unilateral >bilateral Polyp may be restricted to the middle ear or may extend into the external canal Smooth, pink nodule can often be visualized in the canal at the level of the tympanum Secondary bacterial otitis common
	Neoplasia	<ul style="list-style-type: none"> Chronic Older cats Secondary infections may fail to respond to appropriate treatment Vestibular signs, facial nerve paralysis and pain on opening the mouth may be seen 	<ul style="list-style-type: none"> Unilateral A mass may be visualized within the canal Secondary bacterial otitis common
	Pemphigus foliaceus	<ul style="list-style-type: none"> Acute onset, chronic disease Most cats have multiple sites affected Signs of systemic illness common, including lethargy, fever and decreased appetite Variable pruritus Typically, an excellent response to glucocorticoids 	<ul style="list-style-type: none"> Bilateral Pustules, erosions and crusts with secondary alopecia on affected skin Pinnae are the most commonly affected site; ear canals are affected less often Secondary infection of affected skin is common
	Contact reaction	<ul style="list-style-type: none"> Recent treatment with topical otic product Otic pruritus and discomfort worse after treatment 	<ul style="list-style-type: none"> Bilateral if both ears treated Marked otic inflammation, which may extend onto the concave pinnae Cytology may show worsening inflammation despite improvement in degree of infection
Uncommon	Ceruminous gland cystomatosis	<ul style="list-style-type: none"> Older cats Male cats over-represented Cats with a history of chronic otitis Persians and Abyssinians over-represented 	<ul style="list-style-type: none"> Bilateral Dark brown to gray-blue cystic papules and nodules present on the concave pinnae extending into the canal Secondary infection can occur
	Proliferative and necrotizing otitis externa (PNOE)	<ul style="list-style-type: none"> Kittens and young adults Patients may have a history of an incomplete response to glucocorticoids 	<ul style="list-style-type: none"> Bilateral Concave pinnae and ear canals affected Proliferative plaques covered in thick adherent keratinaceous exudate Secondary infection can occur
	Idiopathic facial dermatitis of Persian and Himalayan cats	<ul style="list-style-type: none"> Chronic Young Persian and Himalayan cats Progressive pruritus Poor response to glucocorticoids and antibiotics 	<ul style="list-style-type: none"> Bilateral Otic erythema and black, waxy debris Black debris in the hair on the face, progressing to erythema, crusting and ulcers Secondary infection can occur, particularly on the face
	Ceruminoliths	<ul style="list-style-type: none"> Chronic history of otitis externa Chronic use of ear medications or cleansers may predispose 	<ul style="list-style-type: none"> Hard concretion of cerumen, keratin and/or dried medication seen on the floor of the horizontal canal close to the tympanum on otoscopy
	Idiopathic ceruminous otitis	<ul style="list-style-type: none"> Excessive debris may be present lifelong 	<ul style="list-style-type: none"> Bilateral Accumulation of ceruminous debris Secondary infection can occur
	<i>Aspergillus</i> species	<ul style="list-style-type: none"> Chronic History of treatment with oral and topical antibiotics common, especially fluoroquinolones Immunosuppression may predispose 	<ul style="list-style-type: none"> Unilateral >bilateral Brown ceruminous debris Mixed infection is common Rarely nodular otitis Otitis media may occur
	<i>Demodex cati</i>	<ul style="list-style-type: none"> Generalized <i>D. cati</i> infestation usually occurs in immunocompromized cats 	<ul style="list-style-type: none"> Bilateral Ceruminous otitis
	<i>Cryptococcus neoformans</i>	<ul style="list-style-type: none"> Acute Access to outdoors Males may be over-represented Additional signs of systemic illness may occur, including upper respiratory signs and sudden blindness 	<ul style="list-style-type: none"> If widespread disease, cutaneous nodules with draining tracts may also be seen

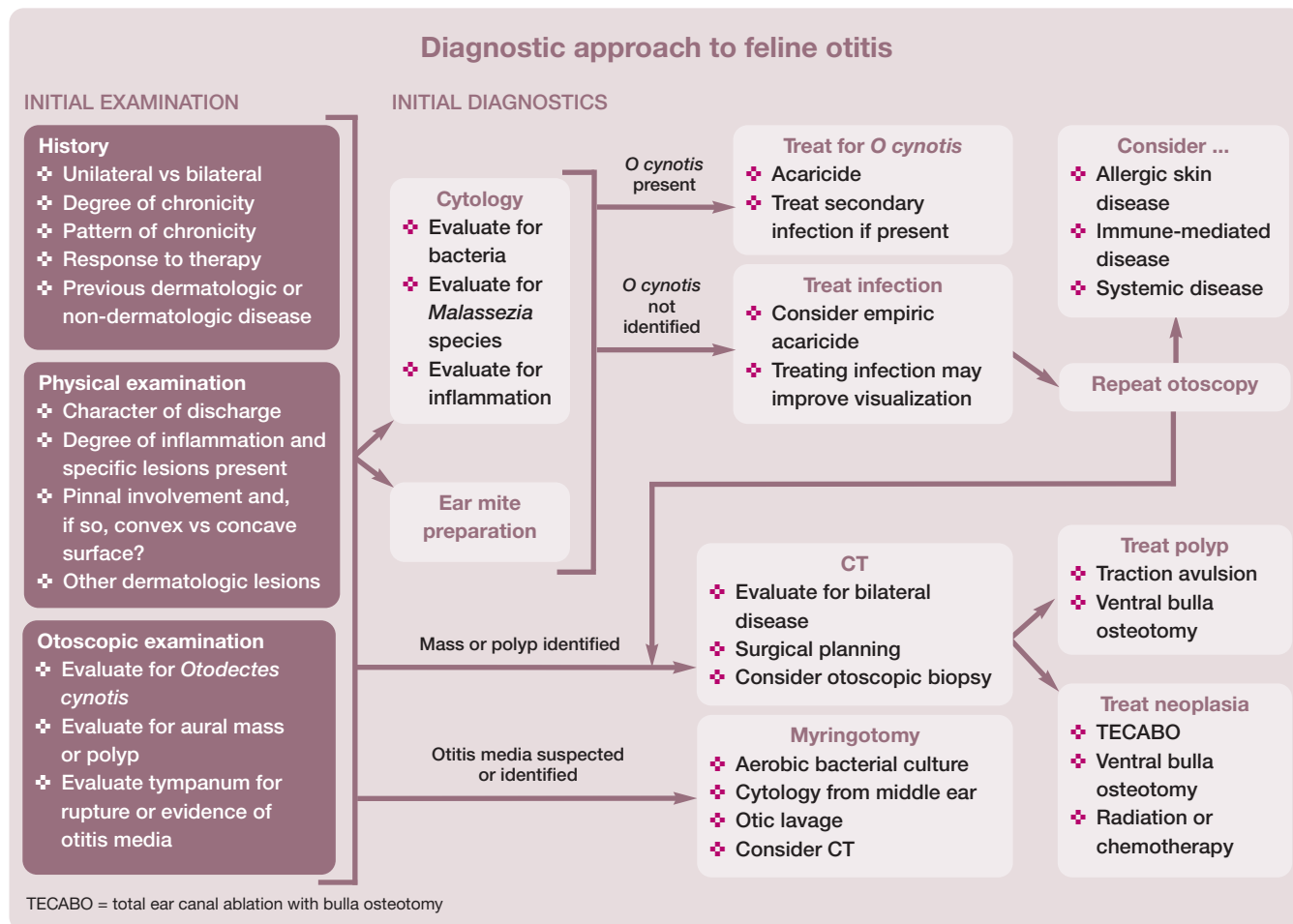
Table 1 Differentiation of diseases contributing to feline otitis (continued from page 435)

Disease or etiology	History	Clinical features
Sebaceous gland dysplasia	<ul style="list-style-type: none"> Occurs congenitally in short-haired kittens (4–12 weeks old) Hypotrichosis starts on the head but quickly generalizes 	<ul style="list-style-type: none"> Bilateral Crusting within the canal and along pinna margins Generalized alopecia and scale with a coarse haircoat Otitis may occur secondary to obstruction of the canal
Cholesterol granuloma	<ul style="list-style-type: none"> Chronic Vestibular ataxia, circling, head tilt and Horner's syndrome may be seen 	<ul style="list-style-type: none"> Unilateral Associated with otitis media A mass may be visualized within the middle ear Infection may be present
Hypothyroidism	<ul style="list-style-type: none"> Chronic Cats with spontaneous hypothyroidism may also have lethargy, weight gain, hypotrichosis, scale or an unkempt haircoat 	<ul style="list-style-type: none"> Bilateral
<i>Demodex gato</i>	<ul style="list-style-type: none"> Other cats in household may be affected Contagious – typically acquired from other cats Affected cats may have a history of pinnectomy 	<ul style="list-style-type: none"> Unilateral in one cat⁴ Pruritus results in self-induced alopecia and excoriations in cats with generalized <i>D gato</i> infestation
<i>Sporothrix schenckii</i>	<ul style="list-style-type: none"> Acute Relatively common in Brazil Reported in a young cat¹³ Access to outdoors 	<ul style="list-style-type: none"> Unilateral Ulcers, erythema and dark pyogranulomatous otic discharge Mixed infection

Rare



Whether otitis is unilateral or bilateral, the lesion character and the presence of concurrent neurologic signs or systemic illness can aid in differentiating between causes.



Primary factors causing otitis

Parasites

Otodectes cynotis

Otodectes cynotis is the most common primary cause of feline otitis externa and is implicated in 53–69% of clinical cases.^{8,11,16} Conventional wisdom holds that *Otodectes* mites are most common in young cats, though older cats may be more likely to have asymptomatic infestations.^{18,19} The reported prevalence of *Otodectes* mite infestation is highly variable in the published literature, ranging from 0.9% to 37%.^{4,12,16,18,20,21} This may be due to differences in populations evaluated (stray vs client-owned), diagnostic techniques and geographic region.

Patients with *Otodectes* mite infestation are usually affected bilaterally.^{4,12} They often present with otic pruritus and abundant dark brown ceruminous debris reminiscent of coffee grounds.^{16,18} One study found that 23% of cats with *Otodectes* mites were also affected in areas other than the ear canals,¹⁵ and feline chin acne has been associated with *Otodectes* mite infestation.¹⁸ Secondary bacterial or *Malassezia* infection may occur.^{11,22}

Otodectes mites can be identified on otoscopy in 67–93% of cases,^{16,23} but the abundant dark cerumen present in most patients with otoacariasis may reduce the sensitivity of otoscopy.¹⁹ If mites are not seen on otoscopy, an ear mite preparation should be performed (see box below). In one study, collecting cerumen with a curette was more rewarding than with a cotton-tipped applicator, with 93% and 51% diagnostic sensitivity, respectively.²³

There are many products that are effective for the treatment of *Otodectes* mite infestation in cats. Historically, otic preparations have been used, but these products require repeated aural treatment, which may reduce compliance. Milbemycin oxime (0.1%, MilbeMite; Elanco) remains a clinically useful otic treatment because it is labeled for kittens as young as 4 weeks of age.

Newer systemic products are dosed less frequently and are usually administered as a topical transdermal preparation, which may improve client compliance. Additionally, they

Multifactorial approach

When evaluating a patient presenting for otitis, it is important to consider all factors that may be contributing to the patient's ear disease. Here the authors use the traditional model describing primary factors, which directly cause otitis (inflammation), predisposing factors, which put the cat at risk for developing otitis, and perpetuating factors, which result in ongoing clinical signs of otitis or prevent clinical resolution (see box on page 439).¹⁷



***Otodectes cynotis* is the most common primary cause of feline otitis externa.**

Technique for ear mite evaluation

- 1 Collect a sample of cerumen using a curette (preferred) or cotton-tipped applicator.
- 2 Apply the cerumen in a layer on the surface of a glass slide.
- 3 Add 1–2 drops of mineral oil, then apply a cover slip.
- 4 Use a microscope to scan the entire slide for mites:
 - use the x 10 objective;
 - lower the condenser;
 - close the iris diaphragm.

✦ Do not forget also to evaluate for ear mites directly using an otoscope!

will also treat mites that migrate outside of the ear canals (most frequently along the head and neck region) more effectively than otic preparations. A systematic review in 2016 of treatment efficacy for *Otodectes* mite infestation identified only two treatments with fair evidence supporting their efficacy: spot-on 10% imidacloprid with 1% moxidectin (Advantage Multi; Bayer) and selamectin (Revolution; Zoetis).²² More recently, researchers have investigated isoxazolines in cats with *O cynotis*. Afoxolaner (no product available labeled for use in cats), selamectin plus sarolaner (Revolution Plus; Zoetis), fluralaner (Bravecto; Merck) and fluralaner plus moxidectin (Bravecto Plus; Merck) resolved *O cynotis* infestations in cats after a single application.^{24–27}

Demodex species

Demodex cati has been identified on ear mite preparations in cats^{15,28} and can be associated with ceruminous otitis externa, with or without pruritus.¹ Infested cats may not show any signs of dermatological disease outside of the ear canal.¹⁵ Cats with generalized demodicosis owing to *D cati* should be evaluated for any disease that may cause immunosuppression.^{1,15} The prevalence of *D cati* infestation is $\leq 1\%$.^{15,16,18} *Demodex gatoi* has been documented in an ear of a cat with otitis externa but is not commonly associated with otic disease.⁴ Isoxazolines are highly effective at treating demodicosis in the dog, and both fluralaner and sarolaner (in combination with selamectin) have been reported to be effective for treatment of feline demodicosis.^{29–32}

Primary fungal disease

Dermatophytosis

The most common fungal disease in cats is dermatophytosis, involving *Microsporum canis* in particular. Dermatophytosis causes lesions of alopecia, erythema and scale, and should be considered as a differential in any cat presenting with pruritus or these non-specific skin lesions. One of the common sites for dermatophytic lesions is the ear, including the canal, pinna and surrounding skin,³³ but it is uncommon to see dermatophytosis restricted to the ear canal. Identification of cats with dermatophytosis is important due to the risks of zoonosis and contagious spread in multi-cat environments. For comprehensive guidelines regarding the diagnosis and treatment of dermatophytosis, readers are referred to the 2017 clinical consensus document from the World Association for Veterinary Dermatology.³⁴

Other fungal diseases

Less commonly, other fungal organisms may cause otomycosis. In a retrospective case series, Goodale et al described nine cats

diagnosed with otitis externa with *Aspergillus* species isolated on culture; *Aspergillus fumigatus* was the most commonly isolated species.³⁵ A single case of acute unilateral otitis externa caused by *Sporothrix schenckii* has been described in a 10-month-old cat in Brazil, which resolved after treatment with itraconazole.¹³ Chronic bilateral otitis interna caused by *Cryptococcus neoformans* var. *grubii* was identified at necropsy in a 7-year-old cat with a 9-day history of vestibular ataxia and head tilt.³⁶ A prospective case series of 35 cats with cryptococcosis identified one cat for which the site of infection was the ears.³⁷

Allergic skin disease

Among cats diagnosed with allergies at a veterinary teaching hospital, 17% had bacterial otitis externa, and 6% had *Malassezia* otitis externa.¹⁴ Otitis externa is most common in cats with feline atopic skin syndrome (formerly 'non-flea non-food hypersensitivity dermatitis') relative to cats with food allergy or flea allergy dermatitis, though it can occur with any type of allergic skin disease.^{38,39} Among cats with feline atopic syndrome, 16–20% had concurrent otitis externa.^{38,39}

Allergic skin disease should be considered in cats where infection recurs after cytologic cure and where other causes have been excluded. Cats with otitis externa owing to allergies are likely to experience pruritus in other body regions, rather than having only otic disease.³⁹ Control of otitis externa in a patient with allergic skin disease requires the underlying allergy to be addressed.

When evaluating for food allergy in patients with otitis externa, it is important to resolve both infection and inflammation before assessing for response to diet change (and considering dietary rechallenge). This is because secondary infection is not expected to resolve without directed therapy. Additionally, owners may not appreciate worsening inflammation in the absence of infection, so it is recommended that patients be re-evaluated (physical examination and otoscopy) during the dietary rechallenge period.

Disorders of cornification

Idiopathic ceruminous otitis

Idiopathic ceruminous otitis is an overproduction or accumulation of ceruminous debris that may predispose to secondary infections.^{40,41} It is poorly characterized in the literature, and there is disagreement among dermatologists as to whether it is an independent clinical entity. Idiopathic excessive cerumen production was described in nine cats with lifelong histories of increased cerumen bilaterally without clinical signs of otitis.¹⁵



To control otitis in a patient with allergic skin disease, it is important to control the underlying allergy.

Idiopathic facial dermatitis of Persian and Himalayan cats

Bond et al described a disorder affecting 13 Persian cats that developed black debris in the hair on their faces, which progressed to erythema and pruritus.⁴² Seven (54%) of the affected cats also had otitis externa, characterized by erythema and black waxy debris. The disease was progressive, and no cat responded completely to therapy with glucocorticoids and antimicrobials. In later case reports, affected cats showed a good response to oral ciclosporin, topical tacrolimus, and combination therapy with oral ciclosporin, dexamethasone and aggressive topical therapy.^{43–45} Though pathophysiology is not well characterized for this disease, the response to immunomodulatory therapy suggests that there may be an immune-mediated component (see 'Immune-mediated diseases' section below).

Hypothyroidism

Spontaneous primary hypothyroidism is rare in adult cats, with only three cases reported in the literature.^{46–48} In two of these cases, the cats were diagnosed with concurrent chronic otitis externa.^{47,48} Cats with spontaneous hypothyroidism tend to present with lethargy, weight gain, hypotrichosis, scale and an unkempt haircoat.

Congenital hypothyroidism may occur in kittens,⁴⁹ and secondary hypothyroidism may occur as a result of trauma⁵⁰ or from treatment of hyperthyroidism.^{51–53} Otitis externa has not been reported in association with congenital or secondary hypothyroidism in cats.

Sebaceous gland disease

Overall, sebaceous gland disorders are rare in the cat. A case series involving 10 kittens with sebaceous gland dysplasia described crusting within the ear canals and on the pinnal margins, with one kitten developing severe otitis externa secondarily to the condition.⁵⁴

Immune-mediated diseases

Proliferative and necrotizing otitis externa

Proliferative and necrotizing otitis externa (PNOE) is a rare disease that affects the concave pinna and ear canal, causing proliferative plaques that develop thick, adherent, tan to dark brown layers of keratinaceous exudate (Figure 3a).^{28,55–57} Erosions or ulcers develop over time due to the friable proliferative tissue, which can cause pain and pruritus.^{28,55} Depending on severity, the ear canal may be occluded, predisposing cats to secondary infection.^{28,55–57}

In one cat, the ear canal was severely affected while the pinna was spared.⁵⁸ In a kitten with otitis externa, lesions histologically consistent with PNOE developed on the face, though the canals did not have proliferative or necrotic tissue.⁵⁹



Figure 3 Proliferative and necrotizing otitis externa in a 1-year-old castrated male Siamese cat; (a) at initial presentation and (b) after 1 month of therapy with oral ciclosporin, topical tacrolimus 0.1% ointment, and systemic and topical antimicrobials to treat secondary infection

Though initially described in kittens under a year old,⁵⁵ PNOE has been documented in young adult cats.^{28,58} This disease may spontaneously resolve in kittens⁵⁵ or may persist into adulthood.²⁸ Biopsy is required for definitive diagnosis.

The most common therapies reported in the literature are topical tacrolimus and topical and systemic glucocorticoids.^{28,56–58,60} One of the authors (CC) has successfully treated a few severely affected young adult cats with systemic ciclosporin (Figure 3b). The clinician should evaluate for secondary infection and address it if present.

Pemphigus foliaceus

Pemphigus foliaceus (PF) is the most common autoimmune skin disease of cats.¹⁵ Though 80–92% of cats with PF have pinnal lesions, the ear canal is less frequently affected.^{61–63} Otitis externa has been reported in 7–30% of cats with PF.^{63,64} Most cats with PF have lesions affecting multiple sites.^{61–63} The primary lesion of PF is a subcorneal pustule, but these are prone to rupture, so crusts, erosions, alopecia and erythema are more often seen clinically.^{62,63} Otitis externa secondary to PF typically resolves with infection control and treatment of the underlying disease.

PF is most commonly treated with corticosteroids, and monotherapy is effective at inducing remission in 62–70% of affected cats.^{61–63} If corticosteroid monotherapy is insufficient or steroid side effects occur, an alternative or secondary immunomodulatory medication may be used.⁶² The immunomodulatory agents with the strongest evidence in feline PF are ciclosporin and chlorambucil.^{61,62} Relapse is common in cats with PF, occurring

in 27–95% of cases, particularly when medications are tapered or discontinued.^{61–64}

Factors predisposing to otitis

Treatment errors

Healthy cats may have dark ceruminous debris,¹⁵ which can lead owners and veterinary staff to clean or treat these ears unnecessarily. Cleansing or treating a healthy ear is not recommended because it can variously interfere with the ear's natural cleansing mechanisms, cause mechanical trauma, add moisture or result in a contact reaction.⁴⁰

Contributing factors to feline otitis

Primary factors

- ❖ Parasitic
 - *Otodectes cynotis*
 - *Demodex cati*
 - *Demodex gatoi*
- ❖ Fungal
 - Dermatophytosis
 - *Aspergillus* species
 - *Sporothrix schenckii*
 - *Cryptococcus neoformans*
- ❖ Allergic skin disease
 - Feline atopic skin syndrome
 - Food allergy
 - Flea allergy dermatitis
- ❖ Disorders of cornification
 - Idiopathic ceruminous otitis
 - Idiopathic facial dermatitis of Persian and Himalayan cats
 - Hypothyroidism
 - Sebaceous gland disease
- ❖ Immune-mediated disease
 - Proliferative and necrotizing otitis externa

- Pemphigus foliaceus
- ❖ Foreign bodies

Predisposing factors

- ❖ Treatment errors
- ❖ Obstructive ear disease
 - Inflammatory aural polyps
 - Neoplasia
 - Ceruminous gland adenocarcinoma
 - Squamous cell carcinoma
 - Carcinoma of unknown origin
 - Other
 - Ceruminous gland cystomatosis
 - Cholesteatoma
 - Cholesterol granuloma

Perpetuating factors

- ❖ Secondary infection
 - *Malassezia* species
 - Bacterial
- ❖ Contact reactions
- ❖ Ceruminoliths
- ❖ Otitis media
- ❖ Progressive pathologic changes

Obstructive ear disease

Inflammatory aural polyps

Inflammatory aural polyps (IAPs) are benign nodules originating from the epithelium lining the middle ear, nasopharynx or Eustachian tube. Though often visible on otoscopy and, thus, seemingly amenable to traction avulsion, there is frequently a stalk present that extends from the polyp into the medial compartment of the bulla and beyond.^{65,66} The polyp may be confined to the middle ear, without any extension into the external ear canal.⁶⁵ IAPs are most often unilateral,^{65,67} though a recent study found that 24% of cats with IAPs had them bilaterally.⁶⁶

Cats with IAPs may present initially with bacterial otitis externa, which can be refractory to treatment.⁶⁶ In addition to signs of otitis externa, affected patients may have vestibular signs, respiratory signs, ocular discharge or blepharospasm, or Horner's syndrome.^{66,68} IAPs occur most commonly in young cats and kittens, though they can develop at any age.^{66,68,69}

If visible on otoscopy, IAPs often appear as a smooth, pink nodule in the canal at the level of the tympanum (Figure 4). CT is recommended to visualize the extent of the lesion, support the diagnosis and evaluate for bilateral disease.^{65,66} In one study, 4/6 cats with bilateral IAPs were identified only by CT or video-otoscopy (see box).⁶⁶ Definitive diagnosis requires histopathology.⁶⁵

IAPs are usually treated in one of two ways: traction avulsion or ventral bulla osteotomy (VBO).^{66,68} At the time of the procedure, cats should be evaluated for concurrent nasopharyngeal polyp.⁶⁵ Complications may occur with either of these treatment approaches, including Horner's syndrome, vestibular signs, hemorrhage and facial nerve paralysis.^{66,68-70} VBO is more invasive and may carry a greater risk of complications.^{69,71} Cats with bilateral polyps should be staged to

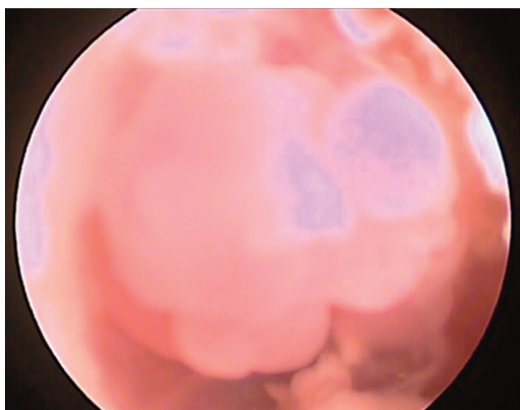


Figure 4 Otoscopic image of an inflammatory aural polyp in the ear canal of a 1-year-old spayed female domestic shorthair cat

Video-otoscopy

While many practitioners rely on a hand-held otoscope, a video-otoscope can be very helpful for the diagnosis and treatment of chronic otitis (Figure 5).

The magnification of the camera lens and light source both greatly improve visualization, and most video-otoscopes have ports to allow the practitioner to insert instruments for lavage and other procedures under direct visualization.

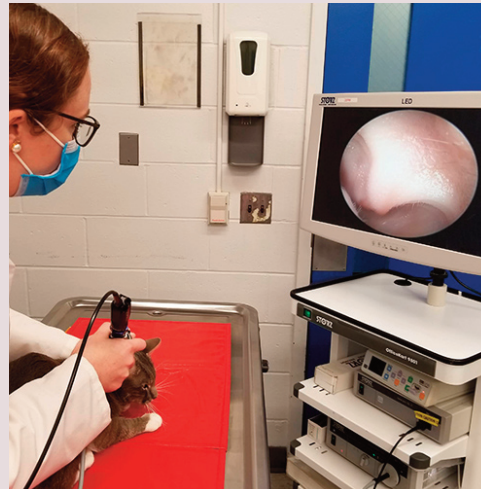


Figure 5 One of the authors (BB) examines the ear canal of a 2-year-old castrated male domestic shorthair cat with otic pruritus using a video-otoscope

Neoplasia should be considered when unilateral disease is present in an older patient, particularly if secondary infections have not responded to appropriate therapy.

reduce the risk of respiratory complications.⁶⁹ IAP recurrence is common and occurs more often in cats that undergo traction avulsion (up to 67%) relative to VBO (5%).^{66,69,71} In one study, none of the cats that received prednisolone after traction avulsion experienced recurrence, relative to 64% of cats that did not receive a steroid.⁷¹

Two newer techniques have been described to address IAPs. A case series reported a per-endoscopic transtympanic technique for removal of polyps with traction followed by curettage of the bulla, which resulted in a lower rate of recurrence (13.5%) as compared with conventional traction avulsion.⁷⁰ Another procedure involved a lateral approach to the ear canal followed by deep traction avulsion.⁶⁸ The recurrence rate varied with surgeon experience (14–35%).⁶⁸

Neoplasia

Neoplastic disease within the ear canal or middle ear predisposes patients to otitis externa by obstructing the canal and preventing normal self-cleaning.⁶⁷ Neoplasia should be considered when unilateral disease is present in an older patient, particularly if secondary infections have not responded as expected to appropriate therapy.⁷² In addition to typical signs of otitis, patients with aural neoplasia may have facial nerve paralysis, vestibular signs or pain on opening the mouth.^{67,73} One study found that cats with neurologic signs at the time of diagnosis had a worse prognosis.⁷³



Figure 6 Ceruminous gland cystomatosis in a 12-year-old spayed female domestic mediumhair cat

The most common aural neoplasm in the cat is ceruminous gland adenocarcinoma (CGA; 37–86% of aural neoplasms), followed by squamous cell carcinoma (SCC; 33%) and carcinoma of unknown origin (CUO; 22%).^{72,73} SCC and CUO are more locally aggressive and carry a worse prognosis than CGA.⁷³ Most aural tumors have low metastatic rates, so outcome depends on local disease progression.⁷³ Cats with CGA have a longer median survival time (49–50 months) than cats with SCC (4 months) or CUO (6 months).^{72,73}

Treatment of otic neoplasia ideally involves surgical resection with a technique such as total ear canal ablation with bulla osteotomy (TECABO).⁷³ In addition to the potential for definitive cure of the neoplasm, surgery may palliate the patient by removing a source of infection and pain. Depending on the tumor type and surgical margins, radiation or chemotherapy may be recommended after surgery.^{67,73} Radiation may also be used alone for palliative effect.

Ceruminous gland cystomatosis

Ceruminous gland cystomatosis tends to occur in older cats, though it can occur at any age. Male cats of any breed, and Persians and Abyssinians may be over-represented.⁷⁴ Affected cats may have a history of chronic otitis externa. On physical examination, multiple small raised cystic papules to nodules, varying in color from dark brown to gray-blue or purple, are seen in the canal and on the concave pinnae (Figure 6).⁷⁴ The number of cysts can range from a few to so many that they

For ceruminous gland cystomatosis, the number of cysts can vary, but there can be so many that they obstruct the canal.



obstruct the canal. Diagnosis is often presumptive, though biopsy can be considered if there is concern for malignant neoplasia. Treatment is focused on controlling secondary infections and inflammation. For patients with recurrent infection secondary to cystomatosis, laser ablation is gaining favor among veterinary dermatologists.^{75,76}

Cholesteatoma and cholesterol granulomas

There is a single case of feline cholesteatoma in the literature.⁷⁷ Two cases of aural cholesterol granuloma have been reported in cats with otitis media,^{78,79} and cholesterol granulomas have been experimentally induced in cats.^{80,81}

Perpetuating factors for otitis

Secondary infection with yeast or bacteria *Malassezia* otitis

Malassezia species are commonly isolated from the ears of cats with otitis externa, though the exact prevalence varies by report. *Malassezia* species have been cultured from 58–95% of cats with otitis externa,^{8–11} meanwhile *Malassezia* species were identified on cytology in 51% of stray cats with cytological otitis externa in Italy.¹⁶ A greater density of *Malassezia* species are expected in patients with otitis externa than in normal cats,^{3,4,7,82} with a mean density of 24 *Malassezia* organisms per HPF on cytology compared with ≤ 2 per HPF in normal cat ears in one study.³

Bacterial otitis

Cocci and rods were identified in 72% and 29%, respectively, of stray Italian cats with otitis externa, and mixed infections were common.¹⁶ Cocci were commonly seen on cytology in cats with allergy (87% of ear canals).⁸² Cocci in cases of feline otitis externa usually belong to *Staphylococcus* species.^{83,84} *Pseudomonas aeruginosa* and *Pasteurella multocida* have been reported as the most common bacterial rods isolated from cats with otitis externa.^{3,66,83,84} Other organisms isolated from bacterial otitis in multiple cats have included *Streptococcus canis*, *Escherichia coli*, *Mycoplasma* species, *Klebsiella* species and *Corynebacterium* species.^{11,66,85,86}



The authors recommend that cytology be performed in all cases of otitis to guide therapy and track progress.

Treatment of secondary infection

Some dermatologists may prefer the use of oral antimicrobials to treat feline otitis owing to concern for the risk of a contact reaction.⁴⁰ However, it is the experience of the authors that aural infections are difficult to resolve without topical treatment, which allows for the local delivery of concentrated therapeutics. The authors recommend that the use of systemic antimicrobials be reserved for cases with otitis media or where topical treatment is not feasible due to patient temperament. Culturing the ear canal is rarely indicated in otitis externa because topical therapies can greatly exceed the breakpoint concentrations used to determine susceptibility. The authors recommend that cytology be performed in all cases of otitis to guide therapy and track progress.

Most otic preparations include a corticosteroid to reduce inflammation. Because inflammation is what allows infection to develop, this is a necessary component of a successful treatment approach. Among topical steroids, mometasone furoate has superior anti-inflammatory activity and is unlikely to result in systemic glucocorticoid

effects because very little (<1% in humans) is absorbed.⁸⁷ Hydrocortisone aceponate is also unlikely to be systemically absorbed, though less potent than mometasone.⁸⁸

Ear cleansing can allow for the removal of a proportion of the infectious burden from the canal. Some practitioners recommend the use of plain saline to reduce the risk of a contact reaction.⁴⁰ In the experience of the authors, using a product with mild ceruminolytic properties can be helpful in cats owing to their abundant ceruminous debris. Clients should be clearly educated on appropriate cleansing technique to avoid mechanical trauma to the canal.

If the patient fails to respond to appropriate topical treatment, otic lavage under general anesthesia could be considered. Patients should be intubated to reduce the risk of aspiration during lavage. CT is recommended prior to otic lavage to allow for assessment of the middle ear. Lavage is performed with warm saline, ideally under direct visualization with a video-otoscope (see box on page 440).⁸⁹

Systemic antimicrobials should be reserved for cases with otitis media or where topical treatment is not feasible due to patient temperament.



Contact reactions and other complications of treatment

Ototoxicity is a potential risk with many topical medications, particularly if they are permitted to make contact with the inner ear. There are few data regarding the incidence of ototoxicity in cats.⁹⁰ Aminoglycosides have induced deafness when administered systemically to cats,⁹¹ and a combination of chlorhexidine and cetrimec was associated with acute vestibular signs in three cats when applied to an ear with a ruptured tympanum.⁹²

Some veterinary dermatologists consider cats to be especially susceptible to contact reactions with otic preparations,⁴⁰ with one veterinary teaching hospital diagnosing contact reactions in 1.4% of patients presenting to its dermatology service.¹⁵ Contact reactions should be suspected when a patient seems to deteriorate clinically after therapy is implemented, and especially if infection is resolved on cytology while the degree of suppurative inflammation worsens.

Topical glucocorticoids cause cutaneous atrophy, which can affect the auricular cartilage in cats, resulting in a potentially permanent drooping appearance to the pinna.⁹³

Ceruminoliths

Ceruminoliths can form in the ears of cats with chronic otitis externa and are thought to be concretions of debris and possibly ear medication and cleanser.^{40,41} The ceruminolith tends to be hard with irregular margins, so it can act as a foreign body, perpetuating inflam-

mation and acting as a nidus of infection.⁴¹ True aural foreign bodies are not common in the cat, though they remain a possibility and should be considered in cases of unilateral otitis externa. Ceruminoliths typically require removal under general anesthesia, often with otic lavage.⁴¹

Otitis media

While, in dogs, otitis media typically results from otitis externa, cats may have otitis media without otitis externa. Among cats undergoing necropsy, 2–10% had evidence of otitis media on gross evaluation, but 56% had histologic evidence of otitis media.^{94,95}

Affected cats may display head shaking or otic pruritus, or their signs may be exclusively neurologic. Neurologic manifestations of otitis media include vestibular signs (head tilt, ataxia), Horner's syndrome and facial nerve paralysis. On otoscopic examination, cats with otitis media may have an opaque or bulging tympanic membrane, or fluid may be visible through the tympanic membrane. If fluid is present, it may be clear, purulent or hemorrhagic.⁹⁵ Otitis media may occur either unilaterally or bilaterally.^{94,95}



In cases of suspected or confirmed otitis media, a myringotomy should be performed under general anesthesia to sample fluid from the middle ear.

In cases of suspected or confirmed otitis media, fluid from the middle ear should be sampled under general anesthesia via a myringotomy procedure. Otic lavage can be performed if indicated. Advanced imaging (CT) is ideal and should be undertaken prior to myringotomy or otic lavage because lavage adds fluid to the ear canal, which can shadow soft tissue structures.

Aerobic culture is always recommended, and in many cases antimicrobial therapy can wait for culture results. In severe cases, empiric antibiotics can be considered while the culture is pending. Cytology of the fluid from the middle ear can help to guide the selection of an appropriate empiric antibiotic.

Progressive pathologic changes

As a result of chronic otitis externa, patients may develop epidermal hyperplasia, hypertrophy of ceruminous glands and inflammatory infiltrates that result in proliferative tissue filling the ear canal.⁶⁷ Though progressive pathologic changes are less commonly reported in cats relative to dogs, ceruminous gland hyperplasia is common in cats with chronic otitis externa and, in one study, was the indication for 30% of cats undergoing TECABO.⁷² Ceruminous gland tumors are thought to develop from malignant transformation of glandular hyperplasia, so controlling otic inflammation may serve as a preventive measure.⁶⁷

The presence of irregular tissue narrows the canal and can lead to pockets where microorganisms are protected from otic treatments, as well as increased susceptibility to infections due to changes in the skin barrier, disruption

Prognosis and sequelae

The overall prognosis for cats with chronic otitis depends broadly on the ability to identify and control the primary, predisposing and perpetuating factors. It is therefore highly patient-dependent.

In cats with severe chronic otitis, intracranial abscess (IA), intracranial empyema (IE) or meningoencephalomyelitis (ME) may occur. Though these sequelae are rare, the prognosis is guarded, which makes early identification and treatment crucial. Cats presenting with IA, IE or ME may have multifocal neurologic signs, with the most common deficits noted including dull mentation, absent menace response, Horner's syndrome or anisocoria, proprioceptive deficits or ataxia, circling, tetraparesis and head tilt.^{96,97} On general physical examination, tachycardia, pyrexia, tachypnea and nasal discharge may be noted.^{96,97} Even in cases that occur secondarily to otitis, aural discharge may not be noted, and otoscopic examination may be normal.^{96,97} Only 37% of cases that occur secondarily to otitis have a known history of ear disease.⁹⁶

If any of these neurologic sequelae are suspected, advanced imaging (MRI or CT) is recommended with cerebrospinal fluid sampling for analysis and culture. Though surgery is recommended in cases of IA or IE, two recent retrospective case series suggest that medical management may be effective in some cases.^{96,97} Selection of an antibiotic based on culture and sensitivity is recommended; however, empiric antibiotics should be started pre-emptively in these cases. *Pasteurella multocida* was the most commonly cultured organism in one case series, being isolated from four cats with IA or ME, so ideally a broad-spectrum antibiotic should be selected that is effective against this organism.⁹⁶ Amoxicillin trihydrate and clavulanate potassium (Clavamox; Zoetis) was commonly used in both case series and is a reasonable empiric choice for IA, IE or ME in the cat.^{96,97}

of the normal cleaning mechanism in the ear and discomfort for the patient. With chronicity, mineralization and ossification of the canal may occur. In patients with end-stage ear changes, TECABO is recommended; this removes the site of infection and improves patient comfort.

In patients with end-stage ear changes, TECABO is recommended to remove the site of infection and improve patient comfort.



KEY POINTS

- ❖ Chronic otitis is multifactorial; the factors that contribute to the development and persistence of otitis can be categorized as primary, predisposing and perpetuating.
- ❖ A successful diagnostic approach involves a combination of history, physical examination with otoscopy, evaluation for *Otodectes cynotis* and cytology. When appropriate, advanced imaging can be considered.
- ❖ Because most causes of chronic otitis tend to affect both ears, the presence of unilateral disease should prompt the clinician to evaluate for an inflammatory polyp or mass.
- ❖ Cytology is vital to identify perpetuating bacterial and yeast infections and guide therapy.
- ❖ To manage chronic otitis, it is necessary to identify and control as many primary, predisposing and perpetuating factors as possible.



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References

- 1 Tater KC, Scott DW, Miller WH Jr, et al. **The cytology of the external ear canal in the normal dog and cat.** *J Vet Med A Physiol Pathol Clin Med* 2003; 50: 370–374.
- 2 Little CJL and Lane JG. **The surgical anatomy of the feline bulla tympanica.** *J Small Anim Pract* 1986; 27: 371–378.
- 3 Ginel PJ, Lucena R, Rodriguez JC, et al. **A semiquantitative cytological evaluation of normal and pathological samples from the external ear canal of dogs and cats.** *Vet Dermatol* 2002; 13: 151–156.
- 4 Tyler S, Swales N, Foster AP, et al. **Otoscopy and aural cytological findings in a population of rescue cats and cases in a referral small animal hospital in England and Wales.** *J Feline Med Surg* 2020; 22: 161–167.
- 5 Hariharan H, Matthew V, Fountain J, et al. **Aerobic bacteria from mucous membranes, ear canals, and skin wounds of feral cats in Grenada, and the antimicrobial drug susceptibility of major isolates.** *Comp Immunol Microbiol Infect Dis* 2011; 34: 129–134.
- 6 Crespo MJ, Abarca ML and Cabañes FJ. **Occurrence of *Malassezia* spp. in the external ear canals of dogs and cats with and without otitis externa.** *Med Mycol J* 2002; 40: 115–121.
- 7 Cafarchia C, Gallo S, Capelli G, et al. **Occurrence and population size of *Malassezia* spp. in the external ear canal of dogs and cats both healthy and with otitis.** *Mycopathologia* 2005; 160: 143–149.
- 8 Nardoni S, Mancianti F, Rum A, et al. **Isolation of *Malassezia* species from healthy cats and cats with otitis.** *J Feline Med Surg* 2005; 7: 141–145.
- 9 Dizotti CE and Coutinho SDA. **Isolation of *Malassezia pachydermatis* and *M. sympodialis* from the external ear canal of cats with and without otitis externa.** *Acta Vet Hung* 2007; 55: 471–477.
- 10 Shokri H, Khosravi AR, Rad MA, et al. **Occurrence of *Malassezia* species in Persian and domestic short hair cats with and without otitis externa.** *J Vet Med Sci* 2010; 72: 293–296.
- 11 Nardoni S, Ebani VV, Fratini F, et al. ***Malassezia*, mites, and bacteria in the external ear canal of dogs and cats with otitis externa.** *Slov Vet Res* 2014; 51: 113–118.
- 12 Bollez A, de Rooster H, Furcas A, et al. **Prevalence of external ear disorders in Belgian stray cats.** *J Feline Med Surg* 2018; 20: 149–154.
- 13 Mascarenhas MB, Botelho CB, Manier BSML, et al. **An unusual case of feline otitis externa due to sporotrichosis.** *JFMS Open Rep* 2019; 5. DOI: 10.1177/2055116919840810.
- 14 Hill PB, Lo A, Eden CAN, et al. **Survey of the prevalence, diagnosis and treatment of dermatological conditions in small animals in general practice.** *Vet Rec* 2006; 158: 533–539.
- 15 Scott DW, Miller WH and Erb HN. **Feline dermatology at Cornell University: 1407 cases (1988–2003).** *J Feline Med Surg* 2012; 15: 307–316.
- 16 Perego R, Proverbio D, De Giorgi GB, et al. **Prevalence of otitis externa in stray cats in northern Italy.** *J Feline Med Surg* 2014; 16: 483–490.
- 17 August JR. **Otitis externa: a disease of multifactorial etiology.** *Vet Clin Small Anim* 1988; 18: 731–742.
- 18 Sotikari ST, Koutinas AF, Leontides LS, et al. **Factors affecting the frequency of ear canal and face infestation by *Otodectes cynotis* in the cat.** *Vet Parasitol* 2001; 96: 309–315.
- 19 Farkas R, Germann T and Szeidemann Z. **Assessment of the ear mite (*Otodectes cynotis*) infestation and the efficacy of an imidacloprid plus moxidectin combination in the treatment of otoacariasis in a Hungarian cat shelter.** *Parasitol Res* 2007; 101: 35–44.
- 20 Akucewich LH, Philman K, Clark A, et al. **Prevalence of ectoparasites in a population of feral cats from north central Florida during the summer.** *Vet Parasitol* 2002; 109: 129–139.
- 21 Duarte A, Castro I, Pereira da Fonseca IM, et al. **Survey of infectious and parasitic diseases in stray cats at the Lisbon metropolitan area, Portugal.** *J Feline Med Surg* 2010; 12: 441–446.
- 22 Yang C and Huang HP. **Evidence-based veterinary dermatology: a review of published studies of treatments for *Otodectes cynotis* (ear mite) infestation in cats.** *Vet Dermatol* 2016; 27: 221–e56.
- 23 Combarros D, Boncea AM, Brément T, et al. **Comparison of three methods for the diagnosis of otoacariasis due to *Otodectes cynotis* in dogs and cats.** *Vet Dermatol* 2019; 30: 334–e97.
- 24 Becskei C, Reinemeyer C, King VL, et al. **Efficacy of a new spot-on formulation of selamectin plus sarolaner in the treatment of *Otodectes cynotis* in cats.** *Vet Parasitol* 2017; 238 Suppl 1: S27–S30.
- 25 Taenzler J, de Vos C, Rainer KAP, et al. **Efficacy of fluralaner against *Otodectes cynotis* infestations in dogs and cats.** *Parasit Vectors* 2017; 10: 30. DOI: 10.1186/s13071-016-1954-y.
- 26 Machado MA, Campos DR, Lopes NL, et al. **Efficacy of afoxolaner in the treatment of otodectic mange in naturally infested cats.** *Vet Parasitol* 2018; 256: 29–31.
- 27 Taenzler J, de Vos C, Rainer KAR, et al. **Efficacy of fluralaner plus moxidectin (Bravecto Plus spot-on solution for cats) against *Otodectes cynotis* infestations in cats.** *Parasit Vectors* 2018; 15: 595. DOI: 10.1186/s13071-018-3167-z.
- 28 Mauldin EA, Ness TA and Goldschmidt MH. **Proliferative and necrotizing otitis externa in four cats.** *Vet Dermatol* 2007; 18: 370–377.
- 29 Matricoti I and Maina E. **The use of oral fluralaner for the treatment of feline generalized demodicosis: a case report.** *J Small Anim Pract* 2017; 58: 476–479.

- 30 Duangkaew L and Hoffman H. **Efficacy of oral fluralaner for the treatment of *Demodex gato* in two shelter cats.** *Vet Dermatol* 2018; 29: 262. DOI: 10.1111/vde.12520.
- 31 Simpson AC. **Successful treatment of demodicosis due to *Demodex cati* with sarolaner/selamectin topical solution in a cat.** *JFMS Open Rep* 2021; 7. DOI: 10.1177/2055116920984386.
- 32 Beccati MB, Pandolfi PP and DiPalma AD. **Efficacy of fluralaner spot-on in cats affected by generalized demodicosis: seven cases [abstract].** *Vet Dermatol* 2019; 30: 454.
- 33 Moriello K. **Feline dermatophytosis – aspects pertinent to disease management in single and multiple cat situations.** *J Feline Med Surg* 2014; 16: 419–431.
- 34 Moriello KA, Coyner K, Paterson S, et al. **Diagnosis and treatment of dermatophytosis in dogs and cats: clinical consensus guidelines of the World Association for Veterinary Dermatology.** *Vet Dermatol* 2017; 28: 266–e68.
- 35 Goodale EC, Outerbridge CA and White SD. ***Aspergillus* otitis in small animals – a retrospective study of 17 cases.** *Vet Dermatol* 2016; 27: 3–e2.
- 36 Paulin J, Morshed M and Armien AG. **Otitis interna induced by *Cryptococcus neoformans* var. *grubii* in a cat.** *Vet Pathol* 2013; 50: 260–263.
- 37 Jacobs GJ, Medleau L, Calvert C, et al. **Cryptococcal infections in cats: factors influencing treatment outcome and results of sequential serum antigen titers in 35 cats.** *J Vet Intern Med* 1997; 11: 1–4. DOI: 10.1111/j.1939-1676.1997.tb00064.x.
- 38 Hobi S, Linek M, Marignac G, et al. **Clinical characteristics and causes of pruritus in cats: a multicentre study on feline hypersensitivity-associated dermatoses.** *Vet Dermatol* 2011; 22: 406–413.
- 39 Ravens PA, Xu BJ and Vogelnest LJ. **Feline atopic dermatitis: a retrospective study of 45 cases (2001–2012).** *Vet Dermatol* 2014; 25: 95–e28.
- 40 Kennis RA. **Feline otitis: diagnosis and treatment.** *Vet Clin North Am Small Anim Pract* 2013; 43: 51–56.
- 41 Rosychuk R. **Feline ear disease: so much more than ear mites.** Proceedings of the Southern European Veterinary Conference; 2008 Oct 17–19; Barcelona, Spain.
- 42 Bond R, Curtis CF, Ferguson EA, et al. **An idiopathic facial dermatitis of Persian cats.** *Vet Dermatol* 2000; 11: 35–41.
- 43 Fontaine J and Heimann M. **Idiopathic facial dermatitis of the Persian cat: three cases controlled with cyclosporine [Abstract].** *Vet Dermatol* 2004; 15 Suppl 1: 64.
- 44 Chung TH, Ryu MH, Kim DY, et al. **Topical tacrolimus (FK506) for the treatment of feline idiopathic facial dermatitis.** *Aust Vet J* 2009; 87: 417–420.
- 45 Carlotti DN, Viaud S and Douet JY. **Efficacy of topical treatment in a case of idiopathic facial dermatitis in a Persian cat [article in French].** *Prat Med Chir Anim Cie* 2009; 44: 117–123.
- 46 Rand JS, Levine J, Best SJ, et al. **Spontaneous adult-onset hypothyroidism in a cat.** *J Vet Intern Med* 1993; 7: 272–276. DOI: 10.1111/j.1939-1676.1993.tb01019.x.
- 47 Blois SL, Abrams-Ogg ACG, Mitchell C, et al. **Use of thyroid scintigraphy and pituitary immunohistochemistry in the diagnosis of spontaneous hypothyroidism in a mature cat.** *J Feline Med Surg* 2010; 12: 156–160.
- 48 Galgano M, Spalla I, Callegari C, et al. **Primary hypothyroidism and thyroid goiter in an adult cat.** *J Vet Intern Med* 2014; 28: 682–686. DOI: 10.1111/jvim.12283.
- 49 Greco DS. **Diagnosis of congenital and adult-onset hypothyroidism in cats.** *Clin Tech Small Anim Pract* 2006; 21: 40–44.
- 50 Mellanby RJ, Jeffery ND, Gopal MS, et al. **Secondary hypothyroidism following head trauma in a cat.** *J Feline Med Surg* 2005; 7: 135–139.
- 51 Welches CD, Scavelli RD, Matthiesen DT, et al. **Occurrence of problems after three techniques of bilateral thyroidectomy in cats.** *Vet Surg* 1989; 18: 392–396.
- 52 Peterson ME and Becker DV. **Radioiodine treatment of 524 cats with hyperthyroidism.** *J Am Vet Med Assoc* 1995; 207: 1422–1428.
- 53 Nykamp SG, Dykes NL, Zarfoss MK, et al. **Association of the risk of development of hypothyroidism after iodine 131 treatment with the pretreatment pattern of sodium pertechnetate Tc 99m uptake in the thyroid gland in cats with hyperthyroidism: 165 cases (1990–2002).** *J Am Vet Med Assoc* 2005; 226: 1671–1675.
- 54 Yager JA, Gross TL, Shearer D, et al. **Abnormal sebaceous gland differentiation in 10 kittens ('sebaceous gland dysplasia') associated with generalized hypotrichosis and scaling.** *Vet Dermatol* 2012; 23: 136–e30.
- 55 Gross TL, Ihrke PJ, Walder EJ, et al (eds). **Necrotizing diseases of the epidermis.** In: *Skin diseases of the dog and cat*. 2nd ed. Ames, IA: Blackwell Science, 2005, pp 79–81.
- 56 Momota Y, Yasuda J, Ikezawa M, et al. **Proliferative and necrotizing otitis externa in a kitten: successful treatment with intralesional and topical corticosteroid therapy.** *J Vet Med Sci* 2016; 78: 1883–1885.
- 57 Vidémont E and Pin D. **Proliferative and necrotizing otitis in a kitten: first demonstration of T-cell-mediated apoptosis.** *J Small Anim Pract* 2010; 51: 599–603.
- 58 Borio S, Massari F, Abramo F, et al. **Proliferative and necrotizing otitis externa in a cat without pinnal involvement: video-otoscopic features.** *J Feline Med Surg* 2012; 15: 353–356.
- 59 McAulliffe L, Sargent S and Locke E. **Pathology in practice.** *J Am Vet Med Assoc* 2020; 257: 287–290.
- 60 Momota Y, Yasuda J, Arai N, et al. **Contribution of oral triamcinolone to treating proliferative and necrotizing otitis externa in a 14-year-old Persian cat.** *JFMS Open Rep* 2017; 3. DOI: 10.1177/2055116917691175.
- 61 Coyner K, Tater J and Rishniw M. **Feline pemphigus foliaceus in non-specialist veterinary practice: a retrospective analysis.** *J Small Anim Pract* 2018; 59: 553–559.
- 62 Bizikova P and Burrows A. **Feline pemphigus foliaceus: original case series and a comprehensive literature review.** *BMC Vet Res* 2019; 15: 22. DOI: 10.1186/s12917-018-1739-y.
- 63 Jordan TJM, Affolter VK, Outerbridge CA, et al. **Clinicopathological findings and clinical outcomes in 49 cases of feline pemphigus foliaceus examined in Northern California, USA (1987–2017).** *Vet Dermatol* 2019; 30: 209–e65.
- 64 Preziosi DE, Goldschmidt MH, Greek JS, et al. **Feline pemphigus foliaceus: a retrospective analysis of 57 cases.** *Vet Dermatol* 2003; 14: 313–321.
- 65 Oliveira CR, O'Brien RT, Matheson JS, et al. **Computed tomographic features of feline nasopharyngeal polyps.** *Vet Radiol Ultrasound* 2012; 53: 406–411.
- 66 Hoppers SE, May ER and Frank LA. **Feline bilateral inflammatory aural polyps: a descriptive retrospective study.** *Vet Dermatol* 2020; 31: 385–e102.
- 67 Sula MJM. **Tumors and tumorlike lesions of dog and cat ears.** *Vet Clin North Am Small Anim Pract* 2012; 42: 1161–1178.
- 68 Janssens SDS, Haagsman AN and Haar GT. **Middle ear polyps: results of traction avulsion after a lateral approach to the ear canal in 62 cats (2004–2014).** *J Feline Med Surg* 2017; 19: 803–808.

- 69 Wainberg SH, Selmic LE, Haagsman AN, et al. **Comparison of complications and outcome following unilateral, staged bilateral, and single-stage bilateral ventral bulla osteotomy in cats.** *J Am Vet Med Assoc* 2019; 255: 828–836.
- 70 Greci V, Vernia E and Mortellaro CM. **Per-endoscopic trans-tympanic traction for the management of feline aural inflammatory polyps: a case review of 37 cats.** *J Feline Med Surg* 2014; 16: 645–650.
- 71 Anderson DM, Robinson RK and White RAS. **Management of inflammatory polyps in 37 cats.** *Vet Rec* 2000; 147: 684–687.
- 72 Bacon NJ, Gilbert RL, Bostock DE, et al. **Total ear canal ablation in the cat: indications, morbidity and long-term survival.** *J Small Anim Pract* 2003; 44: 430–434.
- 73 London CA, Dubielzig RR, Vail DM, et al. **Evaluation of dogs and cats with tumors of the ear canal: 145 cases (1978–1992).** *J Am Vet Med Assoc* 1996; 208: 1413–1418.
- 74 Gross TL, Ihrke PJ, Walder EJ, et al (eds). **Sweat gland tumors.** In: *Skin diseases of the dog and cat*. 2nd ed. Ames, IA: Blackwell Science, 2005, pp 665–694.
- 75 Duclos D. **Lasers in veterinary dermatology.** *Vet Clin North Am Small Anim Pract* 2006; 36: 15–37.
- 76 Corriveau LA. **Use of a carbon dioxide laser to treat ceruminous gland hyperplasia in a cat.** *J Feline Med Surg* 2012; 14: 413–416.
- 77 Alexander A, Mahoney P, Scurrill E, et al. **Cholesteatoma in a cat.** *JFMS Open Rep* 2019; 5. DOI: 10.1177/2055116919848086.
- 78 Ilha MRS and Wisell C. **Cholesterol granuloma associated with otitis media in a cat.** *J Vet Diagn Invest* 2013; 25: 515–518.
- 79 Van der Heyden S, Butaye P and Roels S. **Cholesterol granuloma associated with otitis media and leptomeningitis in a cat due to a *Streptococcus canis* infection.** *Can Vet J* 2013; 54: 72–73.
- 80 Goycoolea MV, Paparella MM, Juhn SK, et al. **Otitis media with perforation of the tympanic membrane: a longitudinal experimental study.** *Laryngoscope* 1980; 90: 2037–2045.
- 81 Hueb MM and Goycoolea MV. **Experimental evidence suggestive of early intervention in mucoid otitis media.** *Acta Otolaryngol* 2009; 129: 444–448.
- 82 Pressanti C, Drouet C and Cadiergues MC. **Comparative study of aural microflora in healthy cats, allergic cats and cats with systemic disease.** *J Feline Med Surg* 2014; 16: 992–996.
- 83 Hariharan H, Coles M, Poole D, et al. **Update on antimicrobial susceptibilities of bacterial isolates from canine and feline otitis externa.** *Can Vet J* 2006; 47: 253–255.
- 84 Kroemer S, Garch FE, Galland D, et al. **Antibiotic susceptibility of bacteria isolated from infections in cats and dogs throughout Europe (2002–2009).** *Comp Immunol Microbiol Infect Dis* 2014; 37: 97–108.
- 85 Hennevelde K, Rosychuk RAW, Olea-Popelka FJ, et al. ***Corynebacterium* spp. in dogs and cats with otitis externa and/or media: a retrospective study.** *J Am Anim Hosp Assoc* 2012; 48: 320–326.
- 86 Ackermann AL, Lenz JA, May ER, et al. ***Mycoplasma* infection of the middle ear in three cats.** *Vet Dermatol* 2017; 28: 417–e102.
- 87 Prakash A and Benfield P. **Topical mometasone: a review of its pharmacological properties and therapeutic use in the treatment of dermatological disorders.** *Drugs* 1998; 55: 145–163.
- 88 Sauv e, F. **Use of topical glucocorticoids in veterinary dermatology.** *Can Vet J* 2019; 60: 785–788.
- 89 Radlinksy MAG. **Advances in otoscopy.** *Vet Clin North Am Small Anim Pract* 2016; 46: 171–179.
- 90 Oishi N, Talaska AE and Schacht J. **Ototoxicity in dogs and cats.** *Vet Clin North Am Small Anim Pract* 2012; 42: 1259–1271.
- 91 Shepherd RK and Martin RL. **Onset of ototoxicity in the cat is related to onset of auditory function.** *Hearing Res* 1995; 92: 131–142.
- 92 Gall e HG and Venker-van Haagen AJ. **Ototoxicity of the antiseptic combination chlorhexidine/cetrimide (Savlon): effects on equilibrium and hearing.** *Vet Q* 1986; 8: 56–60.
- 93 Torres SMF. **Miscellaneous diseases of the pinna.** Merck Veterinary Manual. <https://www.msdvetmanual.com/ear-disorders/diseases-of-the-pinna/miscellaneous-diseases-of-the-pinna> (2013).
- 94 Schlicksup MD, Van Winkle TJ and Hold DE. **Prevalence of clinical abnormalities in cats found to have nonneoplastic middle ear disease at necropsy: 59 cases (1991–2007).** *J Am Vet Med Assoc* 2009; 235: 841–843.
- 95 Sula MM, Njaa BL and Payton ME. **Histologic characterization of the cat middle ear: in sickness and in health.** *Vet Pathol* 2014; 51: 951–967.
- 96 Moore SA, Bentley RT, Carrera-Justiz S, et al. **Clinical features and short-term outcome of presumptive intracranial complications associated with otitis media/interna: a multi-center retrospective study of 19 cats (2009–2017).** *J Feline Med Surg* 2019; 21: 148–155.
- 97 Martin S, Drees R, Szladovits B, et al. **Comparison of medical and/or surgical management of 23 cats with intracranial empyema or abscessation.** *J Feline Med Surg* 2019; 21: 566–574.

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