Ears
The Basics The Veterinary Dermatologist Needs To Know

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Importance

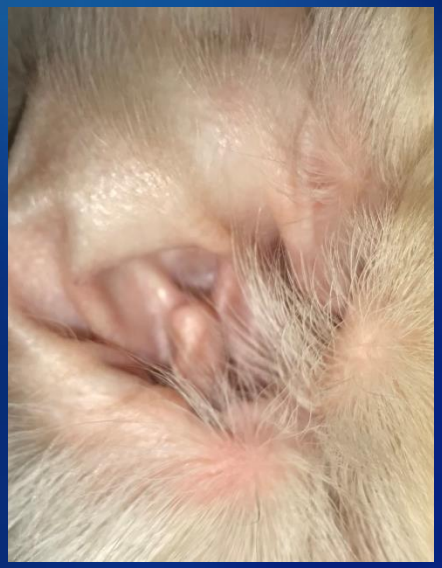
- The external ear, comprised of the pinna, external orifice, and ear canal covered with skin, with minor modifications
  - which is a feature of several specialized body surfaces

Importance

- Veterinary dermatologists will see lots of ear problems
- Ear problem incidence
  - Not really accurately known as it has never been studied well
    - Some items to consider
      - Definition of what is abnormal, what looking for and how examined
      - At one time or over time
      - Role of history
        - » in detecting or missing cases

? Not really Known ?

- No strict definition of what is abnormal



Gigs Rx needed Huck no ear Rx but gets itchy Lolly normal

  - Studies look at a “snap shot” or period of time
    - What about the pet’s lifetime

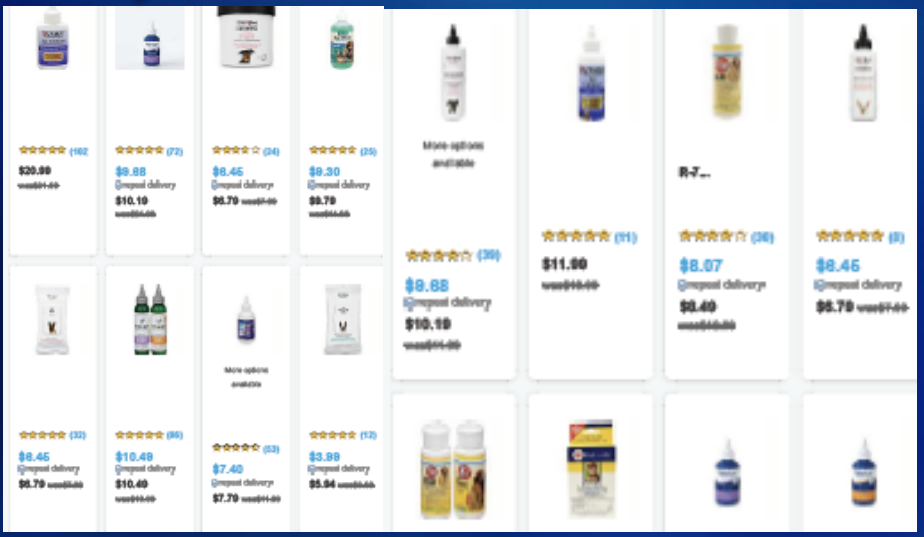
Head Shaking

? Effect of Poor History ?

Swimmers Ear

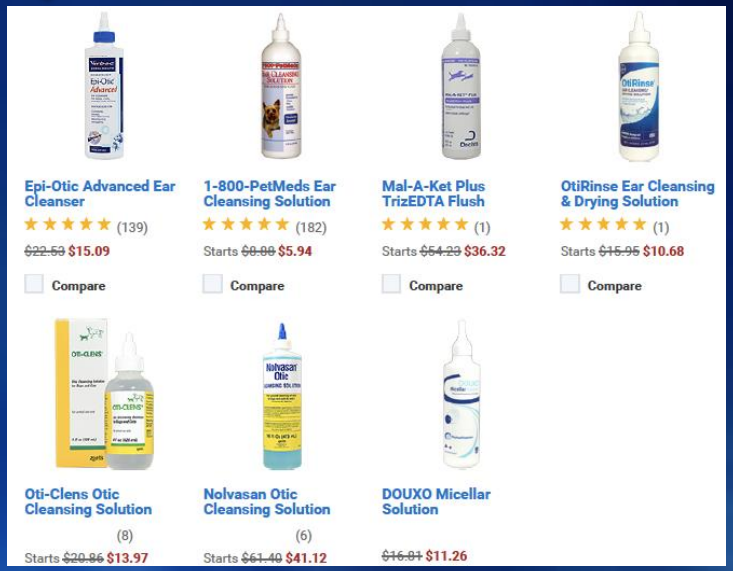
– The cases that would be missed if just examine those with a problem and do not account for those treating or preventing the problem

Petco.com 12-28-18



16 ear care products

1800petmeds.com



7 ear cleansers

History

- If you do not ask owners about cleaning their dogs ears
  - You potentially have not determined
    - The dog is prone to or has ear disease
    - The pattern of pruritus and lesions
    - The age of onset of allergy signs
    - The seasonality accurately
    - The true incidence of otitis

Ear Cleaning [1]

Table 4. Ear cleaning and reasons for cleaning in 314 apparently healthy dogs

Ear cleaning	*N*	%
No	168	53.5
Yes	146	46.5
Reason for cleaning ears (*N* = 146)		
Supposed to be for maintenance, like cutting the nails	97	30.9
Veterinarian told them to	10	3.2
If don't, they get dirty, fill with debris and/or smell	39	12.4

27% of those that clean ears may have a problem

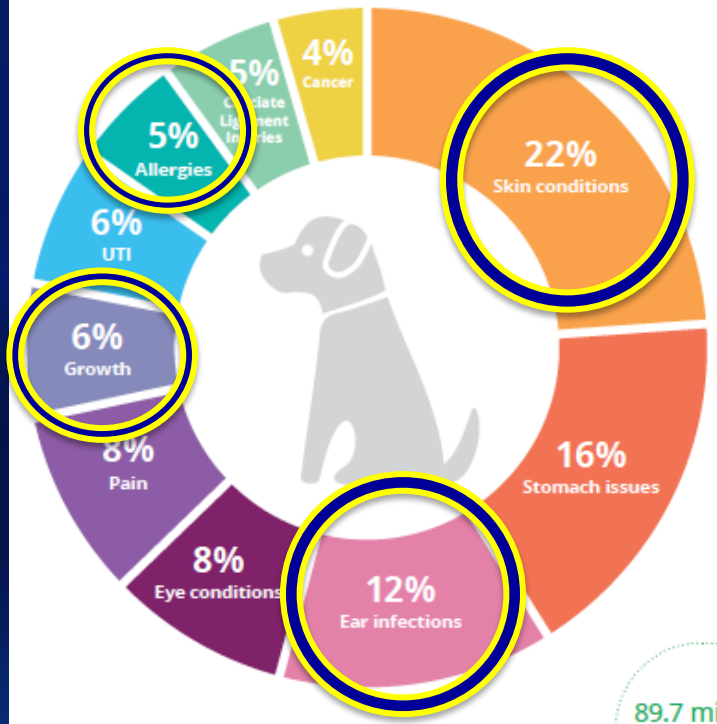
1 Stetina et al(2015). *Vet Dermatol, 26*(4), 246-e254

2018

https://www.healthypawspetinsurance.com/cost-of-pet-care

Top 10 Accidents & Illnesses for Dogs

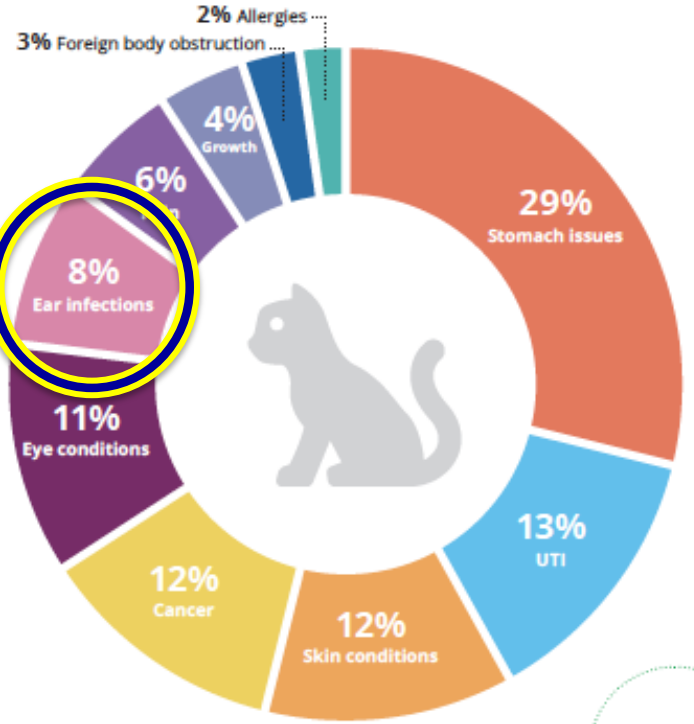
The top reasons for a pet parent to bring their pup to the vet have remained almost the same over the past three years, however this year we saw more cancer claims than in the past. From skin conditions to cruciate ligament surgeries, here are the 10 most common ailments seen at the vet between June 2017 - June 2018.



89.7 million dogs in U.S. homes††

Top 10 Accidents & Illnesses for Cats

This year, cats have a couple new frequent ailments including allergies and foreign body surgeries (watch out for missing string!). While cats share many of the same ailments as dogs, their physiology is uniquely feline. Here are the most common conditions for our curious kitties from June 2017 - June 2018.



94.2 million cats in U.S. homes††

What About Peer Reviewed Studies

My Favorite

OPEN ACCESS Freely available online

2014

PLOS | ONE

Prevalence of Disorders Recorded in Dogs Attending Primary-Care Veterinary Practices in England

Dan G. O'Neill[1]*, David B. Church[2], Paul D. McGreevy[3], Peter C. Thomson[3], Dave C. Brodbelt[1]

most prevalent organ system affected was the integument (36.3%, 95% CI: 33.9–38.6)

VetCompass Animal Surveillance database
140,000 dogs Sept 1,09 – March 31,13
Estimate that 3,648 cases represent a disorder
With 2.5 % expected frequency and precision 0.05% at 95% confidence interval

Lund et al (1999) *J Am Vet Med Assoc, 214*(9), 1336-1341
13% of 31,484
Diez, et al (2015). *J Small Anim Pract, 56*(7), 463-469
14% of 2,986 no age effect

Table 2. Prevalence results for the most frequent disorders recorded in dogs, purebreds only and crossbreds only that attended primary veterinary practices in England.

	Overall			Purebred		Crossbred		
Disorder	No.	Prev[a]%	95% CI[b]	Prev[a]%	95% CI[b]	Prev[a]%	95% CI[b]	P-value
Otitis externa	396	10.2	9.1–11.3	11.2	10.0–12.4	6.5	4.7–8.3	**0.001**
Periodontal disease	361	9.3	8.3–10.3	9.4	8.2–10.5	9.2	7.4–11.0	1.000
Anal sac impaction	277	7.1	6.1–8.1	7.1	6.0–8.1	7.5	5.7–9.4	1.000
Overgrown nails	276	7.1	6.1–8.2	6.9	5.8–8.0	8.0	6.1–9.9	1.000
Degenerative joint disease	256	6.6	5.7–7.5	6.4	5.3–7.4	7.5	5.7–9.4	1.000
Diarrhoea	249	6.4	5.5–7.4	6.8	5.6–8.0	4.9	3.4–6.4	0.255
Obesity	238	6.1	5.2–7.1	6.7	5.6–7.9	3.9	2.3–5.5	**0.006**
Traumatic injury	214	5.5	4.7–6.4	5.5	4.4–6.5	5.7	3.6–7.7	[illegible]
Conjunctivitis	192	4.9	4.1–5.8	5.2	4.2–6.2	4.1	2.8–5.5	1.000
Vomiting	159	4.1	3.3–4.9	4.0	3.1–4.9	4.5	3.0–6.0	1.000
Heart murmur	153	3.9	3.3–4.5	4.1	3.5–4.7	3.4	2.1–4.7	1.000
Lipoma	137	3.5	2.8–4.2	3.5	2.7–4.2	3.8	2.7–4.9	1.000
Dermatitis	134	3.5	2.8–4.1	3.5	2.8–4.3	3.1	1.9–4.4	1.000
Skin hypersensitivity	113	2.9	2.3–3.5	3.2	2.5–3.9	1.8	0.9–2.6	0.116
Skin mass	110	2.8	2.3–3.4	3.2	2.6–3.8	1.5	0.6–2.4	**0.033**
Claw injury	103	2.7	2.1–3.2	2.6	2.0–3.2	2.6	1.5–3.8	1.000
Behavioural	99	2.6	2.1–3.0	2.6	2.1–3.1	2.4	1.4–3.4	1.000
Gastroenteritis	99	2.6	2.0–3.1	2.4	1.9–2.9	3.1	2.0–4.3	1.000
Dog bite injury	97	2.5	1.9–3.1	2.4	1.7–3.1	2.9	1.8–4.0	1.000
Laceration	92	2.4	1.8–2.9	2.5	1.8–3.1	2.0	1.1–2.9	0.446

P-values (Holm-adjusted) represent comparison between purebreds and crossbreds.
[a]Prev prevalence.
[b]95% CI 95% confidence interval.
doi:10.1371/journal.pone.0090501.t002

Importance

- It is often chronic or recurrent
- Even short term but often long term the recurrences or chronicity lead to
  - Uncomfortable or painful pets
  - Frustrated owners
  - Deafness
  - Expensive surgery or euthanasia

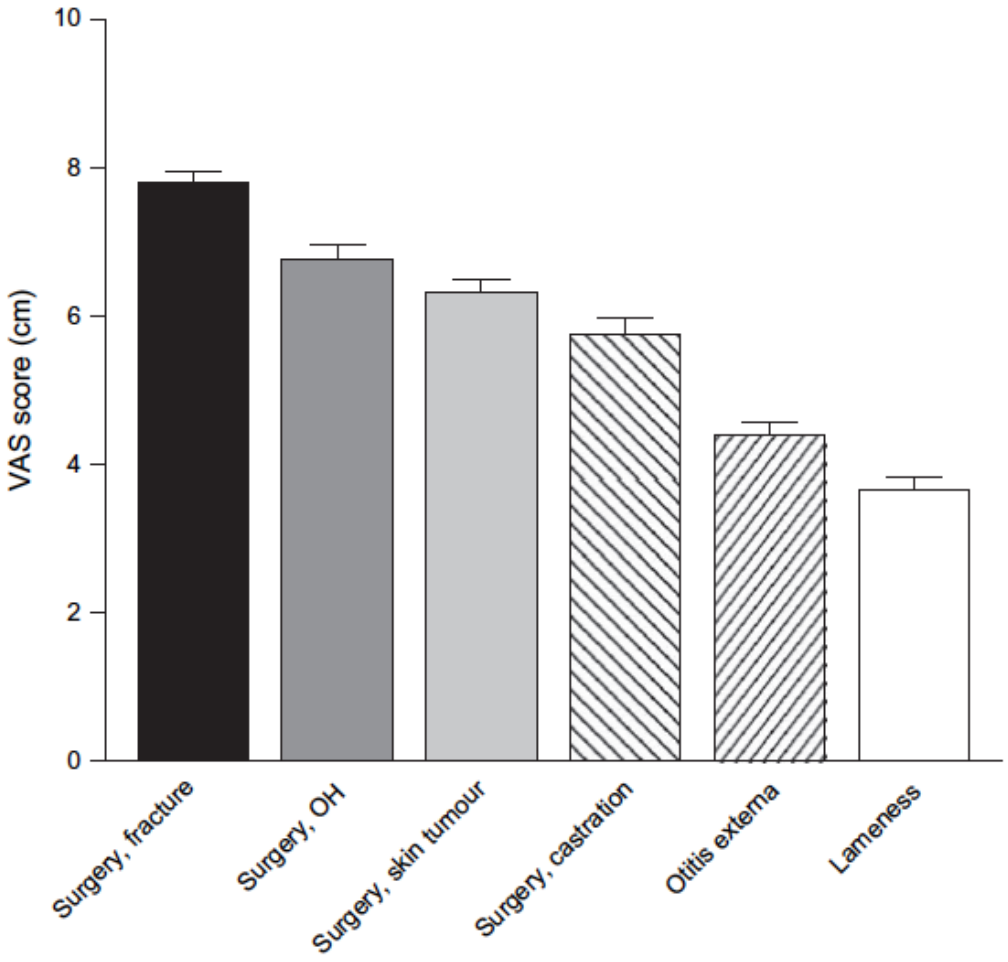


FIG 1. Clinical scenarios listed on the owner questionnaire with respective ratings for the level of animal pain. Owners of dogs and cats (n_{tot}=482) were asked to rate the average animal pain with the presented clinical condition assuming that no analgesics had been administered. The questionnaire stated: ''Your pet has . . .''. For the surgical conditions, pain was asked to be rated as animal pain at home, after the operation. Values are means with 95 per cent confidence intervals; VAS Visual analogue scale

Pain

In Otitis [1]

Pain medications

Always needed 13%

Likely needed 48%

[1]Vaisanen, et al (2008). Opinions of Finnish small animal owners about surgery and pain management in small animals. *J Small Anim Pract, 49*(12), 626-632.

Total Ear Canal Ablation And Lateral Bulla Osteotomy (TECA/LBO) is often performed for end stage otitis.

The primary goal of this procedure is to alleviate chronic pain and discomfort.

My Opinions

- It is the most common reasons clients see multiple veterinarians

Our professions great failure

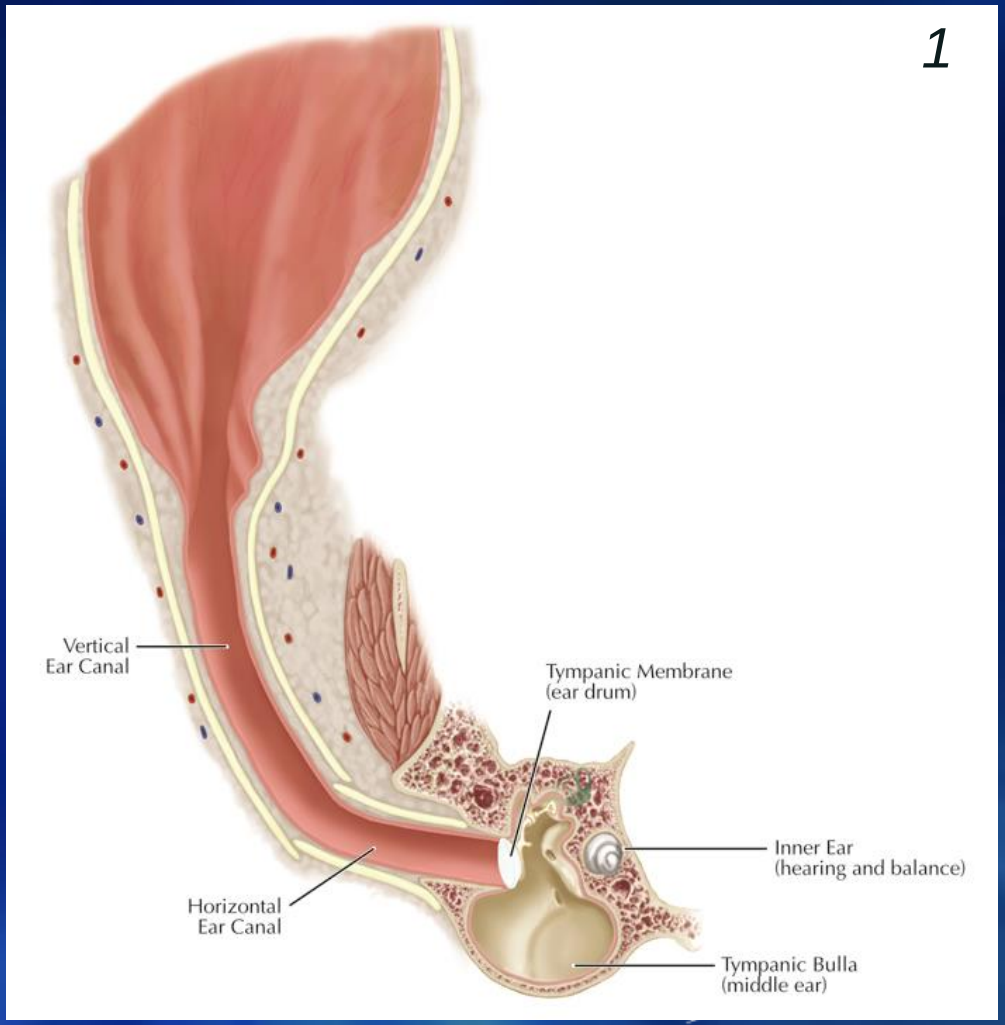
Preventable Pain and Suffering
Expense
Loss of hearing
Unnecessary surgery

Anatomy and Physiology

Where You Need To Start

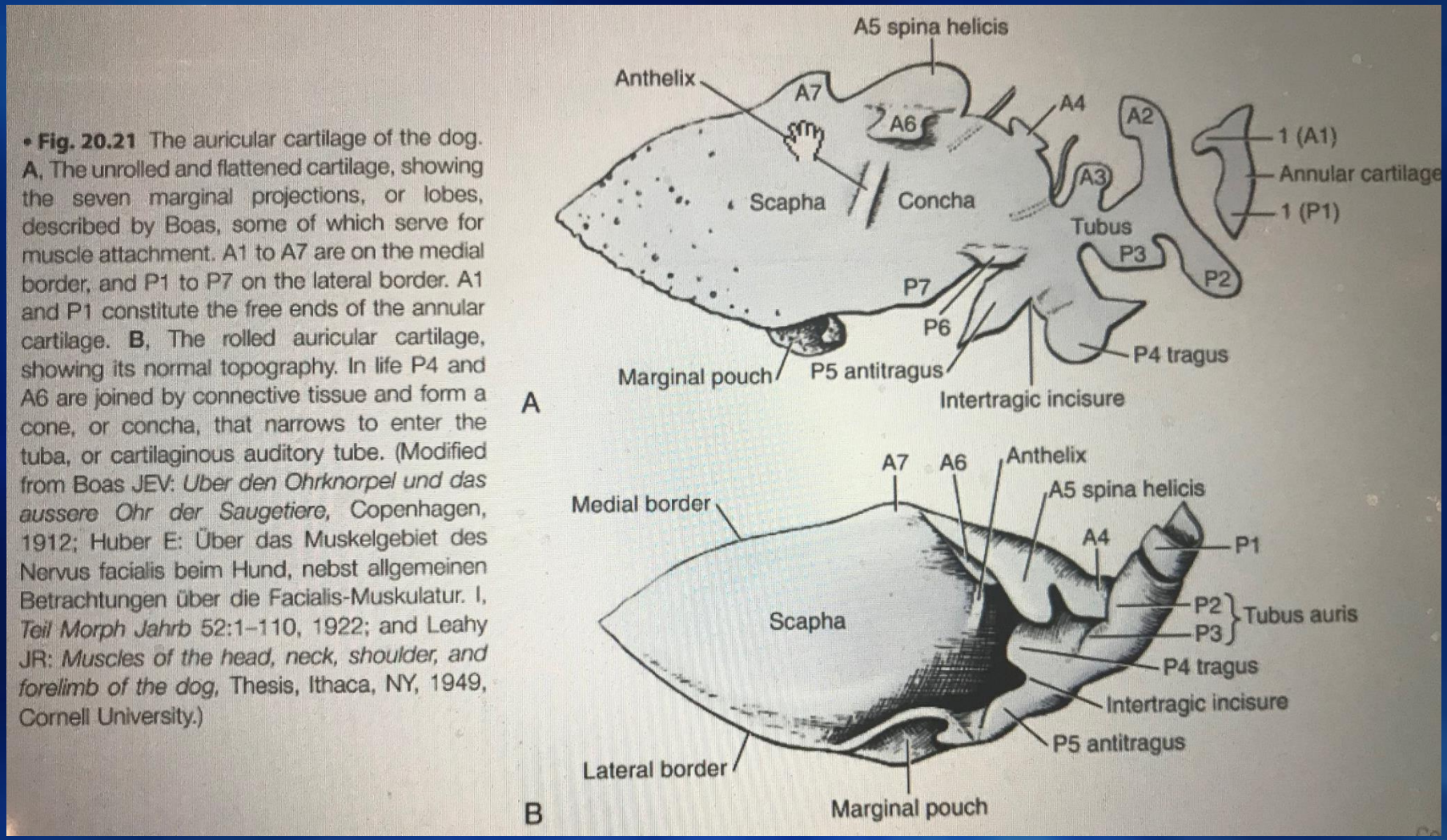
Ear Anatomy

- Pinna
- External Ear Canal
  - orifice to tympanic membrane
  - Cartilage
    - Auricular and annular
  - 5-10 cm
    - 11 cm giant breeds
  - Vertical and horizontal canal
    - Rostral ventral
- Middle Ear
- Inner Ear



[1] Griffin, CE. (2008) Dermatology and Otology in *Pfizer Atlas of Infection in Dogs and Cats*

Cartilage[1]

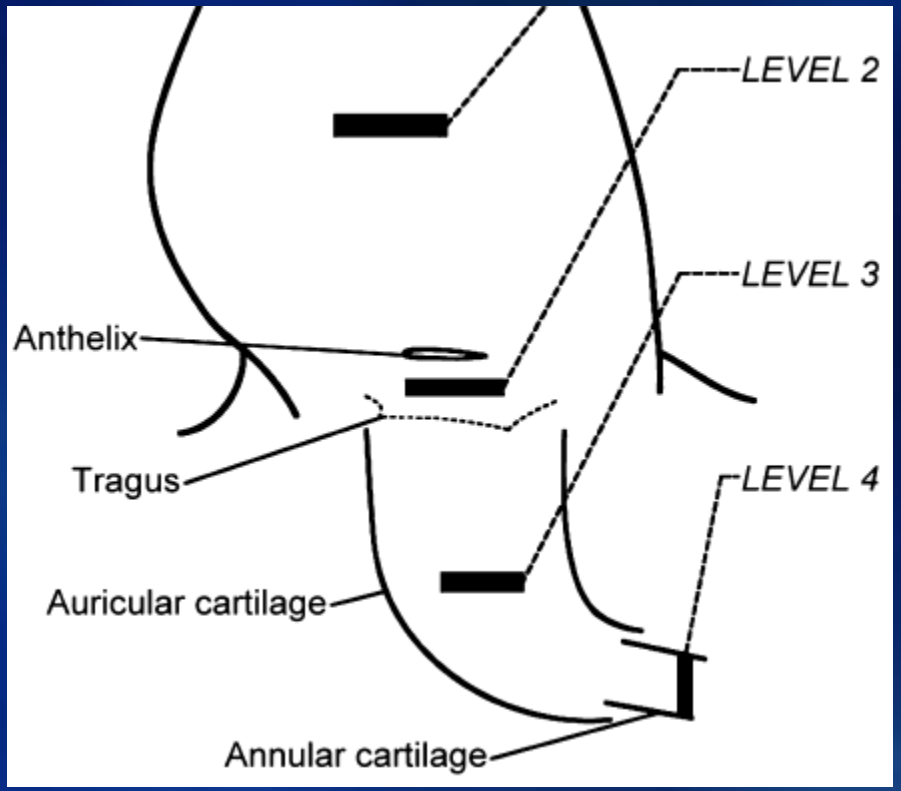


• **Fig. 20.21** The auricular cartilage of the dog. **A**, The unrolled and flattened cartilage, showing the seven marginal projections, or lobes, described by Boas, some of which serve for muscle attachment. A1 to A7 are on the medial border, and P1 to P7 on the lateral border. A1 and P1 constitute the free ends of the annular cartilage. **B**, The rolled auricular cartilage, showing its normal topography. In life P4 and A6 are joined by connective tissue and form a cone, or concha, that narrows to enter the tuba, or cartilaginous auditory tube. (Modified from Boas JEV: *Uber den Ohrknorpel und das aussere Ohr der Saugetiere,* Copenhagen, 1912; Huber E: Über das Muskelgebiet des Nervus facialis beim Hund, nebst allgemeinen Betrachtungen über die Facialis-Muskulatur. I, *Teil Morph Jahrb* 52:1–110, 1922; and Leahy JR: *Muscles of the head, neck, shoulder, and forelimb of the dog,* Thesis, Ithaca, NY, 1949, Cornell University.)

1 Hermanson, Evans, deLahunta -Miller and Evans' Anatomy of the Dog – 5th ed pg 856

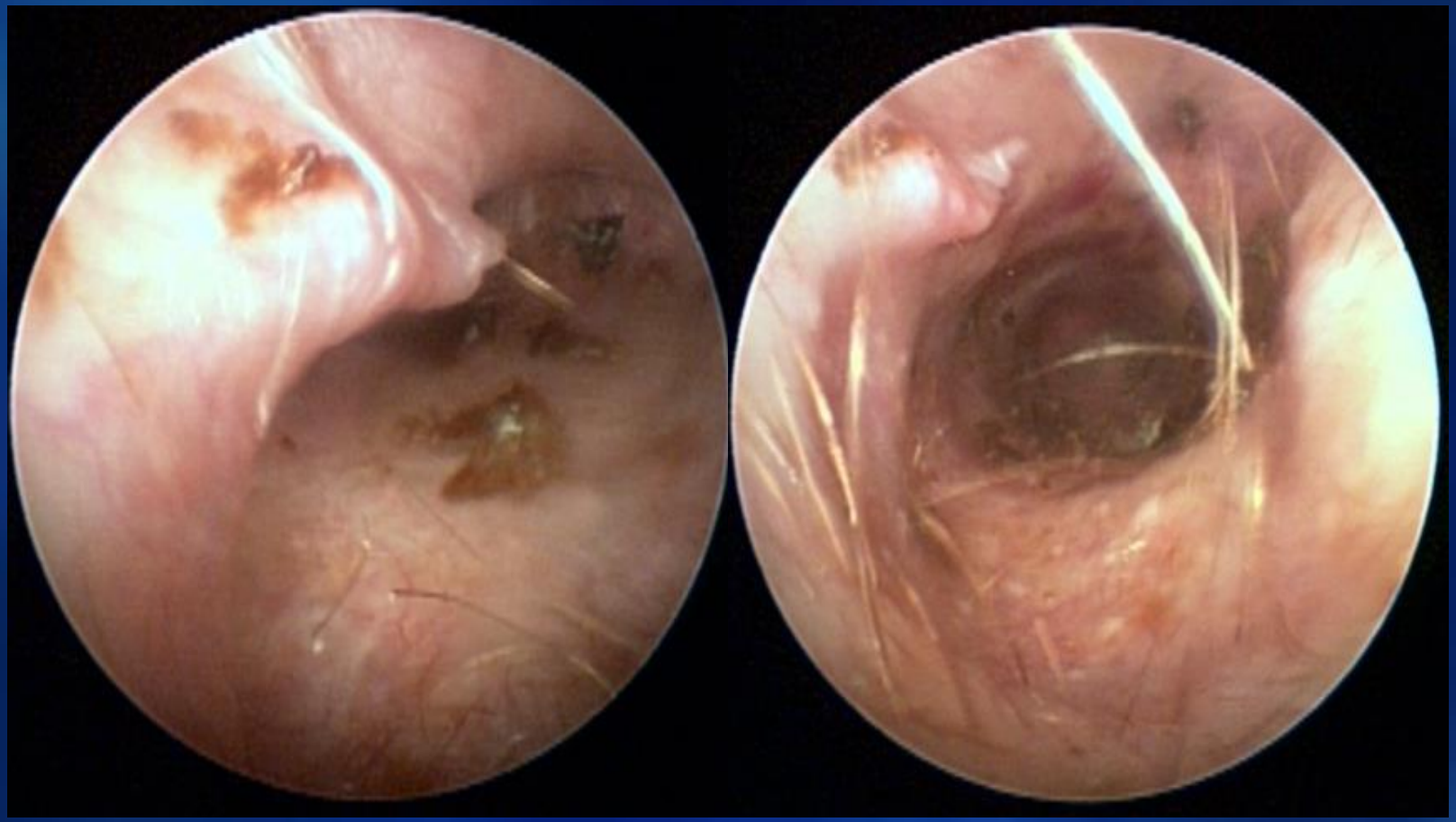
Diameter Lumen [1]

- "…the distal end of the external ear canal was 5.8 ± 1.5 cm (range 2.1–7.9 cm). The second diameter examined, at the proximal opening of the auricular cartilage, measured on average 0.7 ± 0.2 cm (range 0.3–1.0 cm). The mean diameter at the most proximal opening of the cartilaginous part of the external ear canal measured 0.5 ± 0.1 cm (range 0.3–0.8 cm).
- A positive correlation between the diameter of the distal end of the external ear canal and body weight was found ($r = 0.42$, $P < 0.05$,"



[1] Huang et al (2009) Vet Dermatol **20**(5-6): 422-428

Auricular Projection[1]



- Pain when pressure put against it, especially if inflamed

Terminology Recommended by A deLahunta

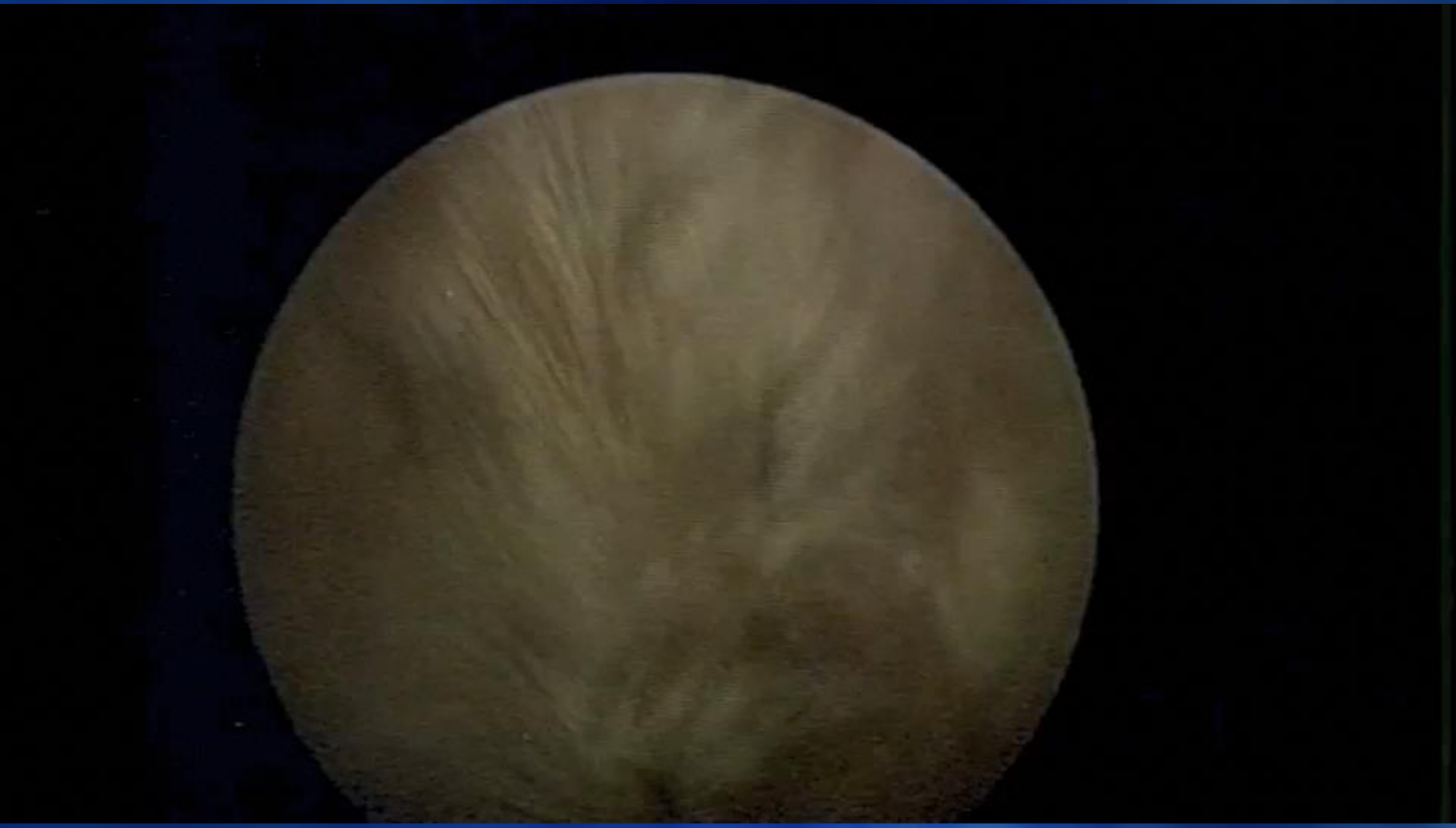
[1] Griffin C (2009) Compend Contin Educ Vet **31**(11): 504-512

Otoscopic Examination Technique

- Acquired skill
- Atraumatic
- Visualize cone placement
- Tip of cone
  - Down lumen of canal

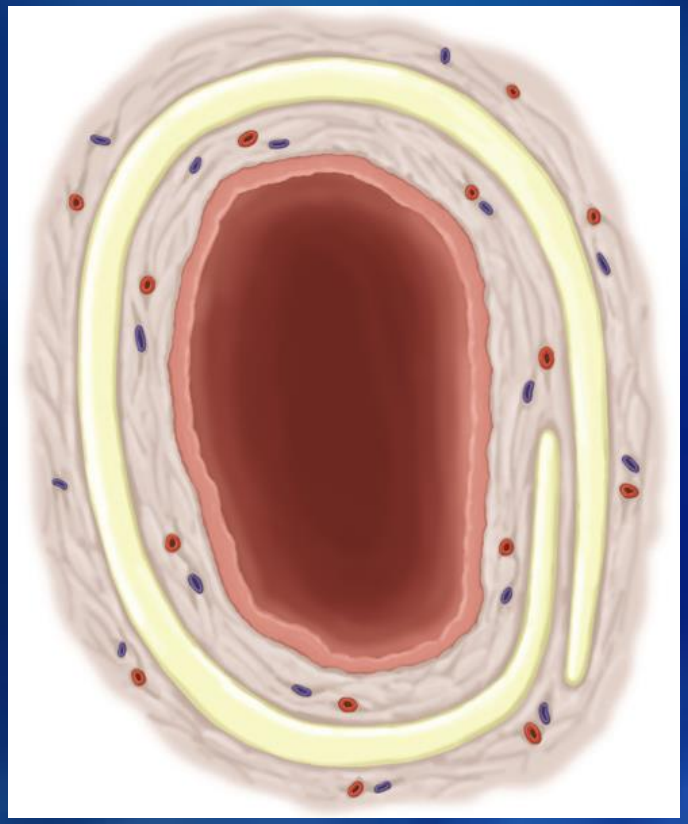
Technique

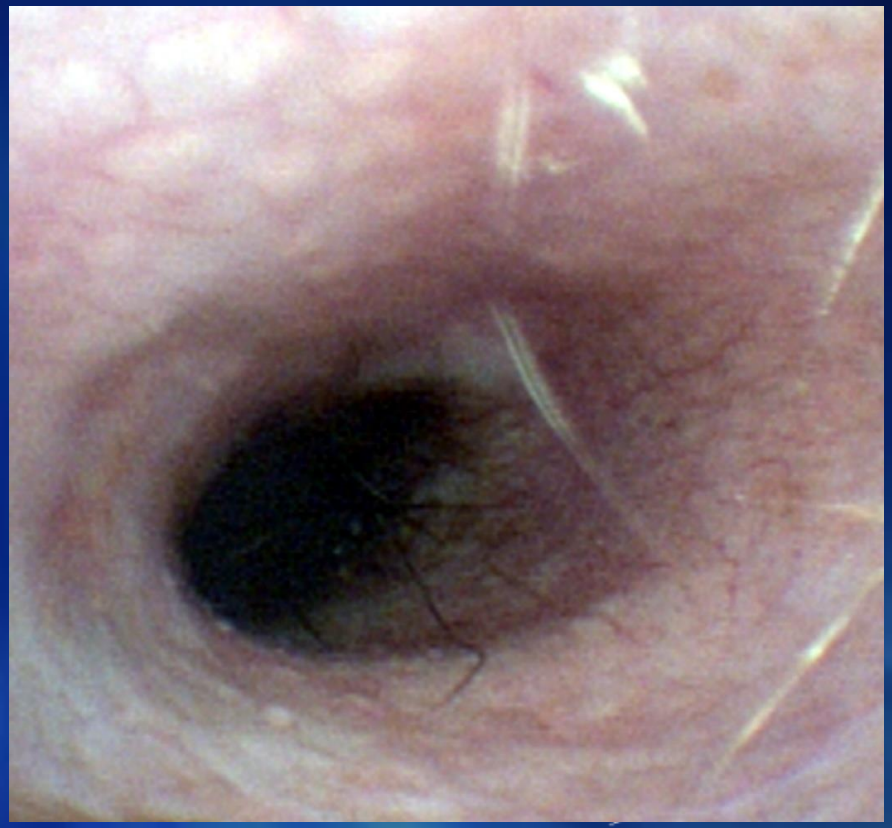
- Straighten the canal
- Pull canal over tip of cone
  - Accomplished by pulling the pinnae up and then lateral and down towards the otoscope cone.



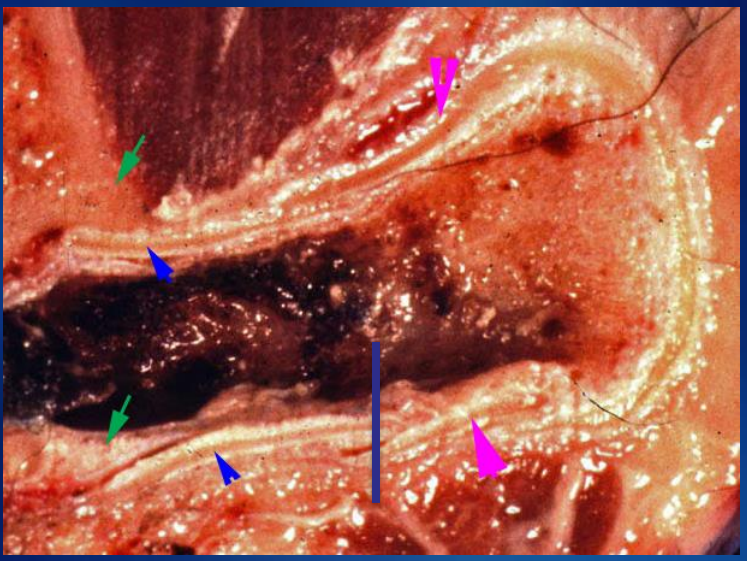
Ear Canal

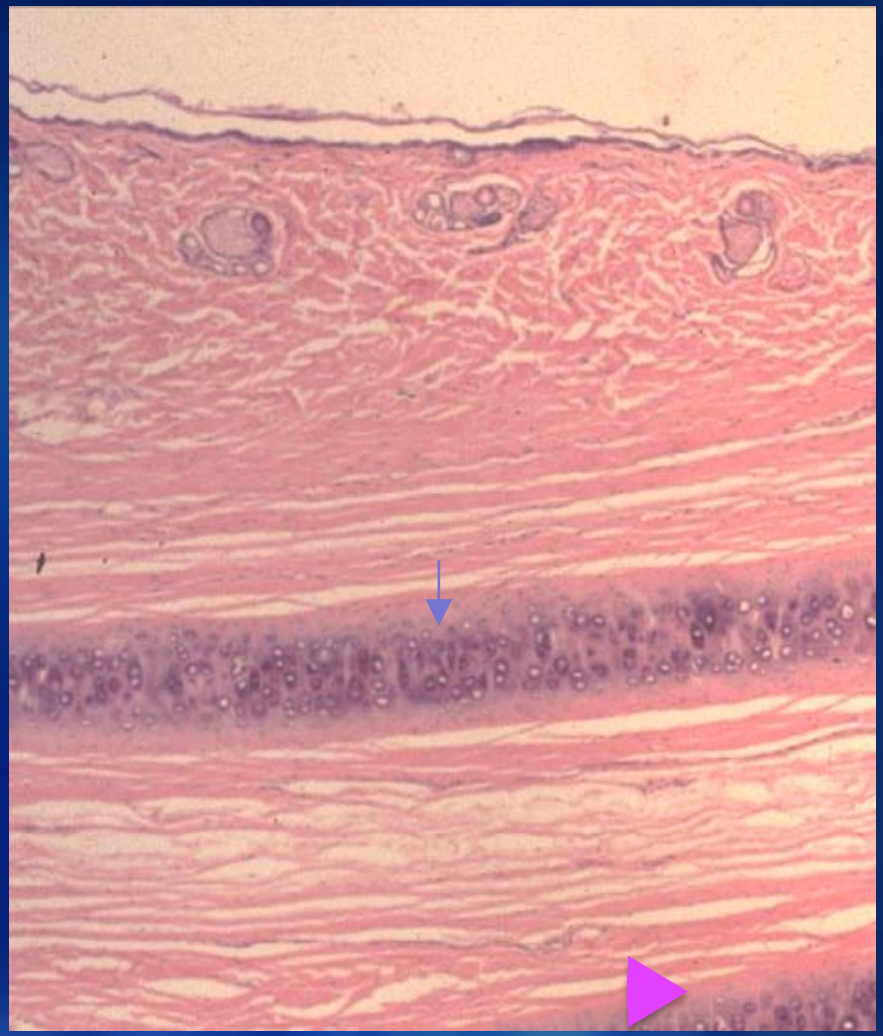
- Smooth wall with hair follicles and open lumen





Normal Skin





- Auricular cartilage
- Anular cartilage

Cerumen | definition of cerum

cerumen

Also found in: **Dictionary**, **Thesaurus**, **Encyclopedia**, **W**
Related to cerumen: **tinnitus**

cerumen [sĕ-roo´men]

a waxy secretion of the glands of the external acoustic r

ce·ru·men (sĕ-rū'men),

The soft, brownish yellow, waxy secretion (a mod
canal.
Synonym(s): **ear wax**, **earwax**
[L. *cera,* wax]

Farlex Partner Medical Dictionary © Farlex 2012

cerumen /ce·ru·men/ (sĕ-roo´men) earwax; the
´minalceru´minous

Dorland's Medical Dictionary for Health Consumers. © 2007 by Sa

cerumen (sə-rōō'mən)

n.

See **earwax**.

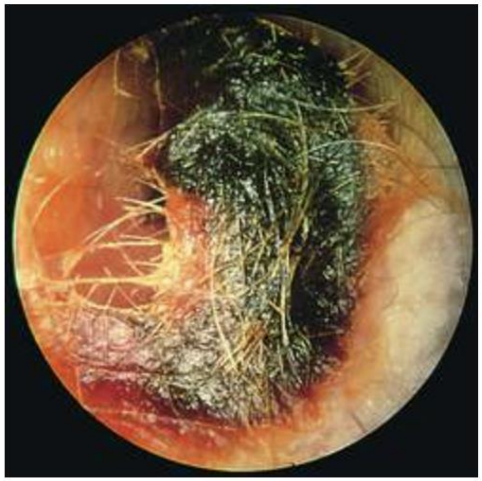
Web search definition of cerumen by m

cerumen

[sirōō′mən]

Etymology: L, *cera,* wax

a yellowish or brownish waxy secretion produced by vestigial apocrine sweat glands in the external ear canal. Also called **earwax**.



Cerumen

"CITE" Mosby's Medical Dictionary, 9th edition. © 2009, Elsevier.

cerumen Earwax ENT A waxy secretion of the hair follicles and glands of the external auditory canal which protects the ear by trapping dust, microorganisms, and foreign particles, preventing them from entering and damaging the ear. See Wet cerumen.

"CITE" McGraw-Hill Concise Dictionary of Modern Medicine. © 2002 by The McGraw-Hill Companies, Inc.

ce·ru·men (sĕ-rū'mĕn)

The soft, brownish yellow, waxy secretion (a modified sebum) of the ceruminous glands of the external auditory meatus.
[L. *cera,* wax]

"CITE" Medical Dictionary for the Health Professions and Nursing © Farlex 2012

Cerumen

- Constantly producing exfoliating corneocytes, intercellular material and glandular secretions
- Combined = earwax
- Protective role
  - Inhibit infection
    - May promote growth of Malassezia[1]
  - Promote cleaning, foreign body removal

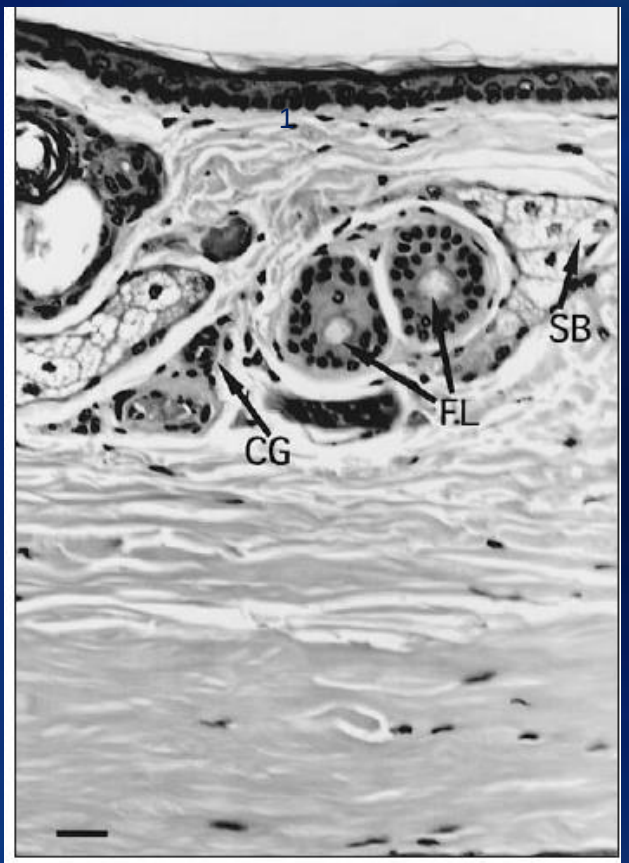
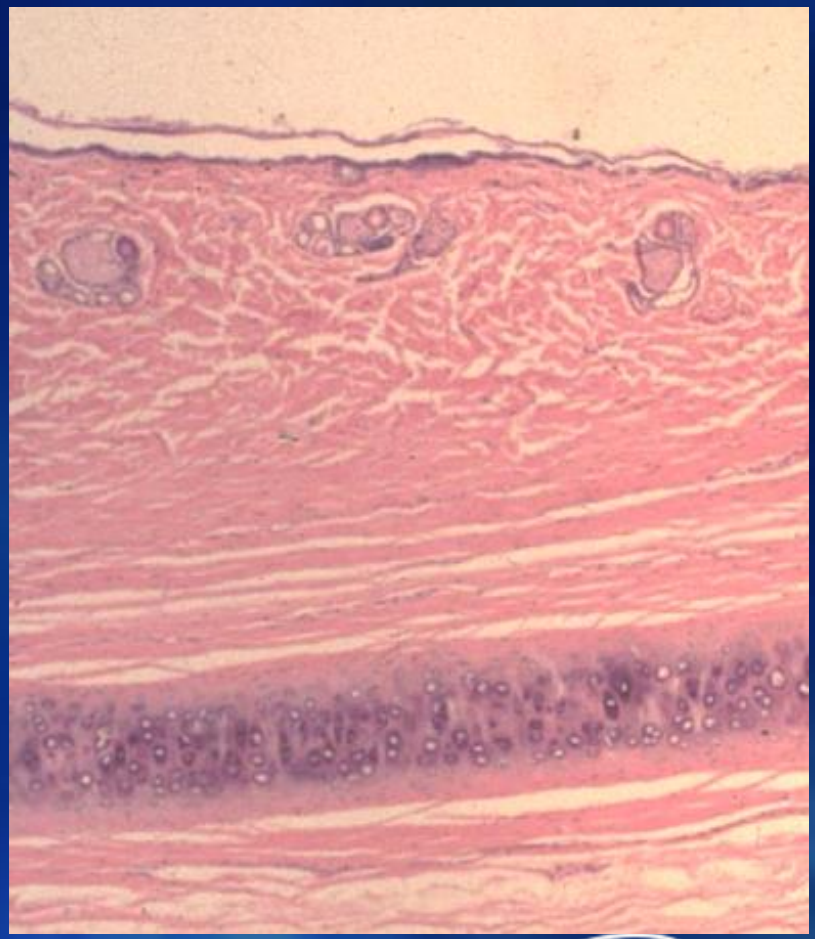


Figure 3—High magnification photomicrograph of transverse section of a normal horizontal ear canal in a dog. Notice the normal hair follicles (FL), sebaceous glands (SB), and cerumen glands (CG). H&E stain; bar = 20 μm.

[1] Gabal, M. A. (1988) Mycopathologia **104**(2): 93-98

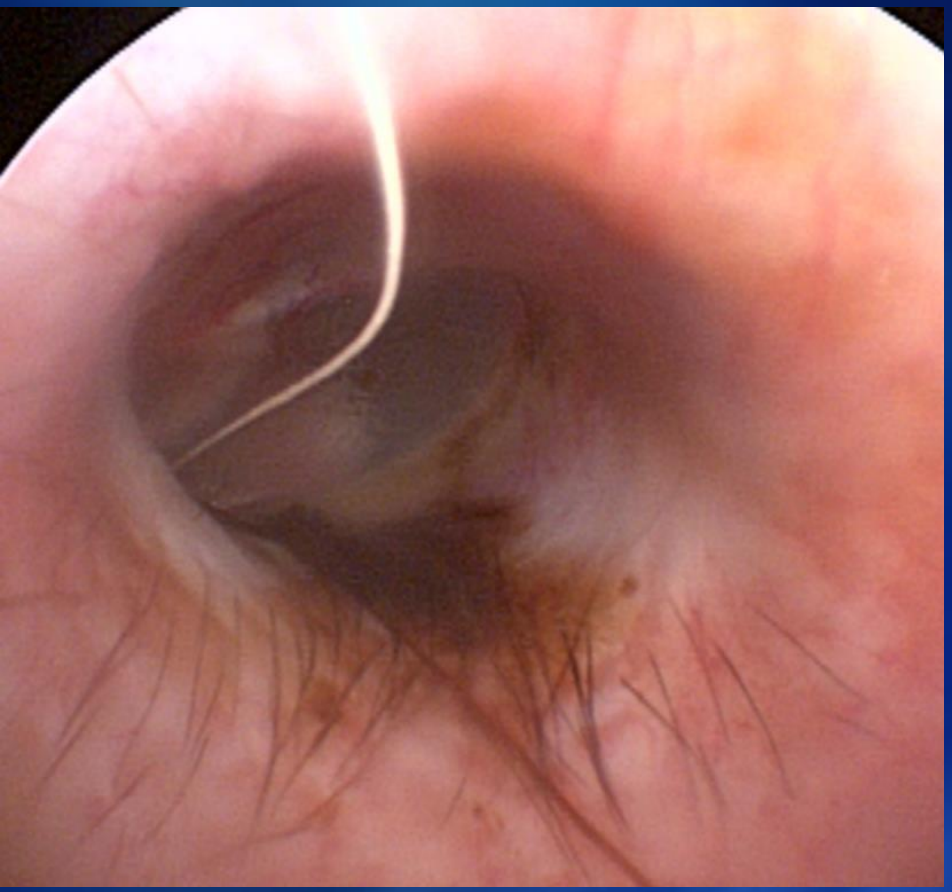
Cerumen

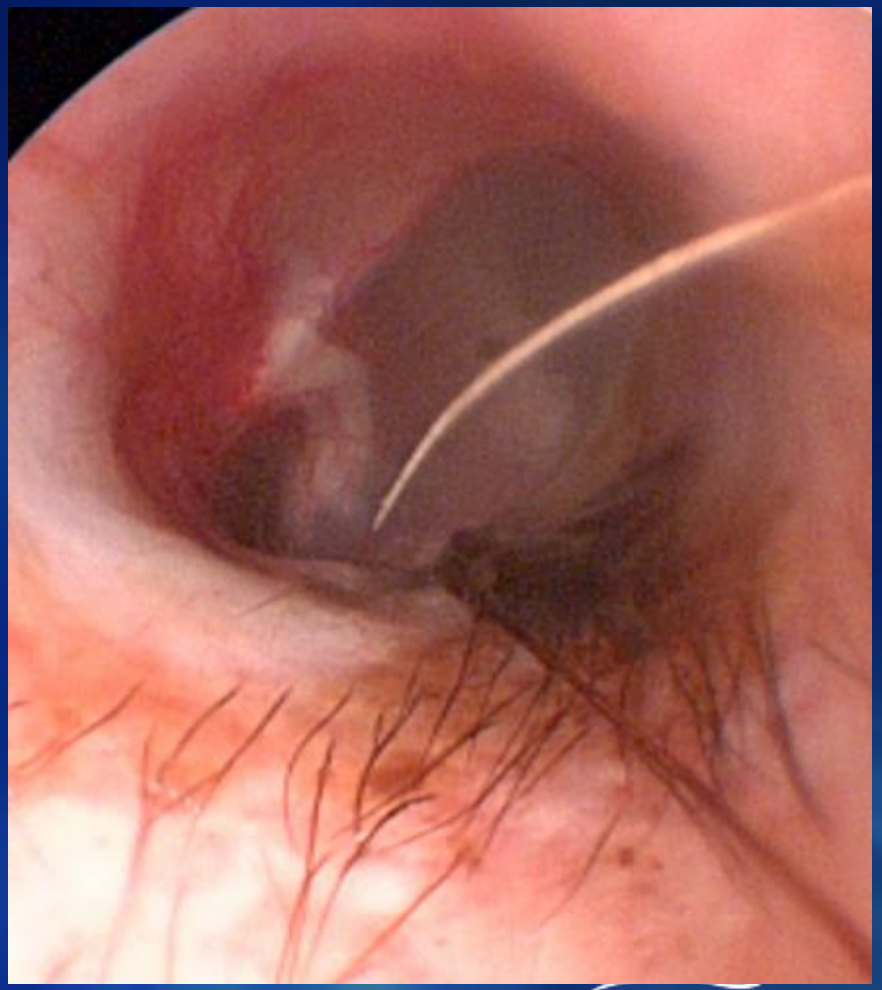
- Canine cerumen mainly composed of [1]
  - Triglycerides,
  - Sterol esters,
  - Fatty acid esters
  - Squalene



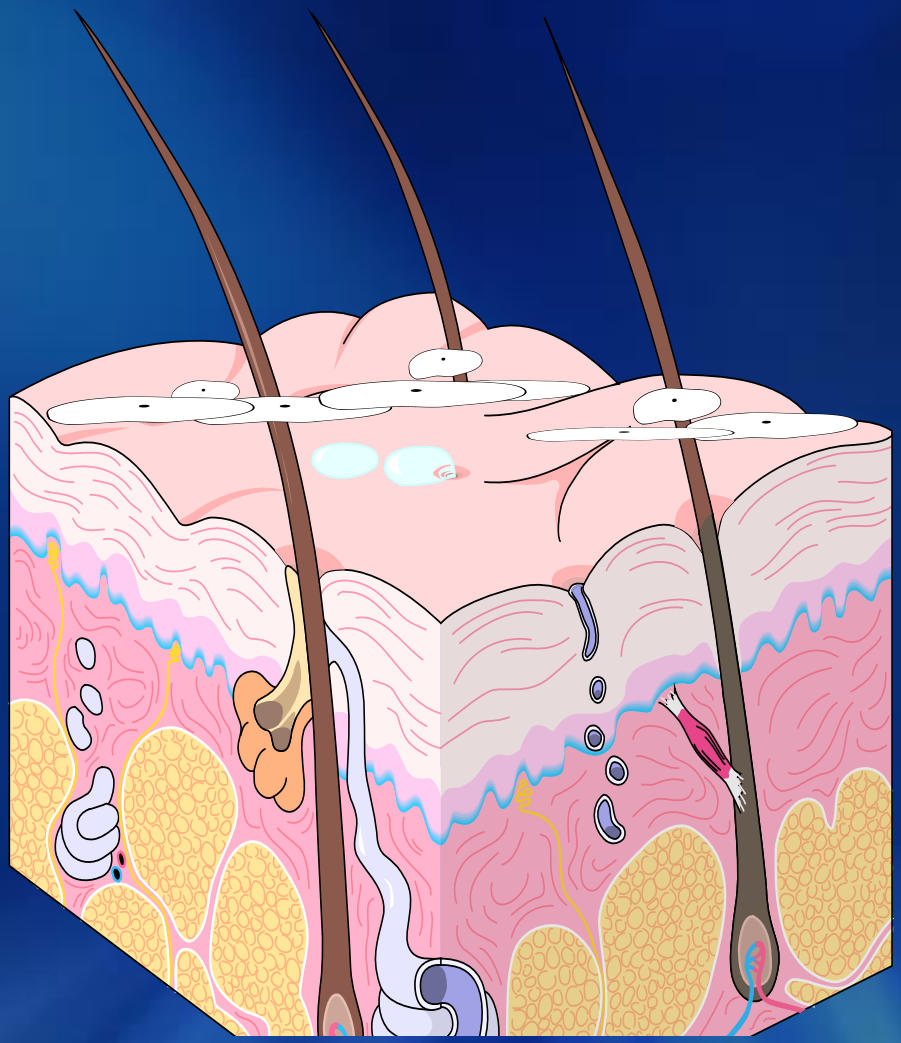
[1] Stahl, J., et al. BMC Vet Res, 2013. **9**(1): p. 70

Hairs As Approach Tympanum

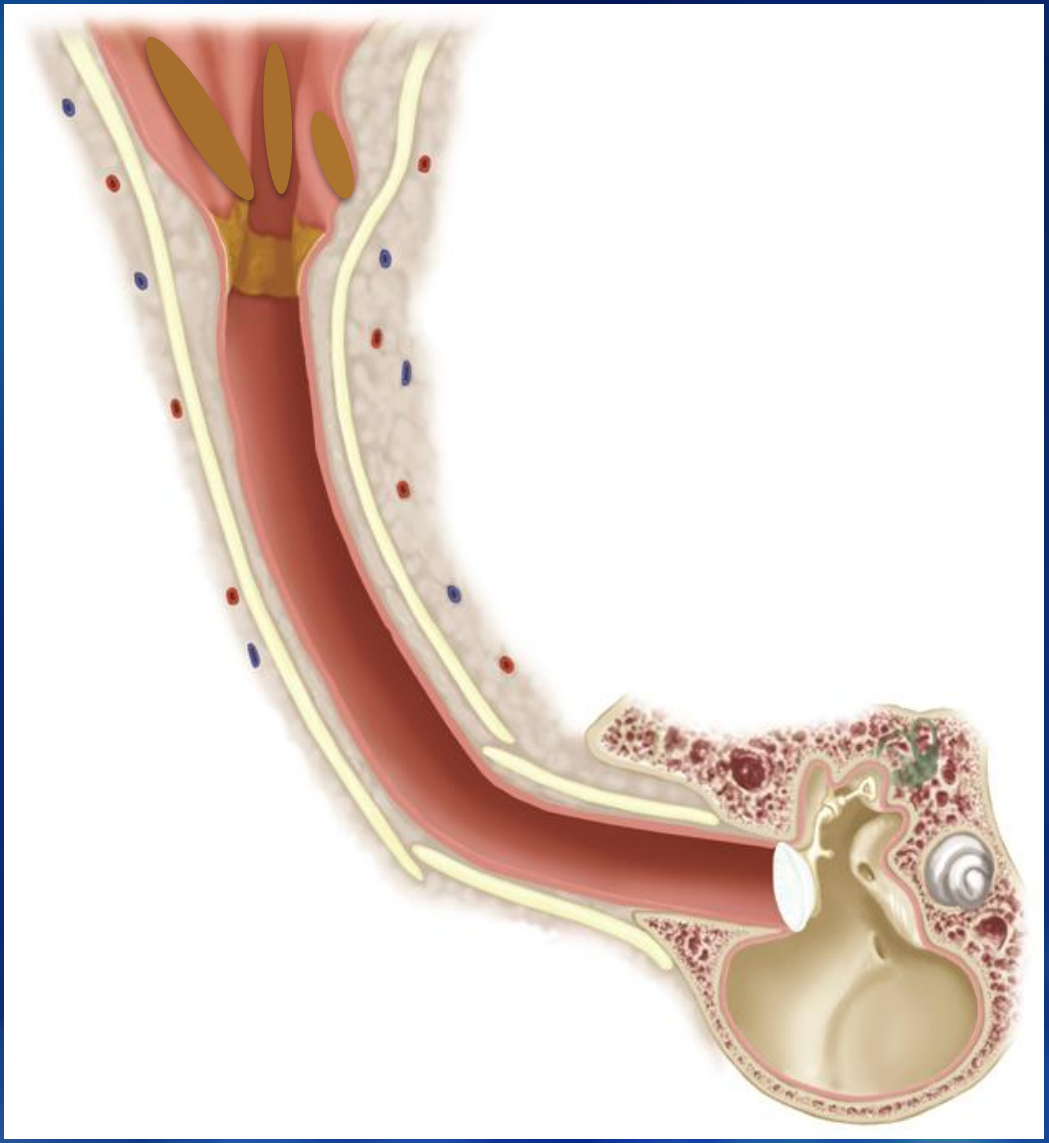


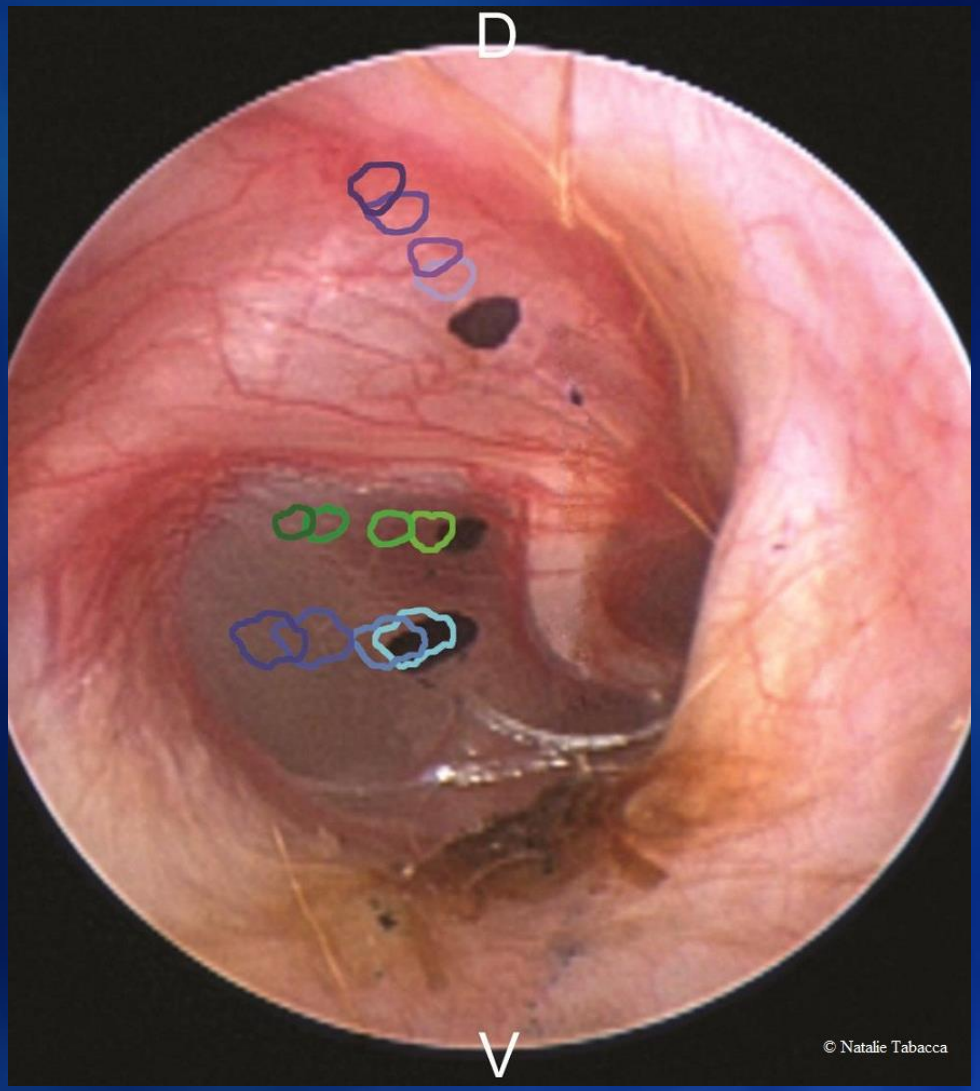


Normal Desquamation



Normal Physiology



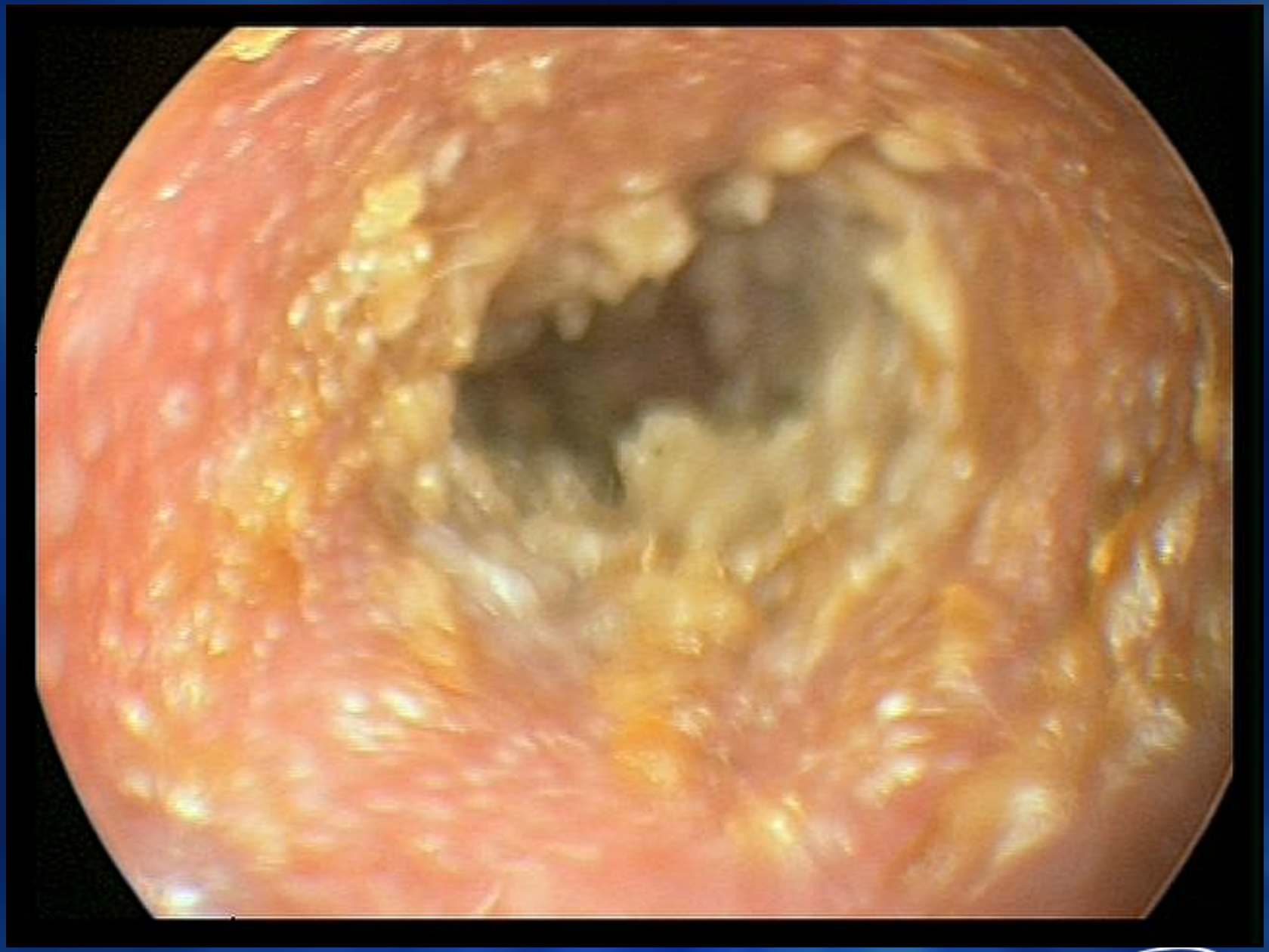


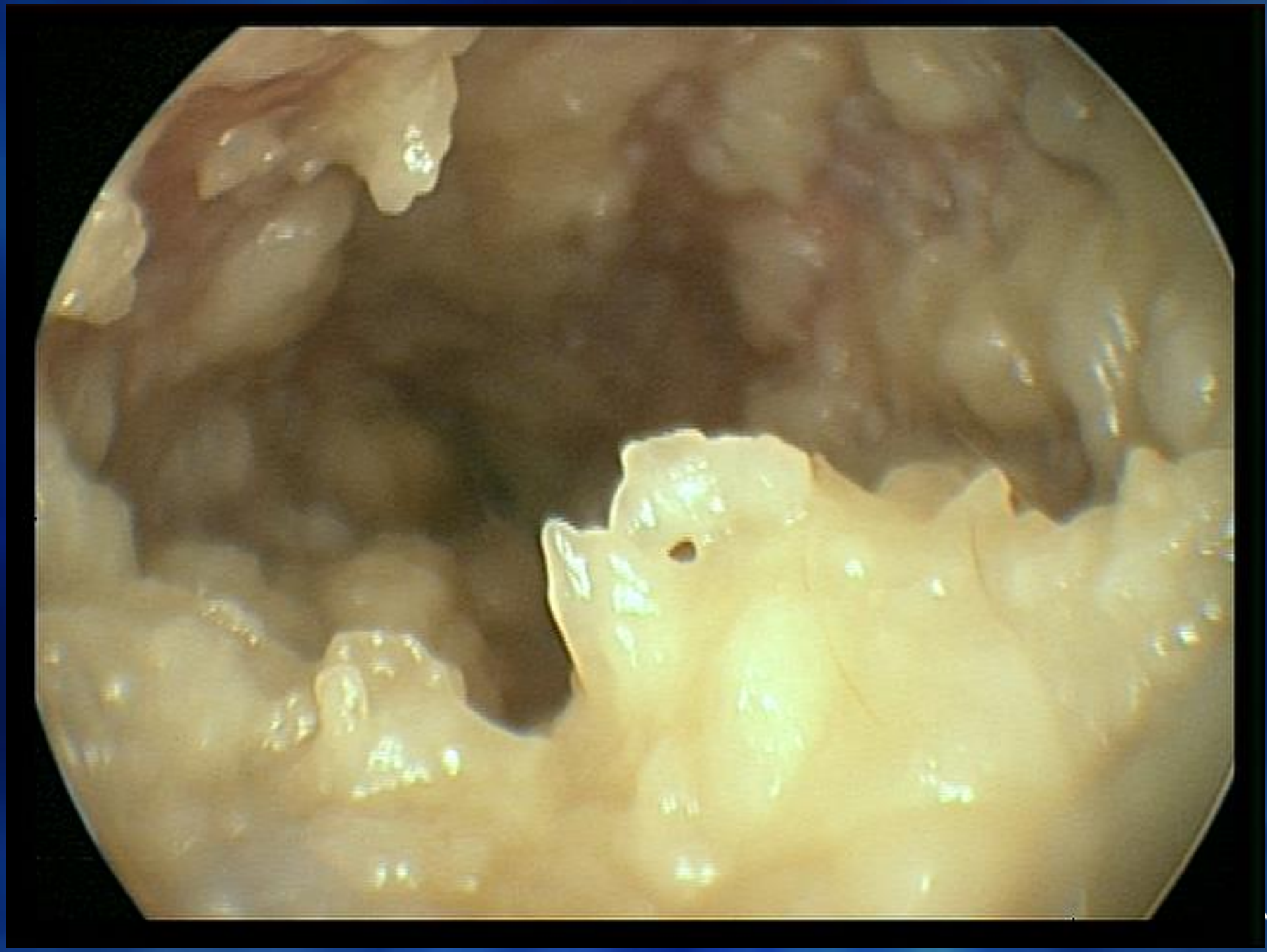
Courtesy N Tabacca

- Tabacca, N.E., et al., *Epithelial migration on the canine tympanic membrane. Vet Dermatol, 2011.* ***22(6): p. 502-10.***

Assessing Self Clean

- The ear has been effectively cleaned by hospital staff or owner
- Otoscopic exam after the ear has not been cleaned for at least 7 day or more
  - Often go one the two weeks no cleaning
  - Examine ear canal for amount of debris present





Veterinary Cleansers and Cerumenolytics

- Artificial canine cerumen has been produced and shows various cerumenolytics remove from 0 to 95% of cerumen13 [1,2,3]

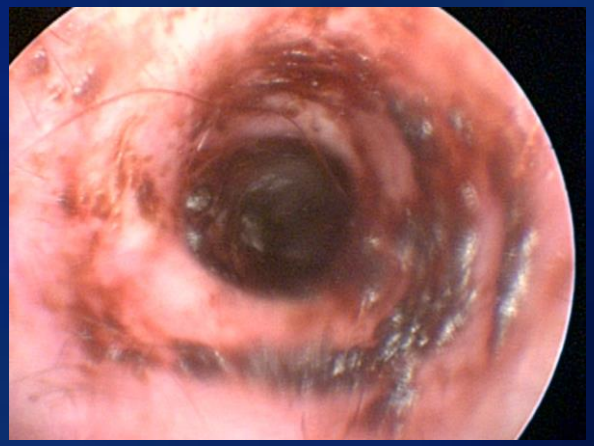


Figure 2. Appearance of a selection of the tubes after three consecutive assays in phase I showing different degrees of standardized synthetic cerumen (SSC) disintegration. As described in Table 1, after test 3, water (A) and Epiotic (EP) did not show any effect on the SSC plug, whereas Cerumene (CE), Specicare (SP) and Otoclean (OT) induced an increasing degree of SSC disintegration and removal.

1

[1] Sanchez-Leal et al. (2006) *Vet Dermatol, 17*(2), 121-127
[2] Nielloud et al (2004) *Vet Dermatol, 15*(Supp 1 Abst WCVD), 65
[3] Santoire et al. (2016) *Vet Derm, 27*(Suppl 1 Abst WCVD), 105-106

Veterinary Cleansers and Cerumenolytics

- None of these studies showed effects on abnormal otic exudates that contain degenerate inflammatory cells and epithelial debris from inflammation
- Humans at least used natural ear wax [1]
  - Cerumen is the brownish yellow, waxy secretion produced by the external auditory meatus

[1] Saxby et al (2013). J Laryngol Otol, *127*(11), 1067-1070

TABLE II
DEGREE OF CERUMEN DISINTEGRATION OVER TIME

Agent	Time elapsed		
	30 min	3 hr	12 hr
Distilled water	+	++	+++
Olive oil	–	–	–
Sodium bicarbonate	+	++	+++
Sofradex	+	++	++
Urea + hydrogen peroxide	–	–	–
Vistamethasone	+	++	++

Adapted with permission.[7] Min = minutes; hr = hours; + = slight disintegration; ++ = partial disintegration; +++ = substantial disintegration; – = no visible change

TABLE III
DRIED WEIGHT OF CERUMEN

Agent	Weight (g)			
	Trial 1	Trial 2	Trial 3	Mean
Distilled water	0.002	0.001	0.001	0.001
Olive oil	0.030	0.029	0.030	0.030
Sodium bicarbonate	0.004	0.006	0.007	0.006
Sofradex	0.005	0.008	0.009	0.007
Urea + hydrogen peroxide	0.030	0.030	0.028	0.030
Vistamethasone	0.008	0.006	0.007	0.007

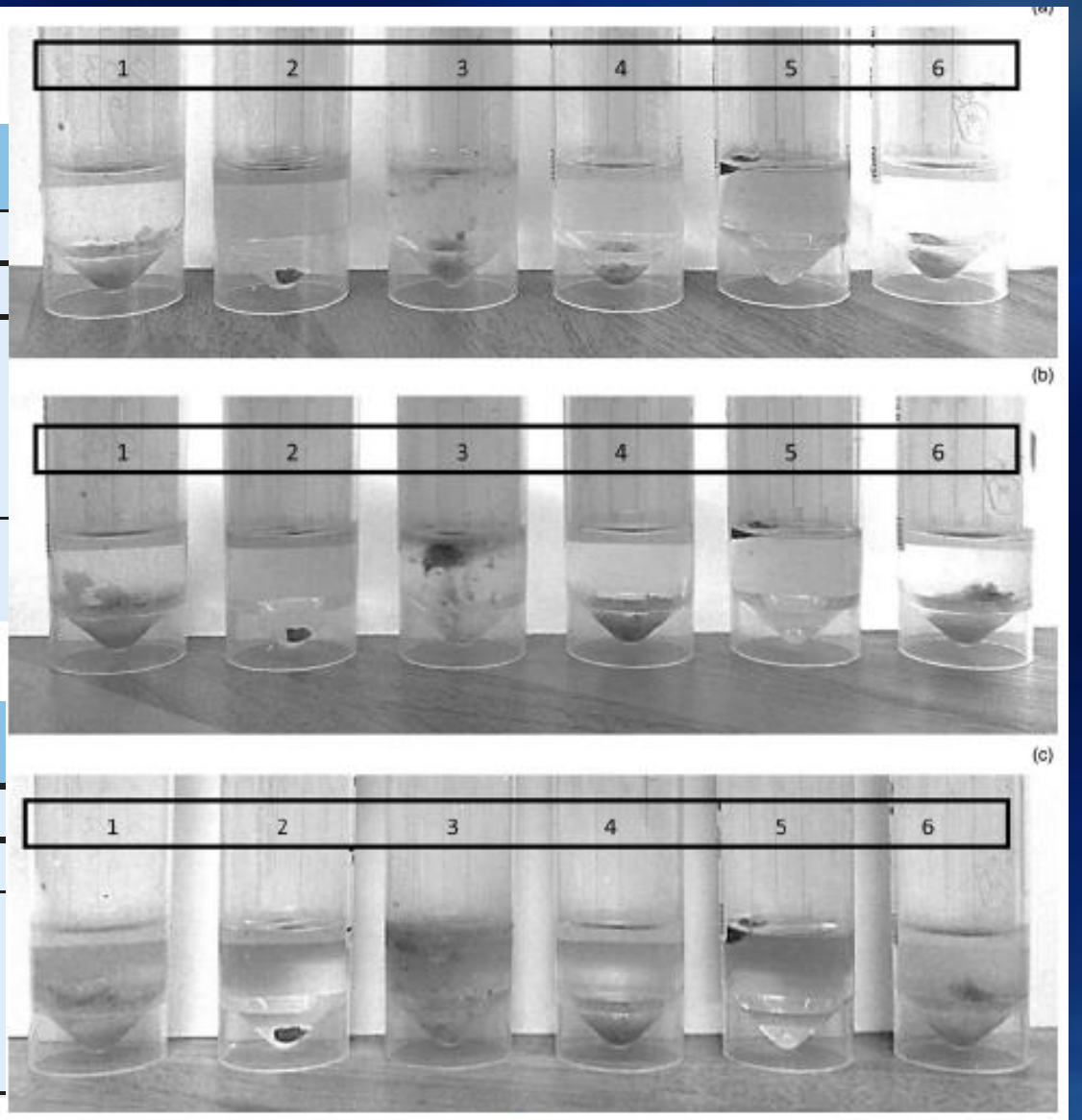
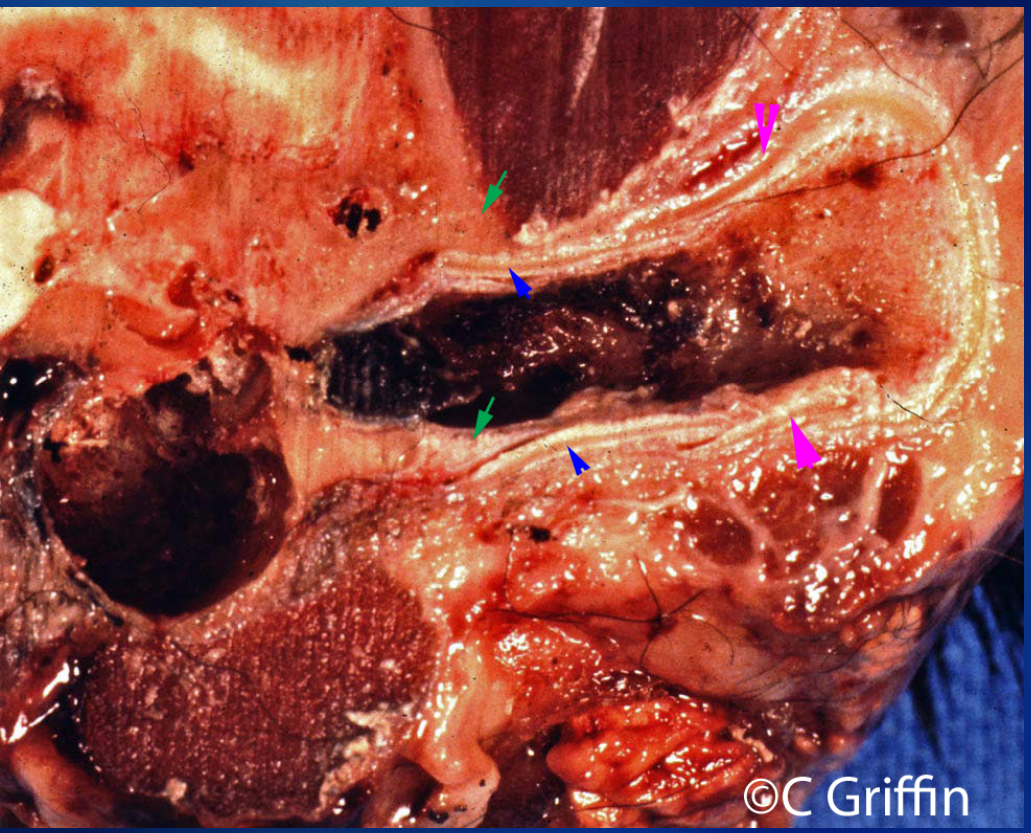


FIG. 1
Photographic evidence of cerumen disintegration at (a) 30 minutes, (b) 3 hours and (c) 12 hours. See Table I for identity of numbered solutions.

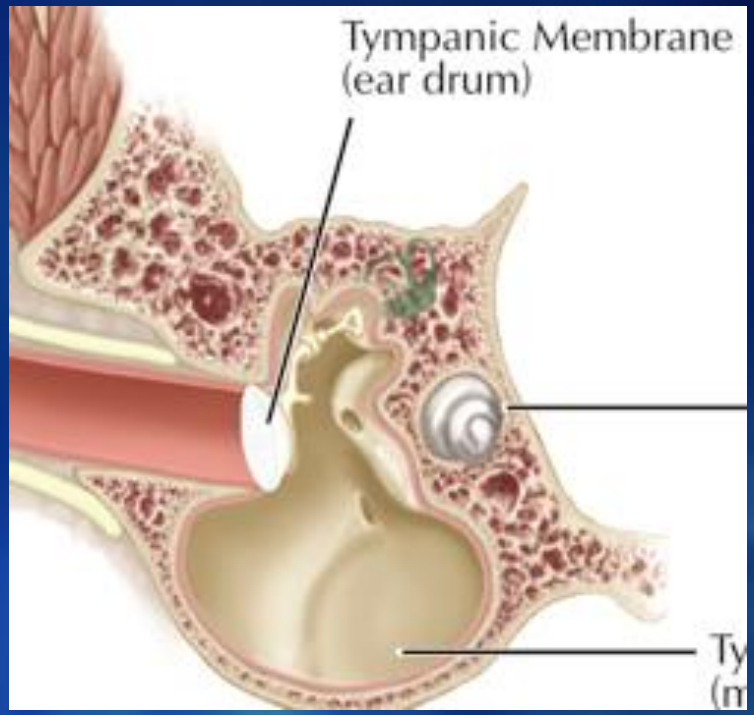
From
Saxby et al (2013). Finding the most effective cerumenolytic. *J Laryngol Otol, 127*(11), 1067-1070

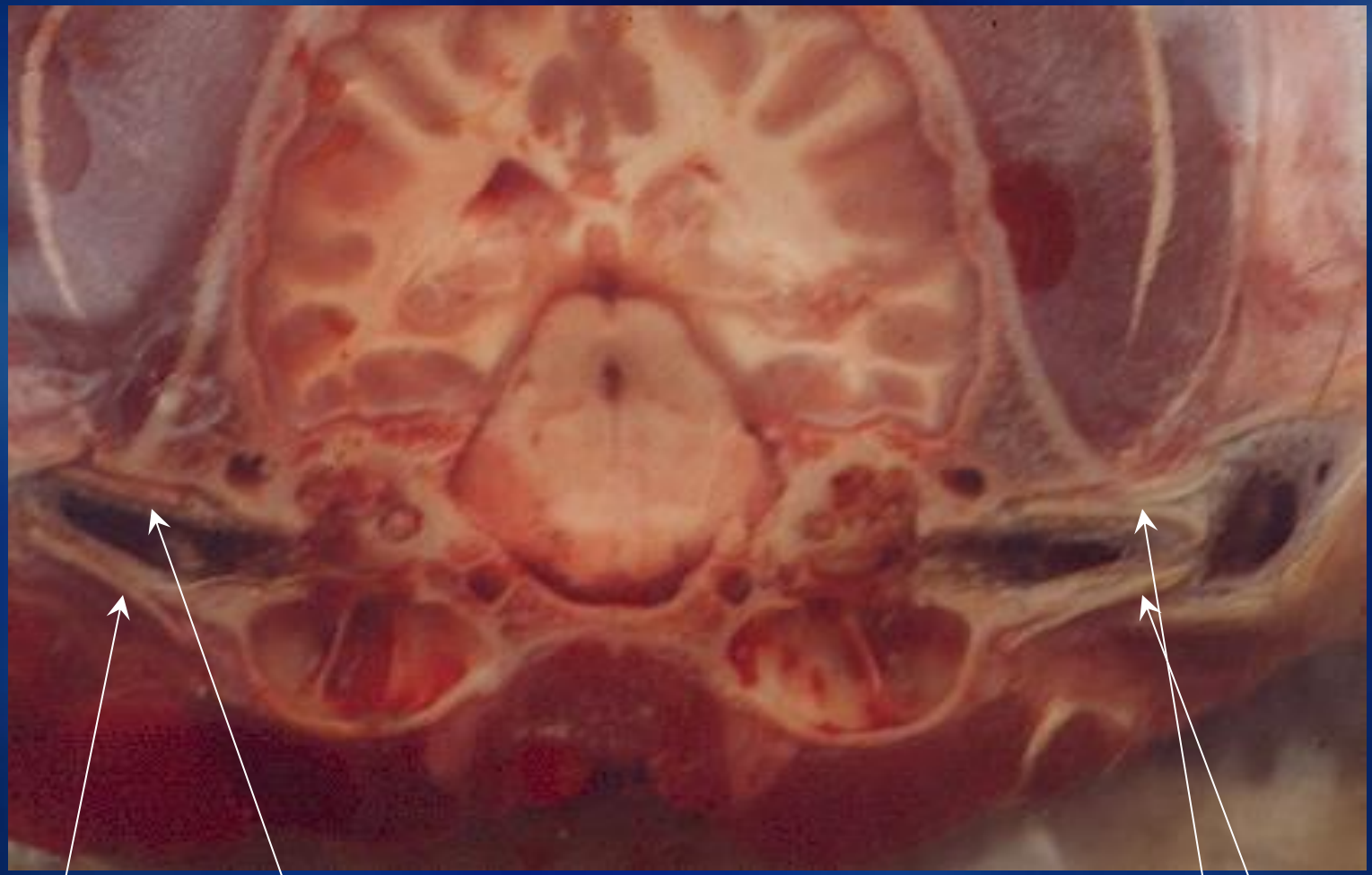
Approaching the middle ear
Skin, Cartilage, Bone



- External acoustic meatus
- Annular cartilage
- Auricular cartilage

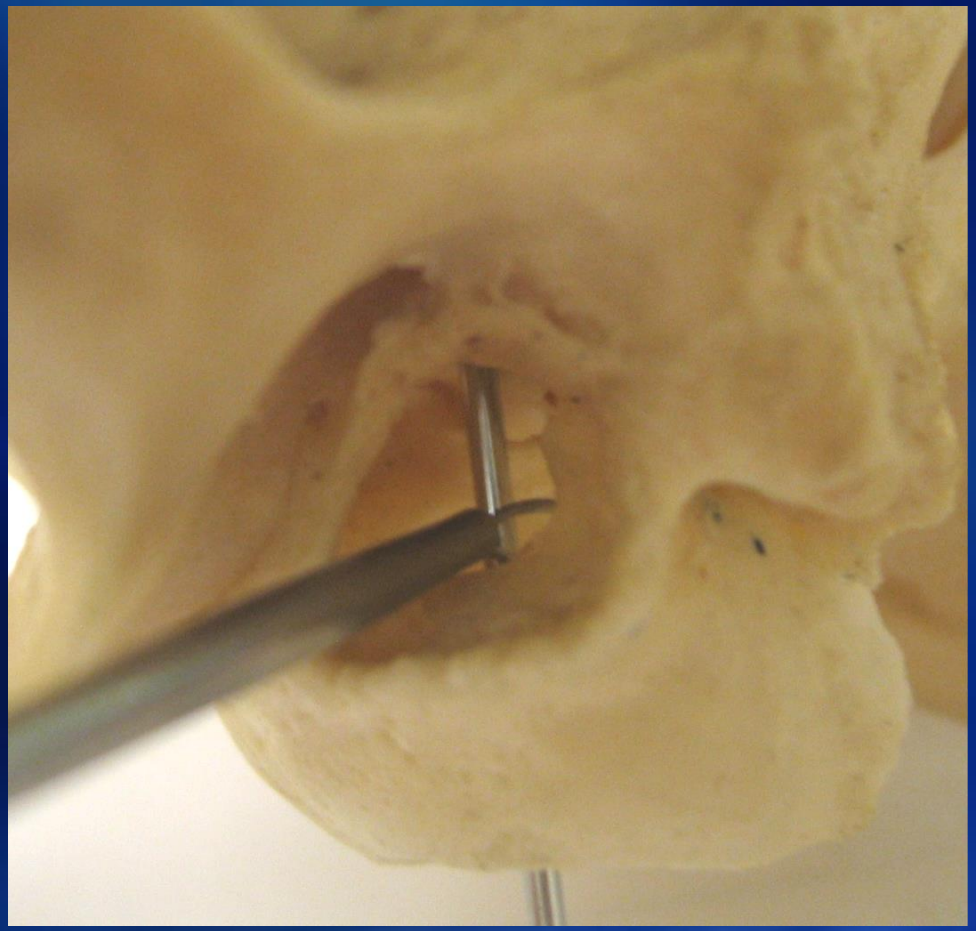
- Horizontal canal
  - Last part overlaps with osseous portion of boney external acoustic meatus

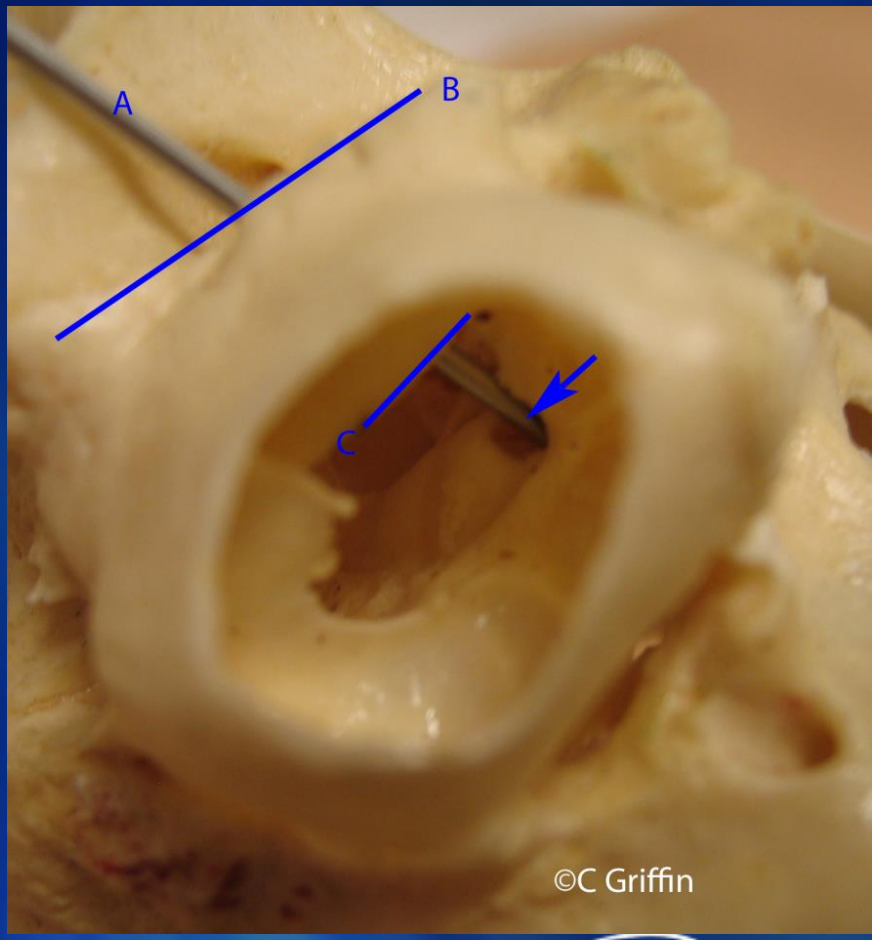




Note top part the bone overlies cartilage ventrally the cartilage goes outside the bone

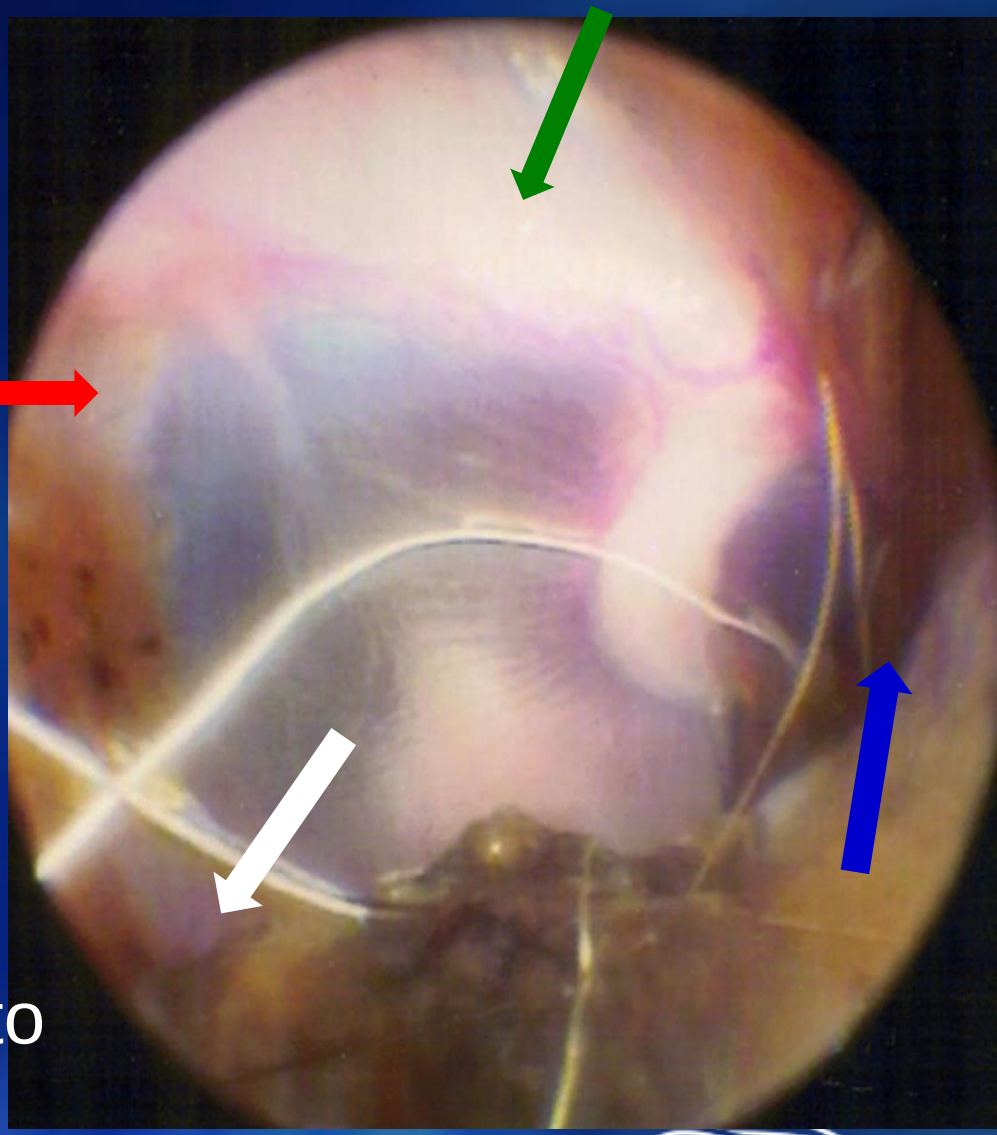
External Acoustic Meatus





Tympanic Membrane

- Two parts.
  - Pars tensa
    - Concave, translucent membrane with a white C-shaped area, the attachment of the manubrium.
  - Pars flaccida



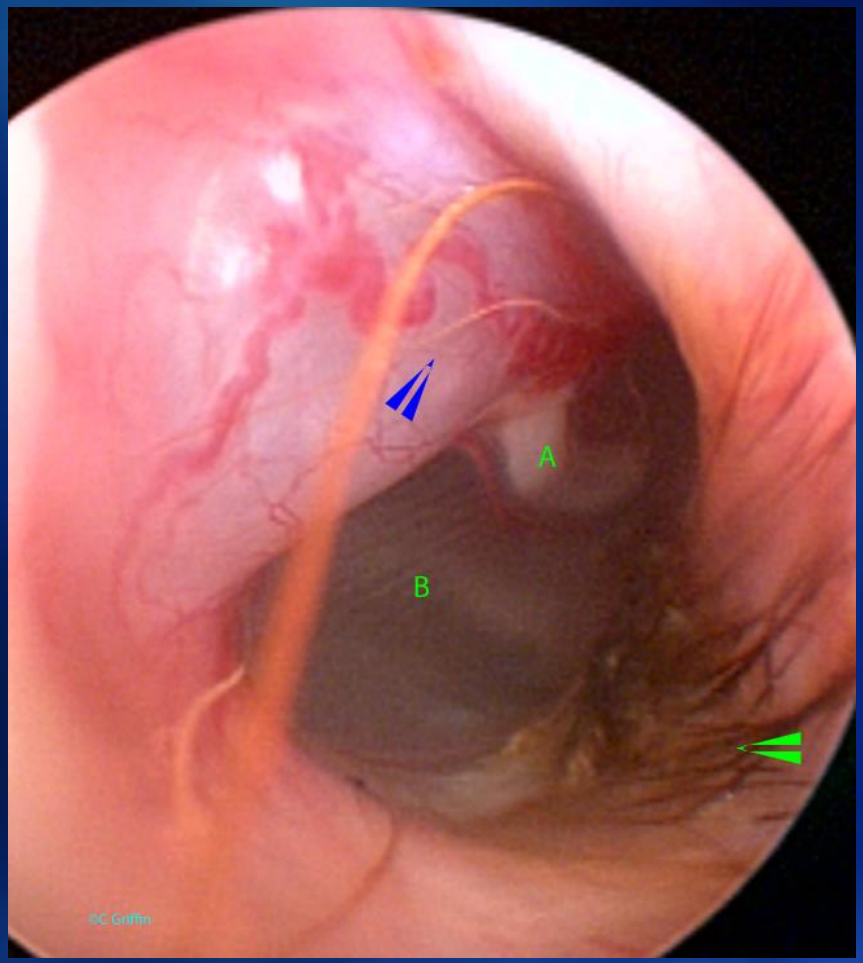
Which color arrow points to the pars flaccida?

Tympanic Membrane

- Inner ring external acoustic meatus
- Angled 30-45^{o}
- Tension to manubrium gives concave outer surface

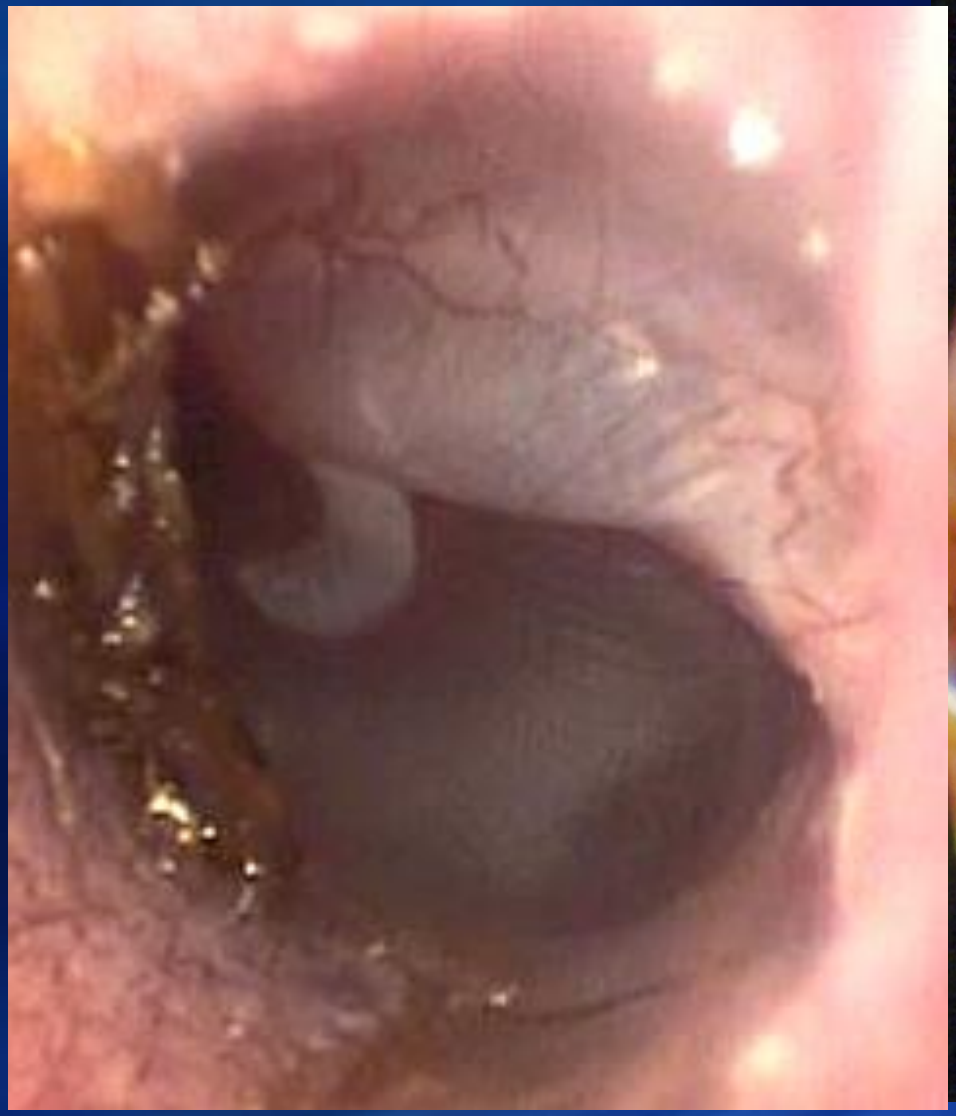
Courtesy Rod Rosychuk

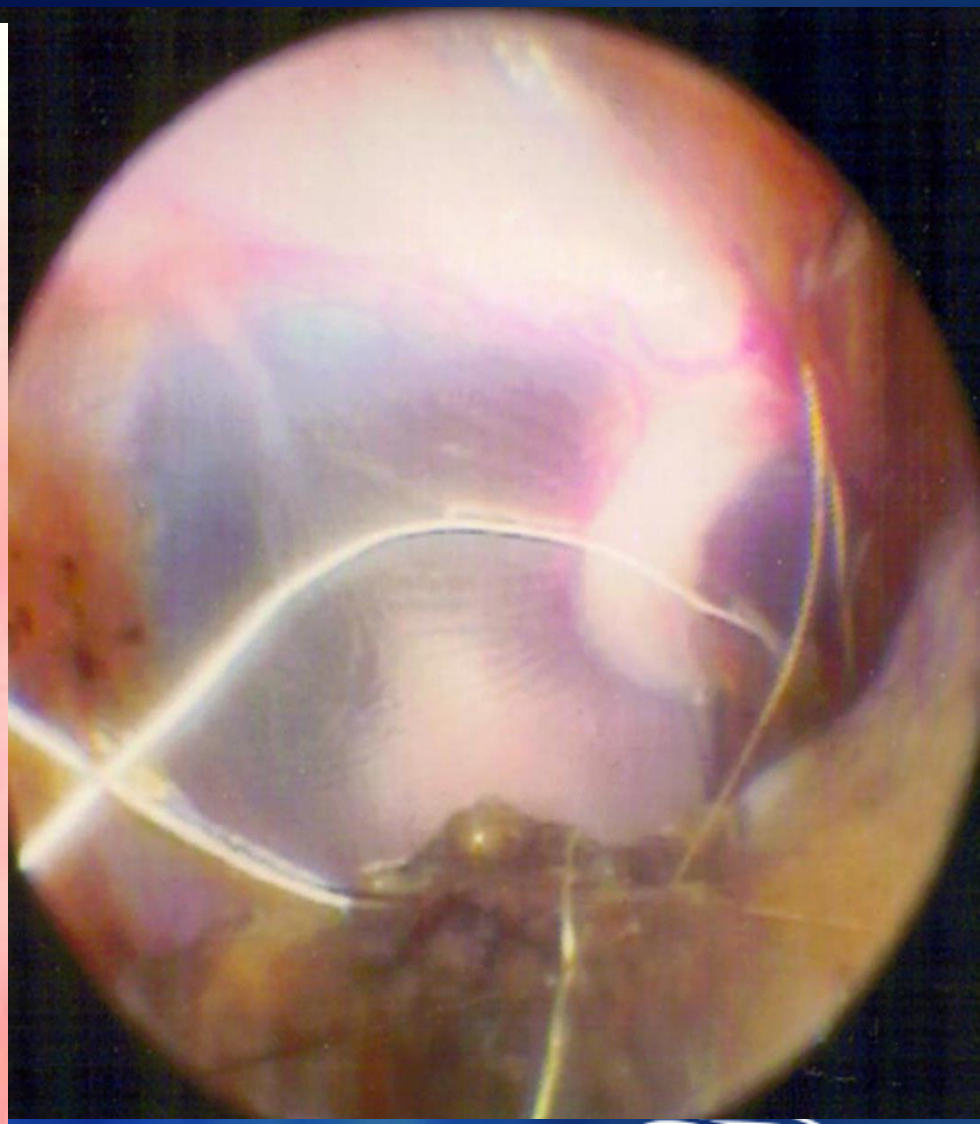
Four Important Structures



- Pars tensa
- Pars flaccida
- Manubrium
- Primary hairs

Tympanic Membrane





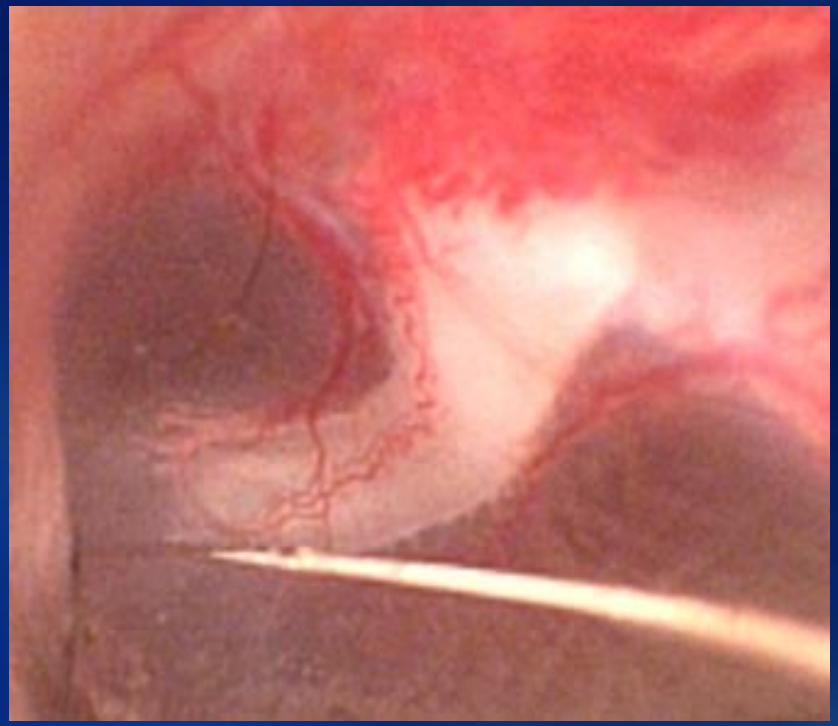
Manubrium Of The Malleus

Attached to the pars tensa

Open end of the “C” pointing toward the nose

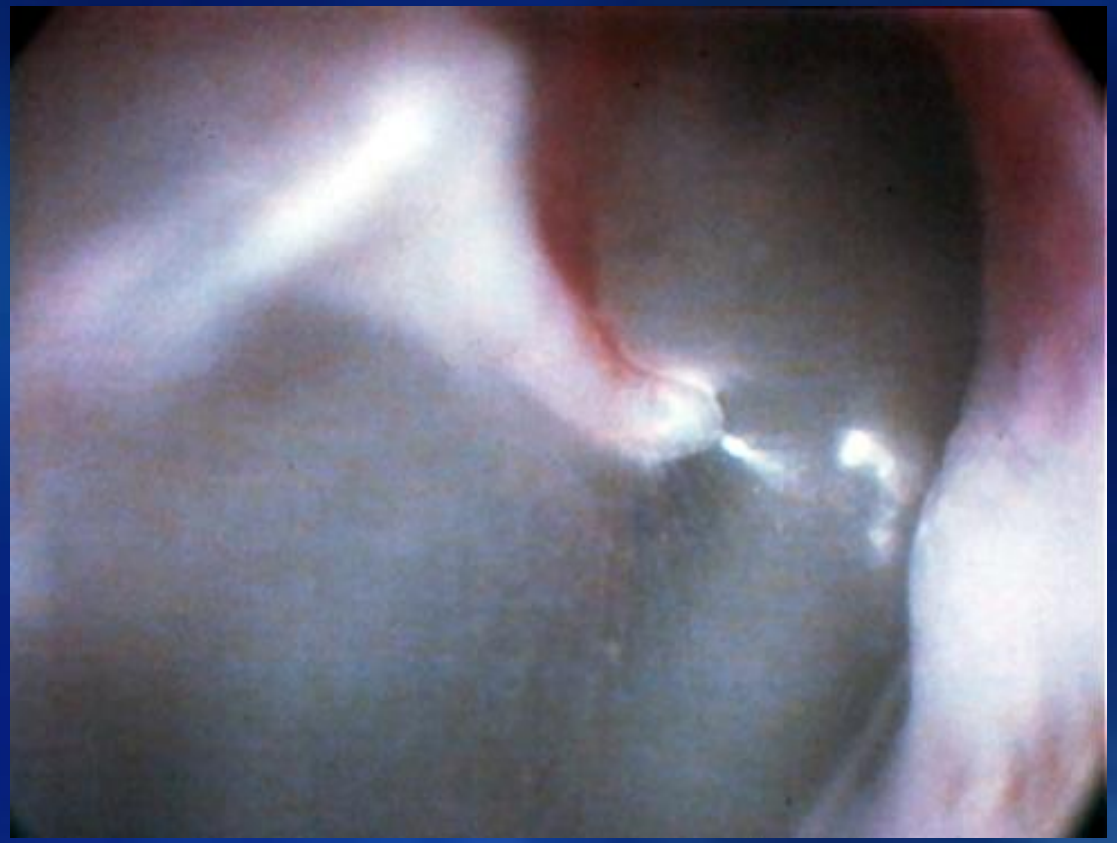
umbo membranae tympani - distal end
germinative epithelium

stria mallearis - line of the “C” shape

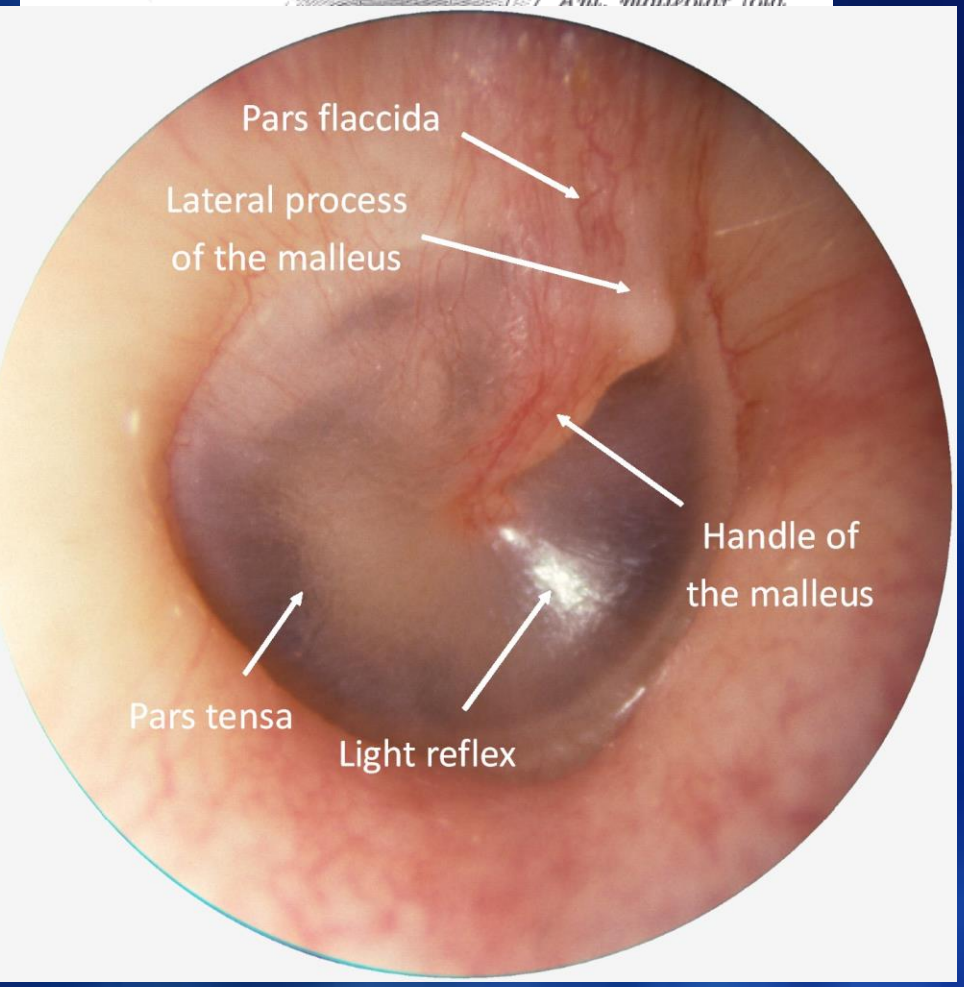


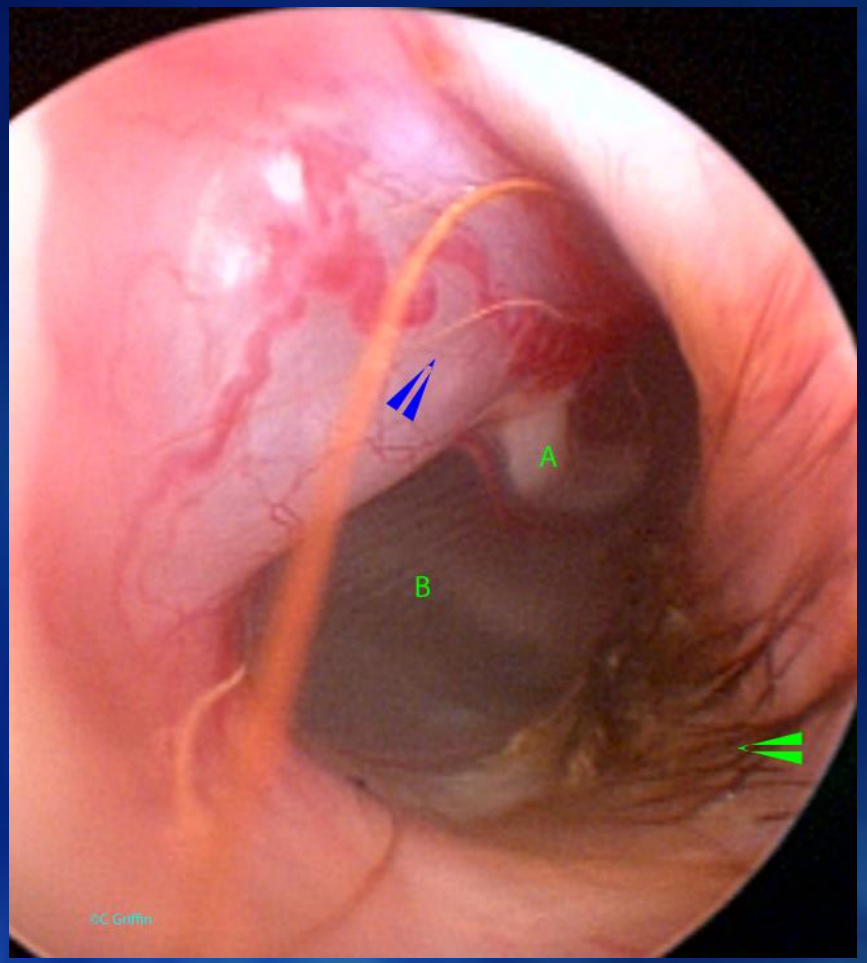
Cat Anatomic Differences

- The manubrium is also less curved than in the dog



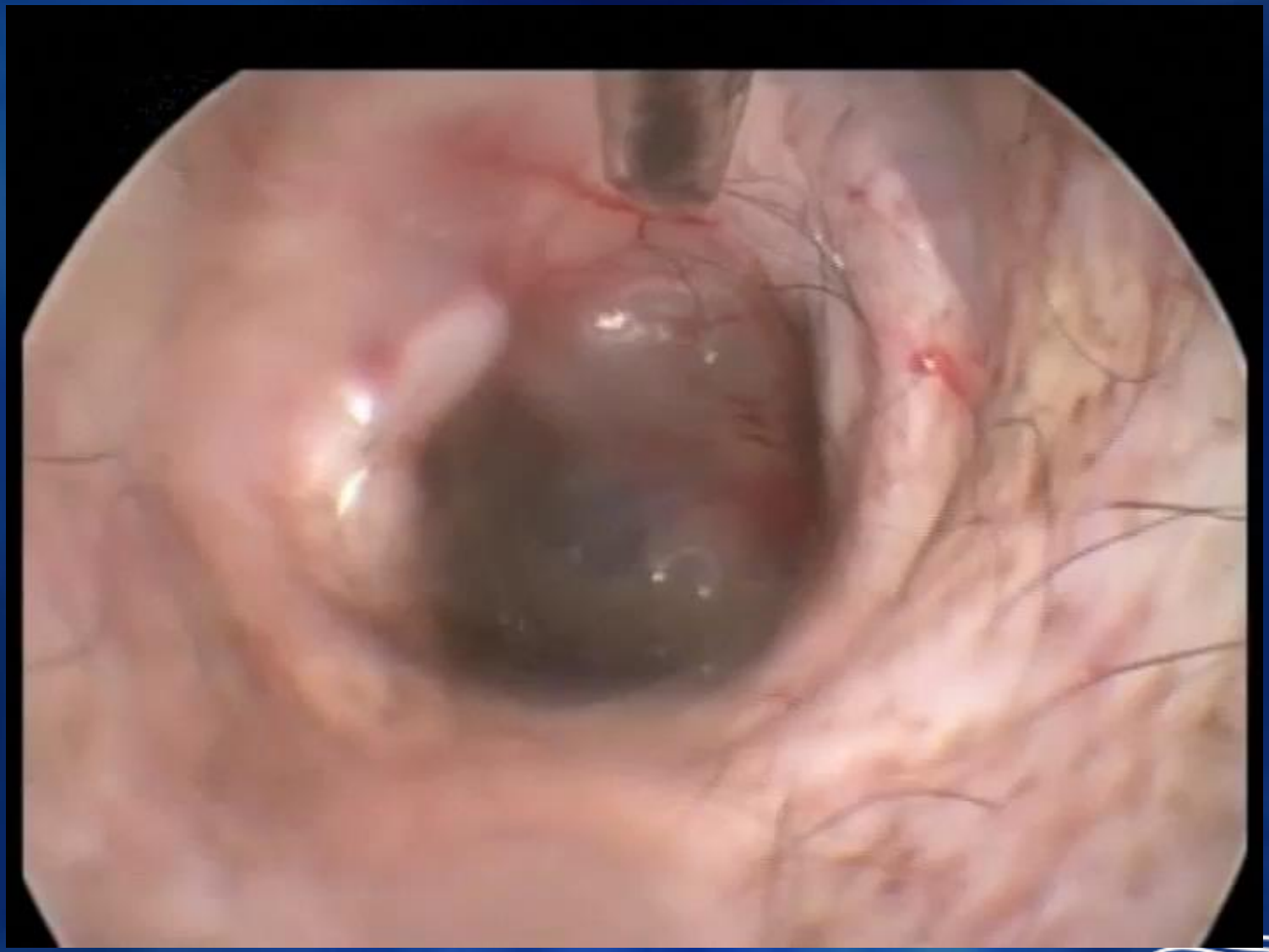
Comparative Pars Flaccida

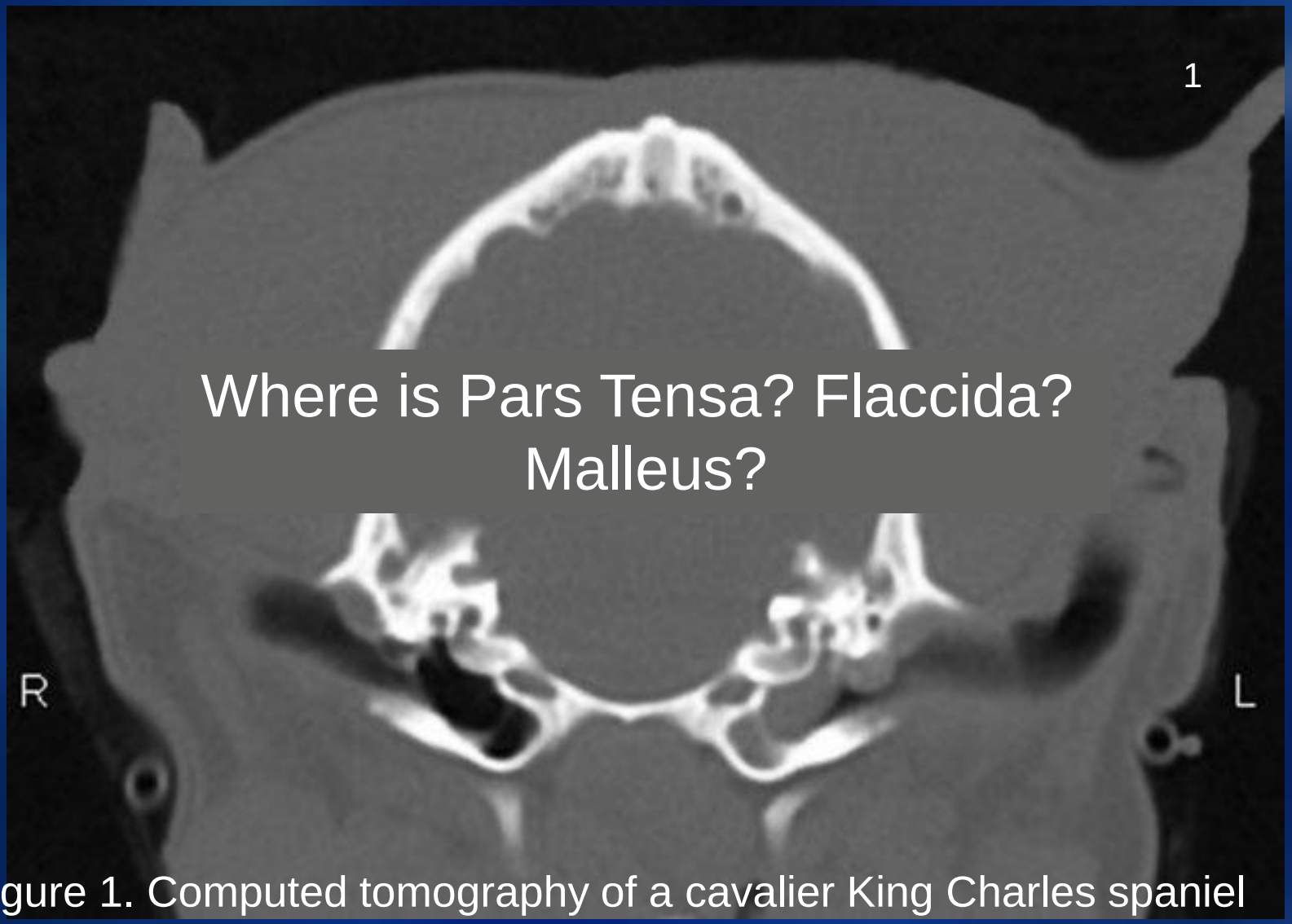




Simpleosce.com/img/

What Can You Do With It

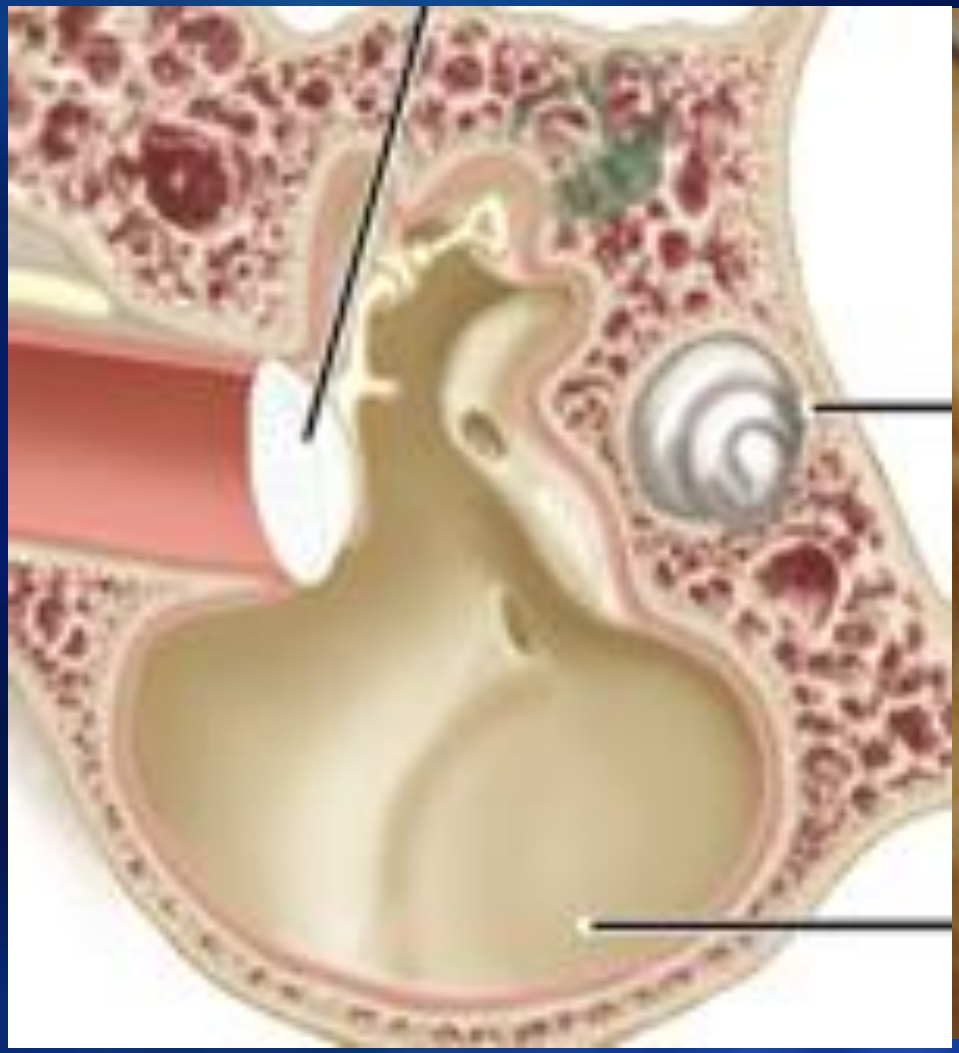


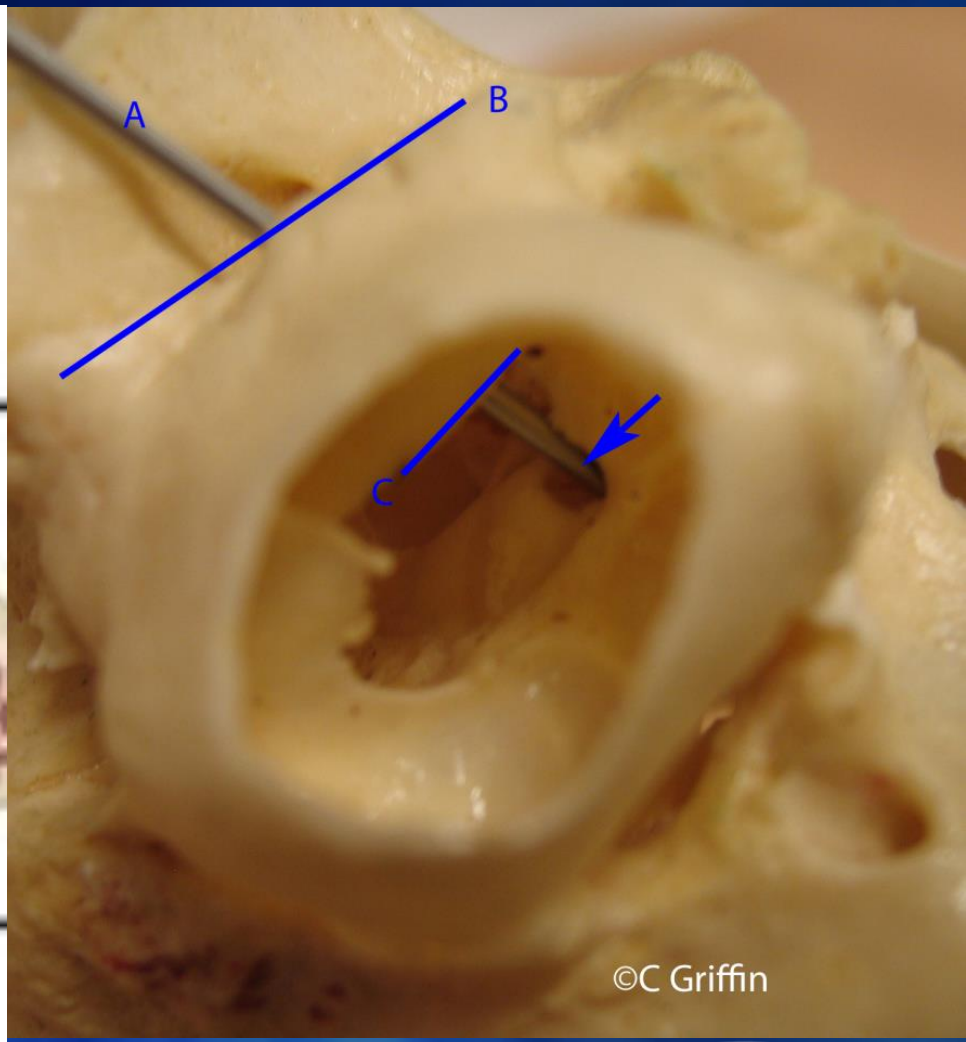


- Figure 1. Computed tomography of a cavalier King Charles spaniel with left-sided unilateral primary secretory otitis media. Note the soft tissue density completely filling the bulla on the left side and the airfilled bulla on the right side.

[1] Cole et al (2015 Vet Dermatol **26**(6): 459-466, e106-457

Middle Ear

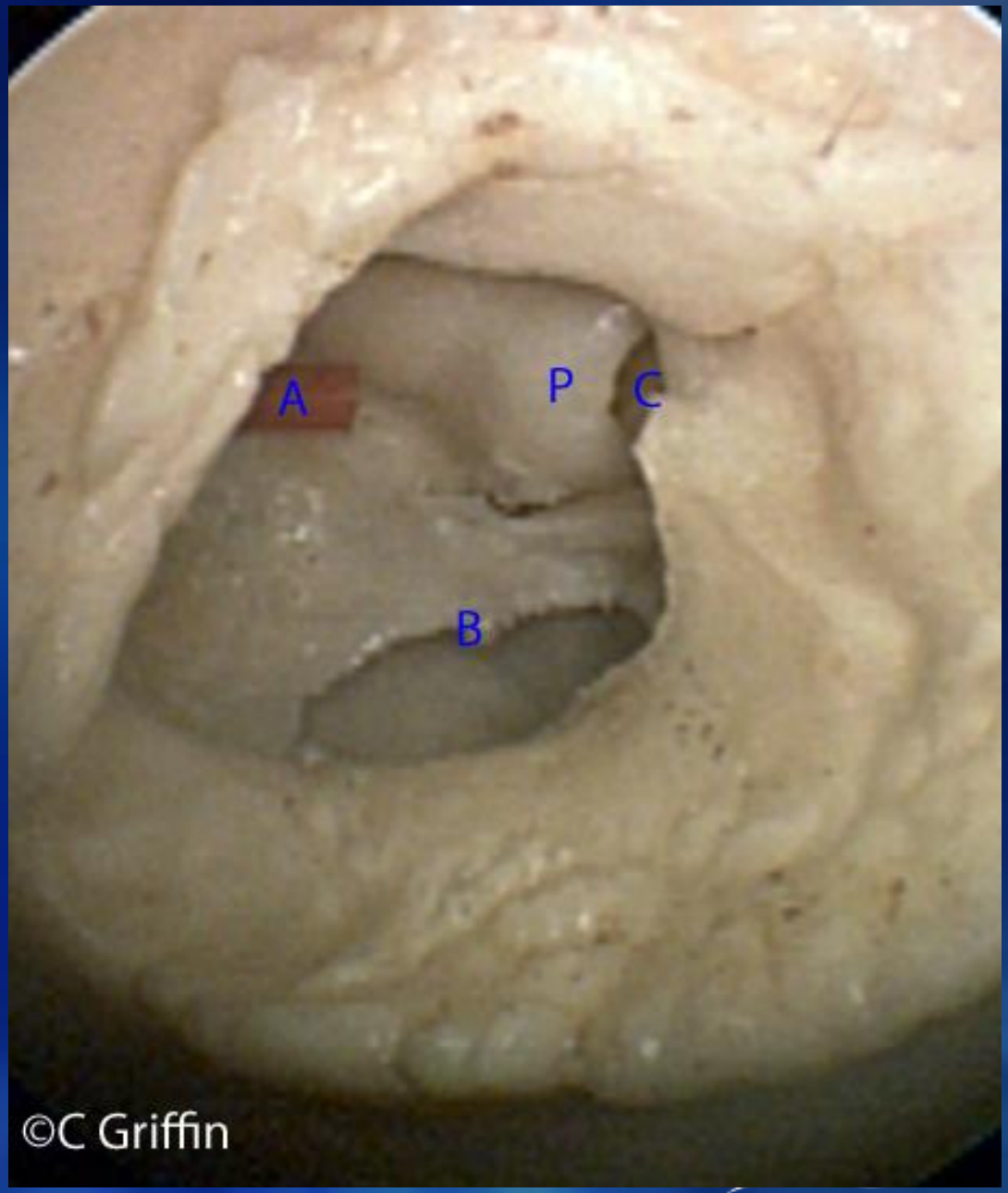


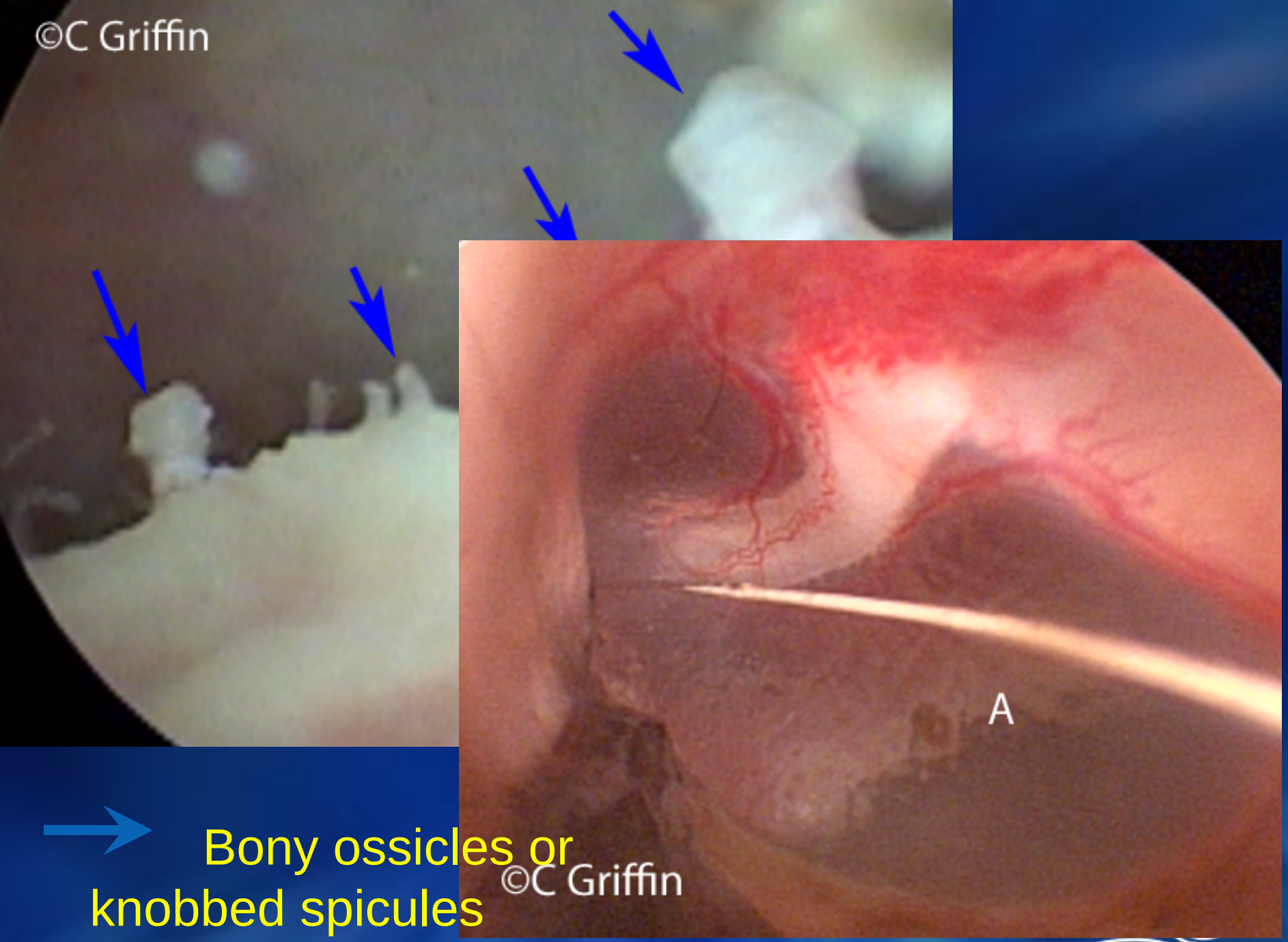


What is the arrow pointing at?

Courtesy R Rosychuk

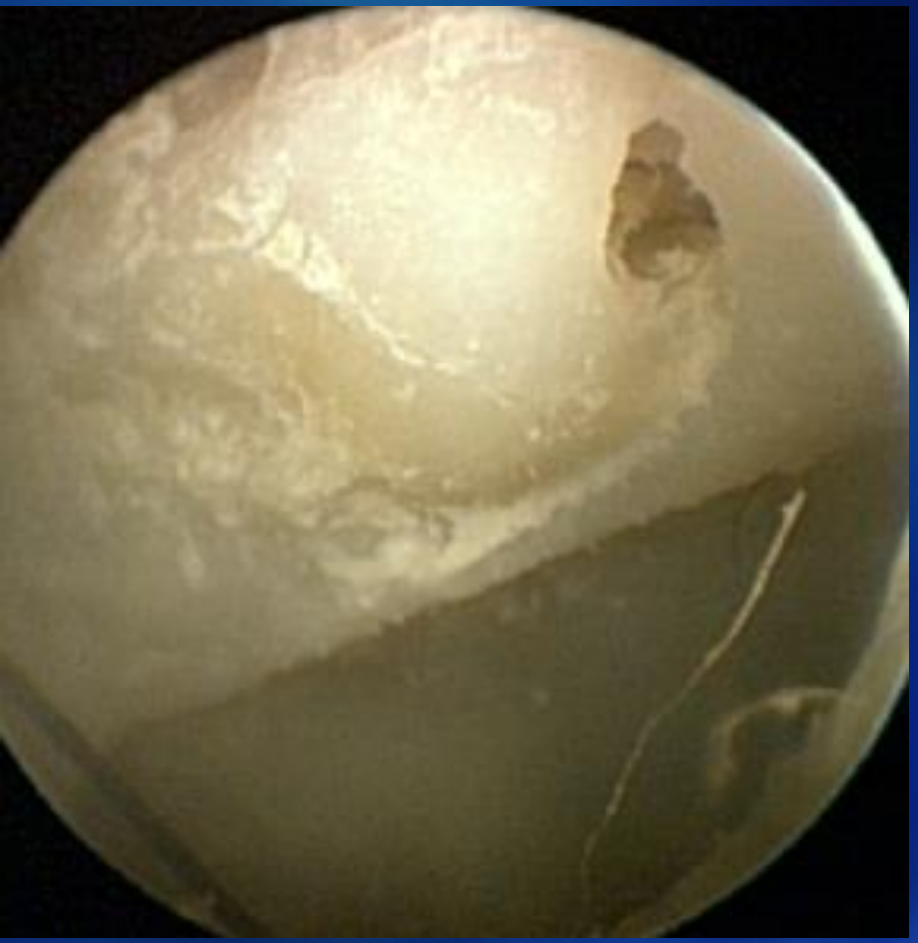
- Auditory tube
- Promontory
- Cochlear Window
- Septum bulla

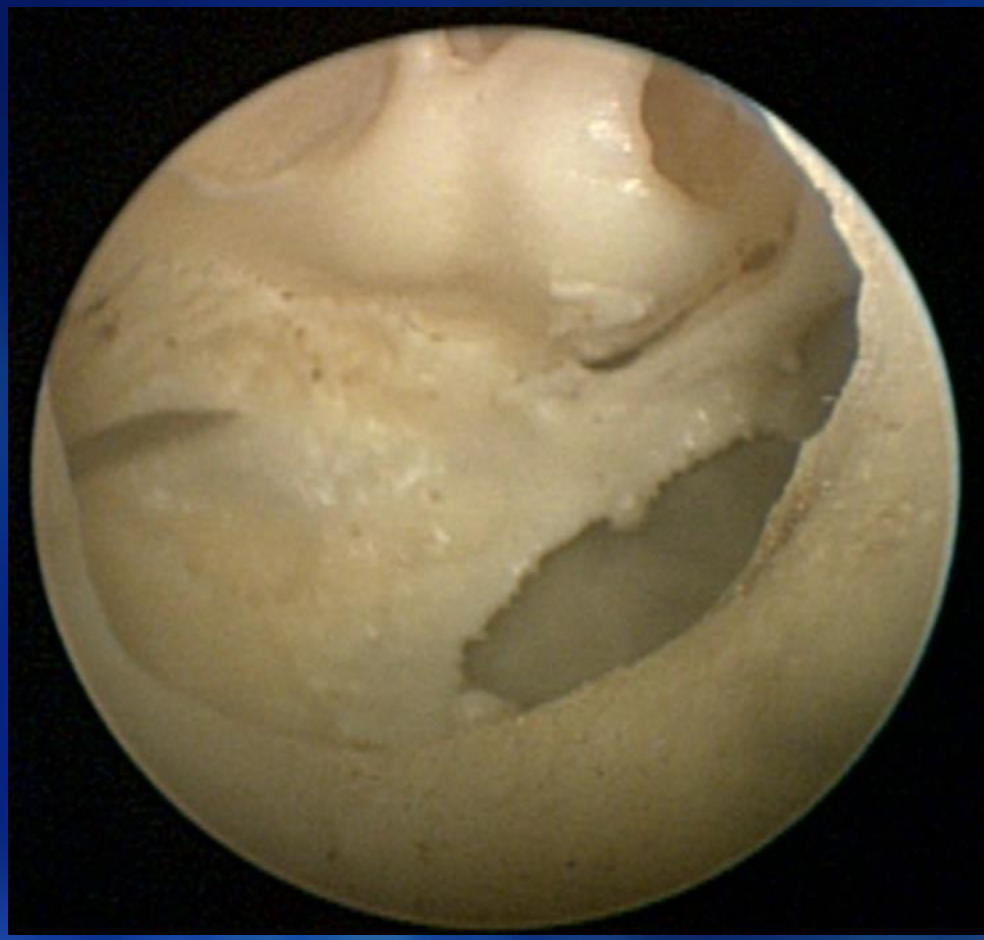




Bony ossicles or knobbed spicules

Septum Bulla, Promontory Variation





Problems

- Species variations in cochlear window permeability, particularly rats, guinea pig, chinchilla and mouse
  - Not use mice as to resistant [1]

[1] Poirrier, A. L., et al. (2010). "Ototoxic drugs: difference in sensitivity between mice and guinea pigs." Toxicol Lett **193**(1): 41-49

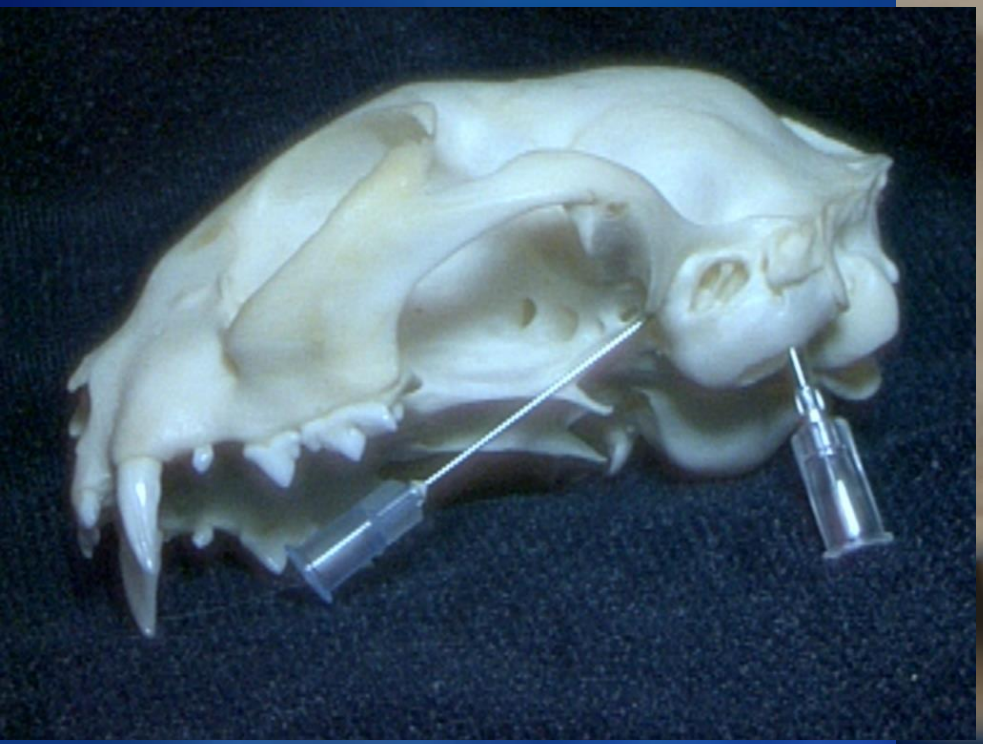
Anatomic Differences

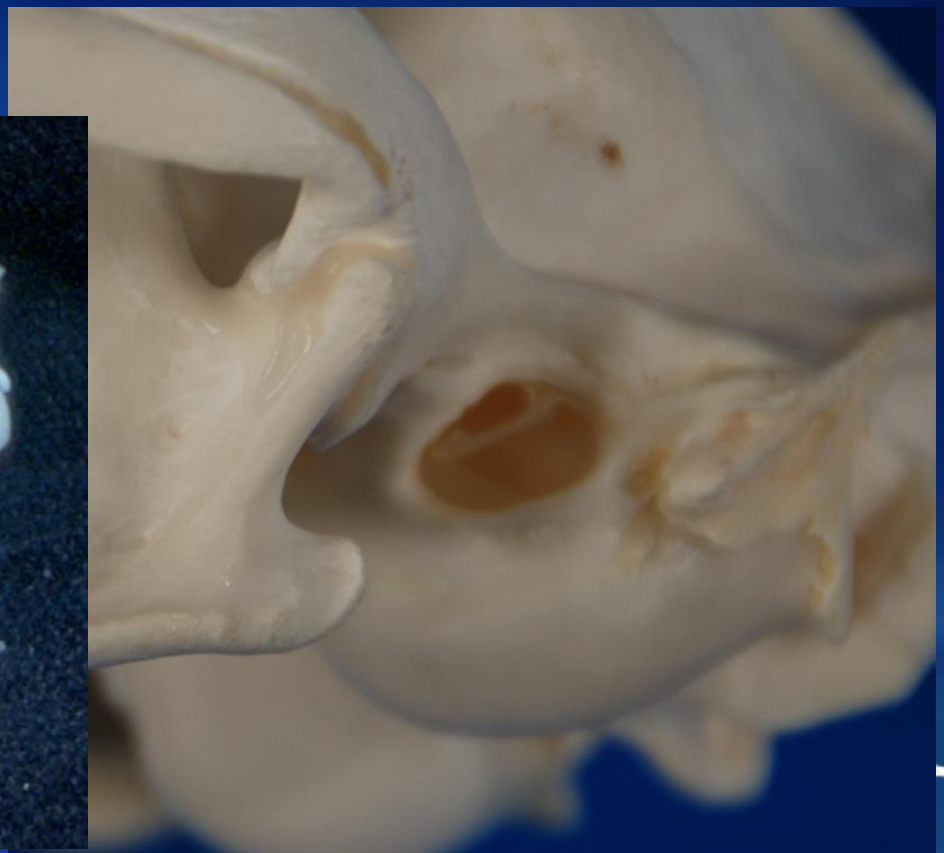
- Relatively short and straighter ear canal

Anatomic Differences

- Points more anterior not ventral

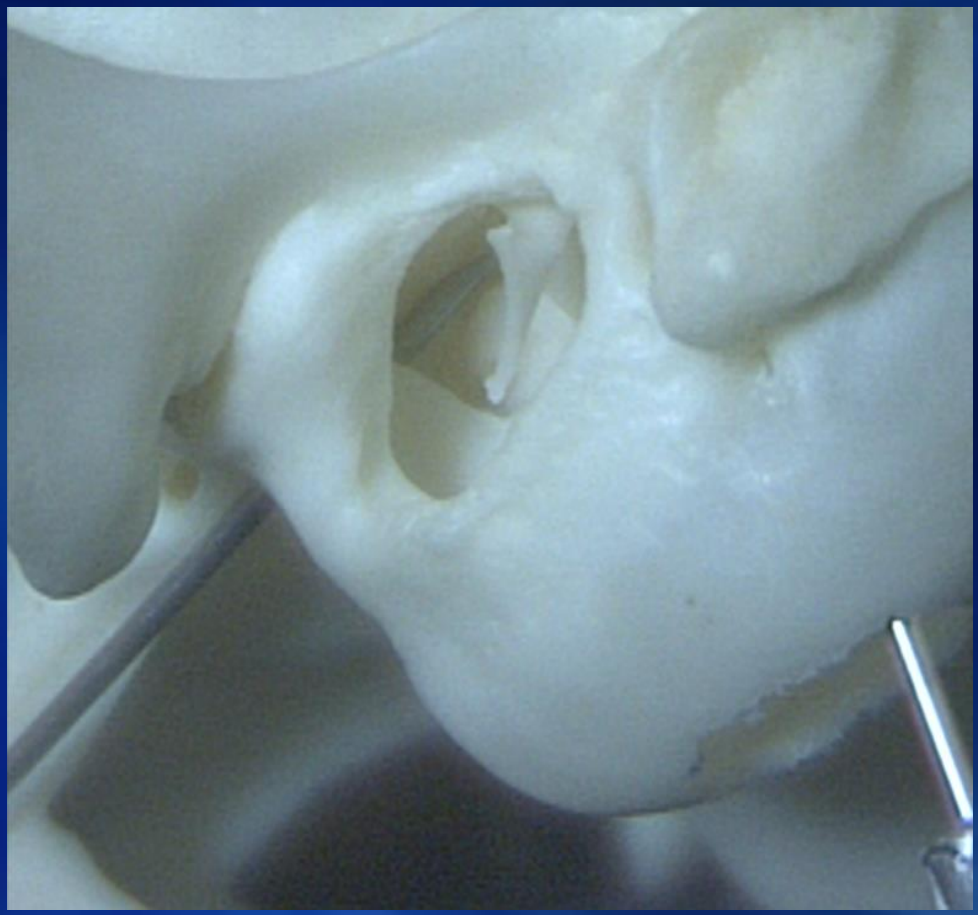
Manubrium directional difference is ?



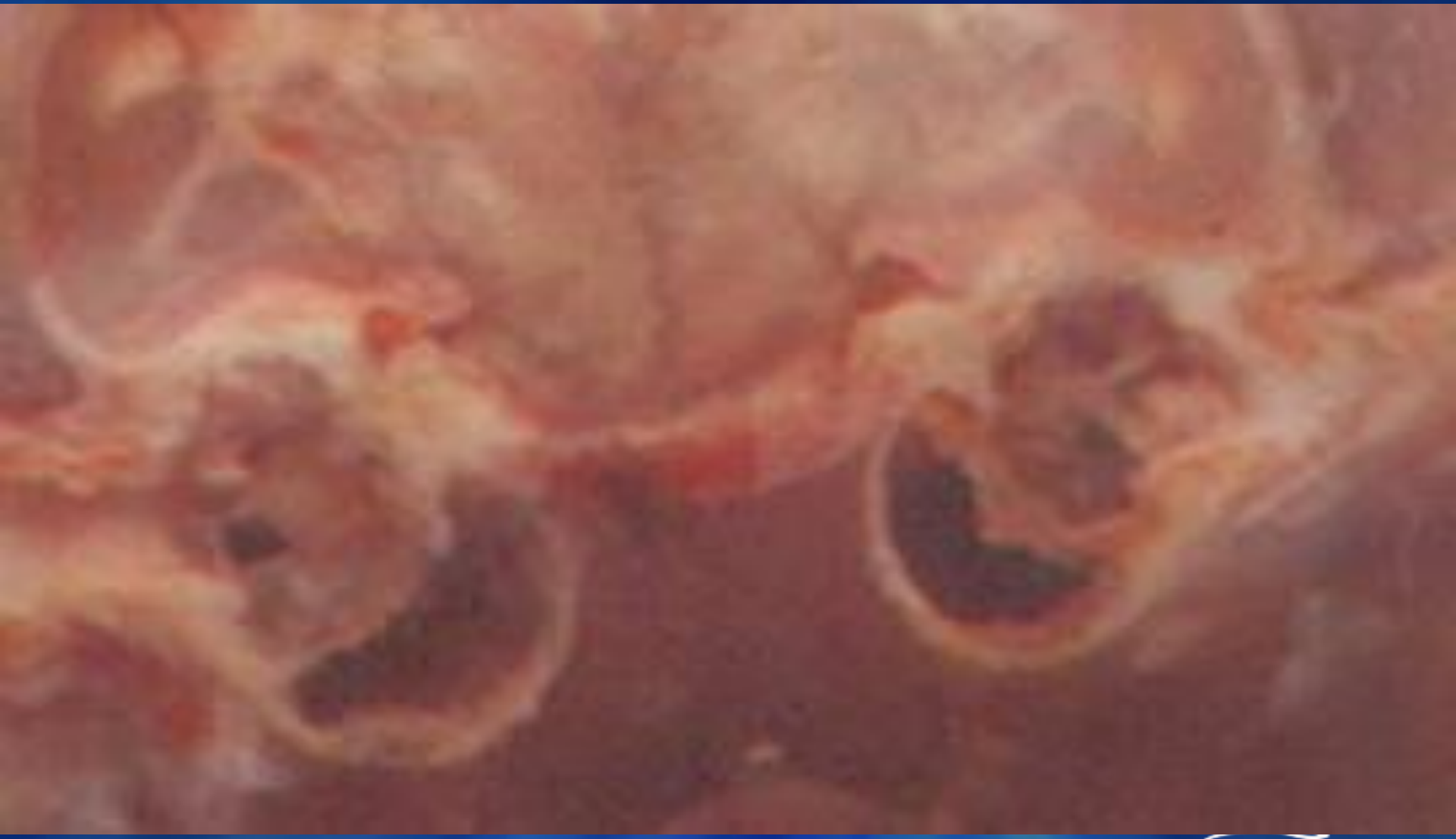


Most Clinical Relevant Anatomic Differences

- Middle ear
  - Much different ventral tympanic bulla (VB)
  - VB is divided by an incomplete septum
    - Two communicating compartments.
    - Dorsally the compartment is more lateral and ventrally more medial



Cat Middle Ear



Round Window and Promontory

Ventral Bulla

Cat

Dog

Clinical Relevant Cat Anatomic Differences

- Middle ear
  - A plexus of the sympathetic nerve runs in the middle ear and when damaged results in Horner's syndrome
  - Septum is more readily damaged when flushing, cleaning or using instruments in the middle ear
    - Horner's syndrome is a much greater risk of complication in cats

Clinical Relevant Cat Anatomic Differences

- Middle ear
  - Concaved saucer shaped with the convex surface facing ventrally
  - Fluid reaching the ventral compartment will have a much more difficult time being removed by positional changes

Making A Complete Diagnosis and Prognosis

Oso
2 year old
labrador
retriever
1.7 years of otitis

Client would like to know what caused this?

Cause

A thing that gives rise to a condition[1]
Something that brings about an effect or a result [2]

[1] Dictionary.com
[2] Merriam Webster Dictionary

Cause Of Otitis

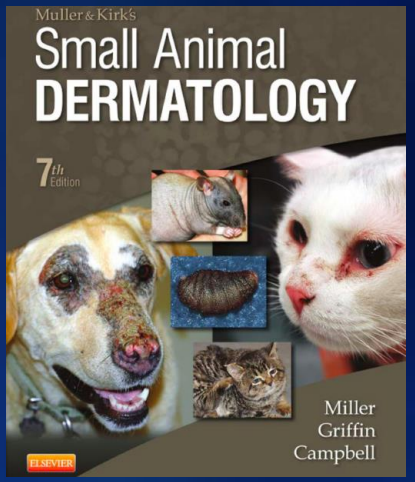
Primary

Of chief importance, principal, earliest in time or order, not derived from, caused by, or based on anything else; original [1]

Numerous skin diseases can cause otitis externa [2]

Primary Causes of Otitis Externa

Disease Category	Specific Diseases/ Examples
Allergy	Adverse food reaction Atopic dermatitis or atopic otitis (no skin disease associated) Contact allergy Flea allergy dermatitis
Autoimmune	Bullous pemphigoid Epidermolysis bullosa Lupus erythematosus Pemphigus foliaceous
Endocrine	Cushing disease Hypothyroid Sex hormone abnormalities (adrenal or gonadal elevated progesterone most typical)
Epithelialization disorders	Lipid-responsive seborrhea Primary idiopathic seborrhea Sebaceous adenitis Vitamin A–responsive dermatosis Zinc-responsive dermatosis
Foreign bodies	Hair Plant awns, foxtail Sand, dirt
Glandular disorders	Altered secretions (rate or type) Sebaceous gland hyper- or hypoplasia
Immune mediated	Drug reactions (topical or systemic) Erythema multiforme Vasculitis, vasculopathy
Microorganisms	Fungal (rare): dermatophytes, *Sporothrix*, *Aspergillus*
Miscellaneous	Auricular chondritis Eosinophilic granuloma complex Idiopathic inflammatory/ hyperplastic otitis of cocker spaniel Juvenile cellulitis Proliferative and necrotizing otitis of cats
Parasites	Chiggers (*Eutrombicula*) *Demodex* *Otodectes cynotis* Ticks (especially *Otobius megnini*)
Viral	Canine distemper



[1] Oxford dictionary

[2] Miller et al. (2013) Muller and Kirk's Small Animal Dermatology. 7th ed, St Louis, Elsevier

Oso
2 yr FS Lab
1.7 years otitis

1.5 year pruritus
legs paws ears

IBD one year
Controlled with diet and metronidazole

And last six months he has not responded to the treatments like he used to

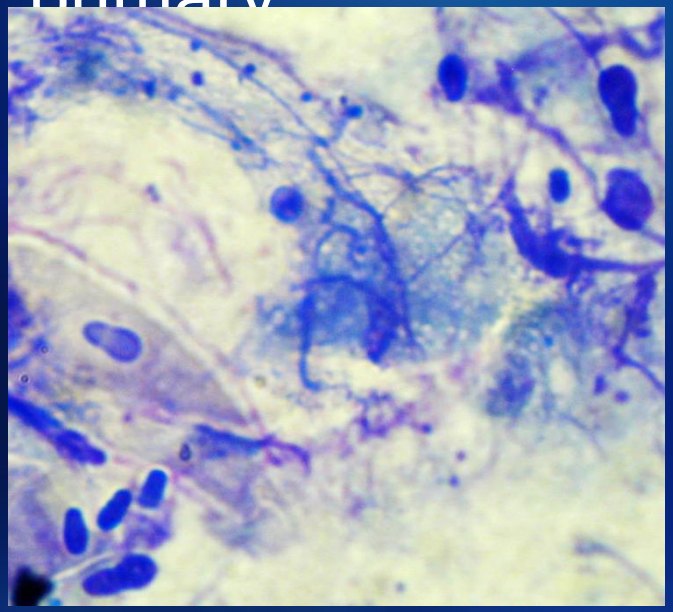
Cause

Secondary

Coming after

Resulting from something else that primary

Secondary Causes of Otitis Externa	
Disease Category	**Specific Diseases/ Examples**
Bacteria	Cocci (*Staphylococcus*, *Streptococcus*, *Enterococcus*) Rods (*Pseudomonas*, *Proteus*, *Escherichia coli*, *Klebsiella*, *Corynebacterium*)
Fungal	*Aspergillus* spp.
Medication reaction	Topical irritant that occurs in inflamed skin only (alcohol, low pH, propylene glycol)
Overcleaning	Excessive moisture and maceration Physical trauma (cotton tipped applicators)
Yeast	Budding (*Malassezia* spp.) Candida (should have pseudohyphae, not just round-form yeast)



Osso cytology

Occur in combination

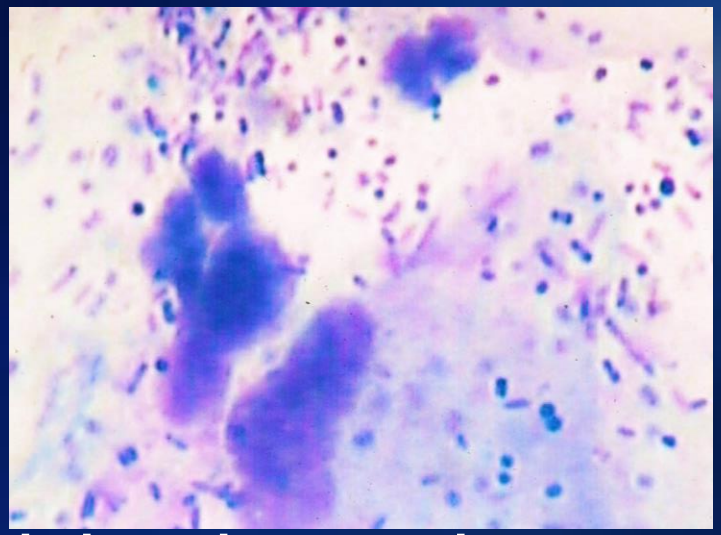
Incidence of Malassezia tended (P=0.098) to be

[1] Zur, et al (2011). The association between the signalment, common causes of canine otitis externa and pathogens. *J Small Anim Pract, 52*(5), 254-258

Making A Complete Diagnosis and Prognosis

Biofilms in otitis

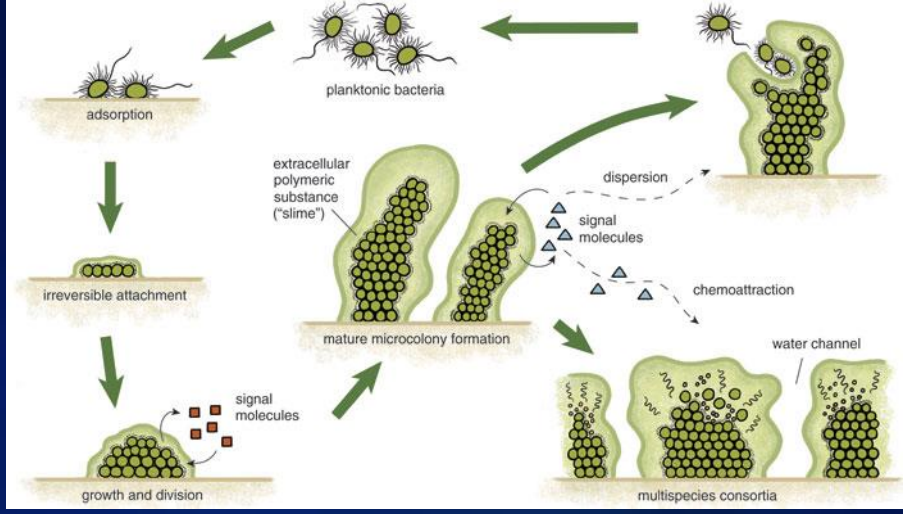
Planktonic Bacteria



- Classic method of studying bacteria as individual cellular organisms
- Free floating
- Each cells divides and forms a colony of the same genetic line though mutations do occur

Graphic by Stephanie Freese
Harrison et al,
2005 American Scientist, Biofilms

Biofilm



- Group of bacteria
  - in a matrix made of polysaccharides, DNA and proteins, which together form an *extracellular polymeric substance— SLIME*
  - May be single species or a diverse group of microorganisms
    - Mix of bacteria or yeast and fungus
  - They communicate by a variety of signals which result in changes
    - Quorum sensing is one example
- Promote survival in harsh environments

Biofilms In Human Ear Disease

- Post, J. C. (2001). "Direct evidence of bacterial biofilms in otitis media." Laryngoscope **111**(12): 2083-2094.
- Galli, J., L. Calo, M. Giuliani, B. Sergi, D. Lucidi, D. Meucci, E. Bassotti, M. Sanguinetti and G. Paludetti (2016). "Biofilm's Role in Chronic Cholesteatomatous Otitis Media: A Pilot Study." Otolaryngol Head Neck Surg **154**(5): 914-916.
- Fusconi, M., V. Petrozza, A. R. Taddei, V. Vinciguerra, A. De Virgilio, F. Chiarini, M. Cirenza, C. Gallinelli, M. Conte and M. de Vincentiis (2011). "Is biofilm the cause of chronic otitis externa?" Laryngoscope **121**(12): 2626-2633.

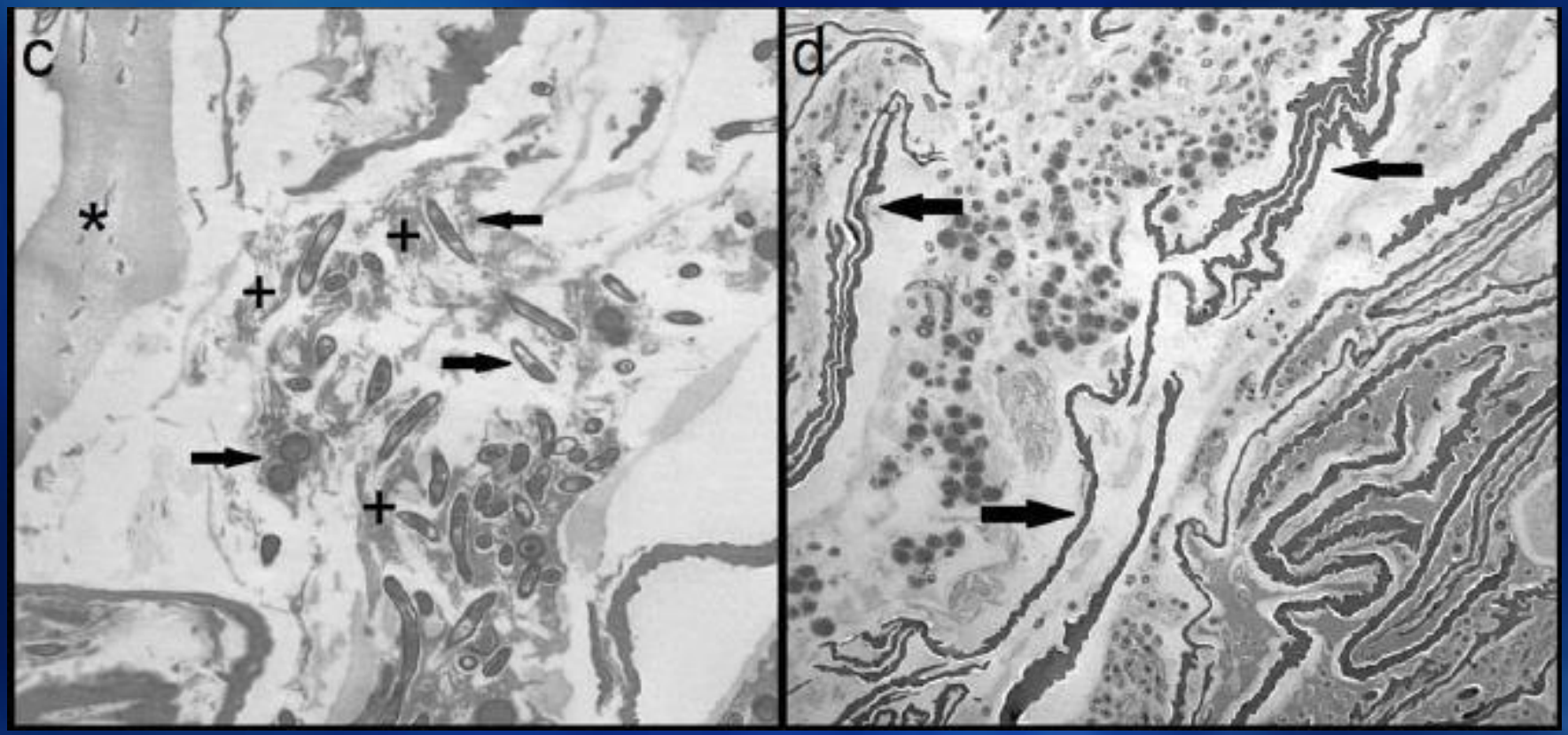
The Laryngoscope

***Laryngoscope*, 121:2626–2633, 2011**

Is Biofilm the Cause of Chronic Otitis Externa?

Massimo Fusconi, MD; Vincenzo Petrozza, MD; Anna Rita Taddei, MD; Vittorio Vinciguerra, MD;

et al



acid. (c) TEM section of a film specimen. The superficial epithelial cells of the external auditory canal form the basal layer (*). Above this layer we observed bacterial clusters (arrows) surrounded by an abundant extracellular matrix (+). (d) TEM section showing precipitated Mediflox (arrows) in the form of compact dark gray amorphous material incorporating the bacterial biofilms (*). (e) Scanning electron micros-

Medical Mycology November 2013, **51**, 863–867

Antifungal susceptibility of *Malassezia pachydermatis* biofilm

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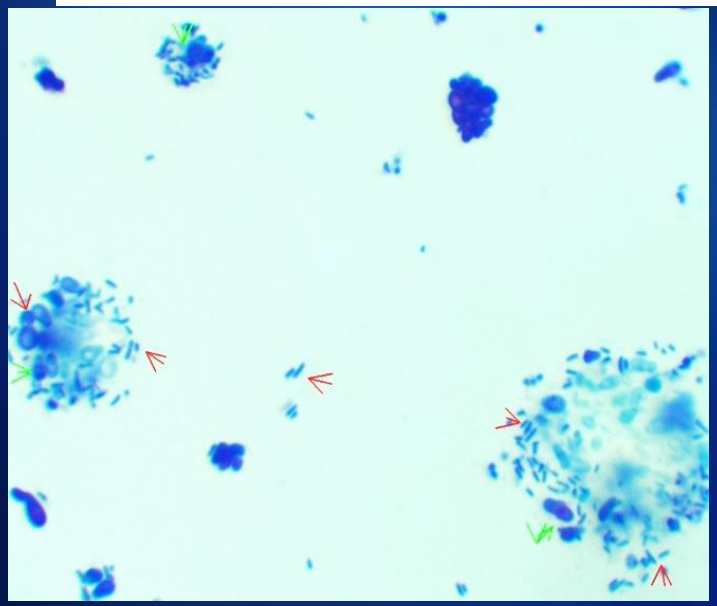
*Department of Veterinary Medicine, University of Bari, Valenzano, Italy, and †Aggeu Magalhães Research Institute, Department of Immunology, Recife, Brazil



Antifungal agents	Cells	MIC (mg/l) All isolates	Range	MICm (SD)	EA (%)
KTZ	Planktonic	0.016[a]	≤0.008–0.064	0.02 (0.013)	13.3
	Sessile	>0.125[a]	0.064–>0.125	0.122 (0.018)	
ITZ	Planktonic	≤0.008[b]	≤0.008–0.016	0.008 (0.002)	3.3
	Sessile	>0.064[b]	0.032–>0.064	0.060 (0.014)	
POS	Planktonic	0.016[c]	≤0.008–0.064	0.018 (0.009)	8.3
	Sessile	>0.125[c]	≤0.008–>0.125	0.117 (0.028)	
TER	Planktonic	0.064[d]	≤0.008–0.125	0.106 (0.077)	1.7
	Sessile	>1[d]	0.5–>1	0.964 (0.165)	
VOR	Planktonic	0.064[e]	0.03–0.125	0.061 (0.037)	10
	Sessile	>0.5[e]	0.064–>0.5	0.440 (0.147)	
FLZ	Planktonic	8[f]	0.5–>64	12.34 (11.24)	15
	Sessile	>64[f]	8–>64	56.8 (17.79)	

Table 1 Ketoconazole (KTZ), itraconazole (ITZ), posaconazole (POS), terbinafine (TER), voriconazole (VOR), and fluconazole (FLZ) MIC50 values of planktonic and sessile cells of *Malassezia pachydermatis* isolated from dogs without (Group A) and with skin lesions (Group B). The MIC50 values, MIC range and mean values (MICm) with standard deviation (SD) were also calculated. Essential agreement (EA) among MICs of planktonic and sessile cells is reported. Statistically significant results ($P \leq 0.05$) are indicated with same letters in superscript.

Biofilm Identification in Wounds [1]

Table 1. Markers for identification of a biofilm in a wound

Clinical sign	Marker	Identification method
Nonhealing wound	Slough	Visual examination
	Shiny	Visual examination
Malodor	Smell	Smell
Necrotic tissue	Necrotic tissue	Visual examination
Unresponsive/recalcitrant to antimicrobial interventions	Lack of change to antimicrobial effect/reoccurring	Visual examination Microbial bioburden test
Polymicrobial microbiology	Cultural and molecular identification	Standard culturable techniques Molecular techniques—PCR
Isolated bacteria showed a high biofilm-forming potential	Biofilm-forming potential	Use microtiter assay with crystal violet
Biopsy—visualization	Evidence of microcolonies	Microscopic examination following a Gram stain Scanning electron microscopy Light microscopy
	Evidence of extracellular polymeric substances	H&E stain, calcofluor white/ethidium bromide; Congo red/Ziehl carbol fuchsin; safranine/FITC-ConA; DAPI/PAS
	Evidence of an inflammatory response (not always evident)	H&E stain

DAPI/PAS, 4′,6-diamidino-2-phenylindole/Periodic Acid-Schiff stain; FITC-ConA, fluorescein isothiocyanate/concanavalin A; H&E, hematoxylin and eosin; PCR, polymerase chain reaction.

[1] Percival et al (2012). *Wound Repair Regen, 20*(5), 647-657

Recognizing Biofilm [1]

- “They are common and under-diagnosed, although they can be easily identified on otoscopy or cytology. Clinically, they form an adherent, thick and slimy discharge that is often dark brown or black (Fig 2). On cytology they appear as variably thick veil-like material that may obscure bacteria and cells (Fig 3).”

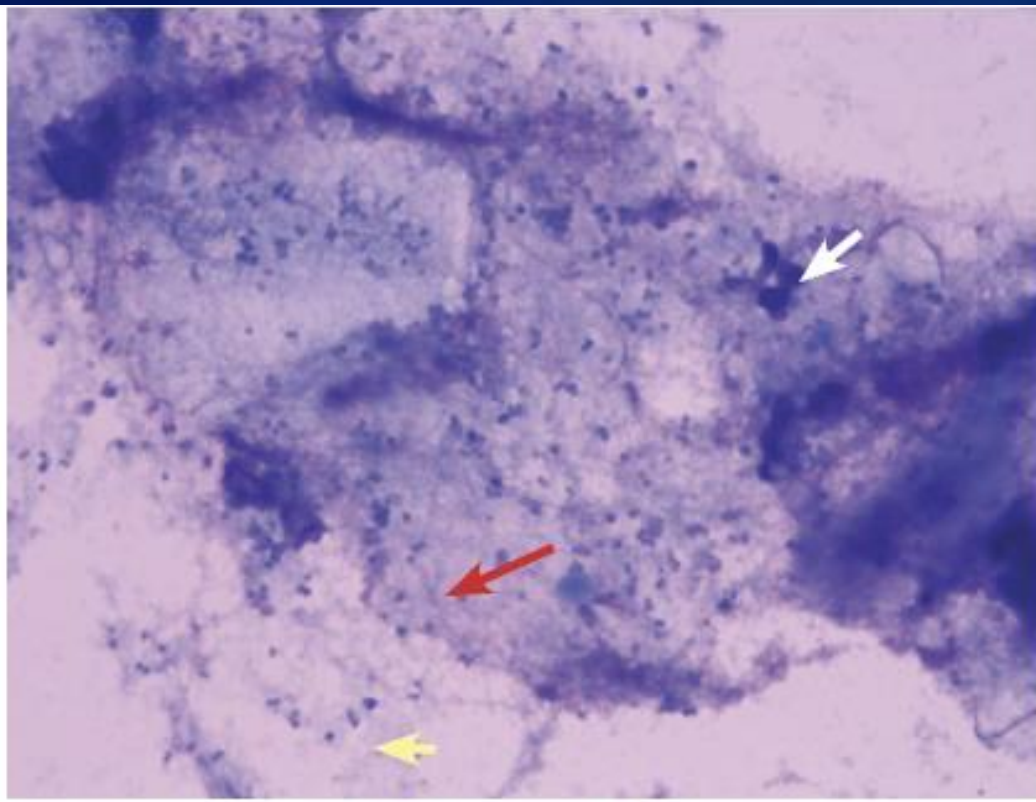


Fig 3: Cytology smear of the biofilm in Fig 2. Note the abundant, variably thick purple staining filaments forming a lace-like pattern (red arrow). There are numerous staphylococci (yellow arrow) and a single neutrophil (white arrow). Rapi-Diff stain, x 400

[1] Nuttall, T. (2016). In Practice Focus: 17-21

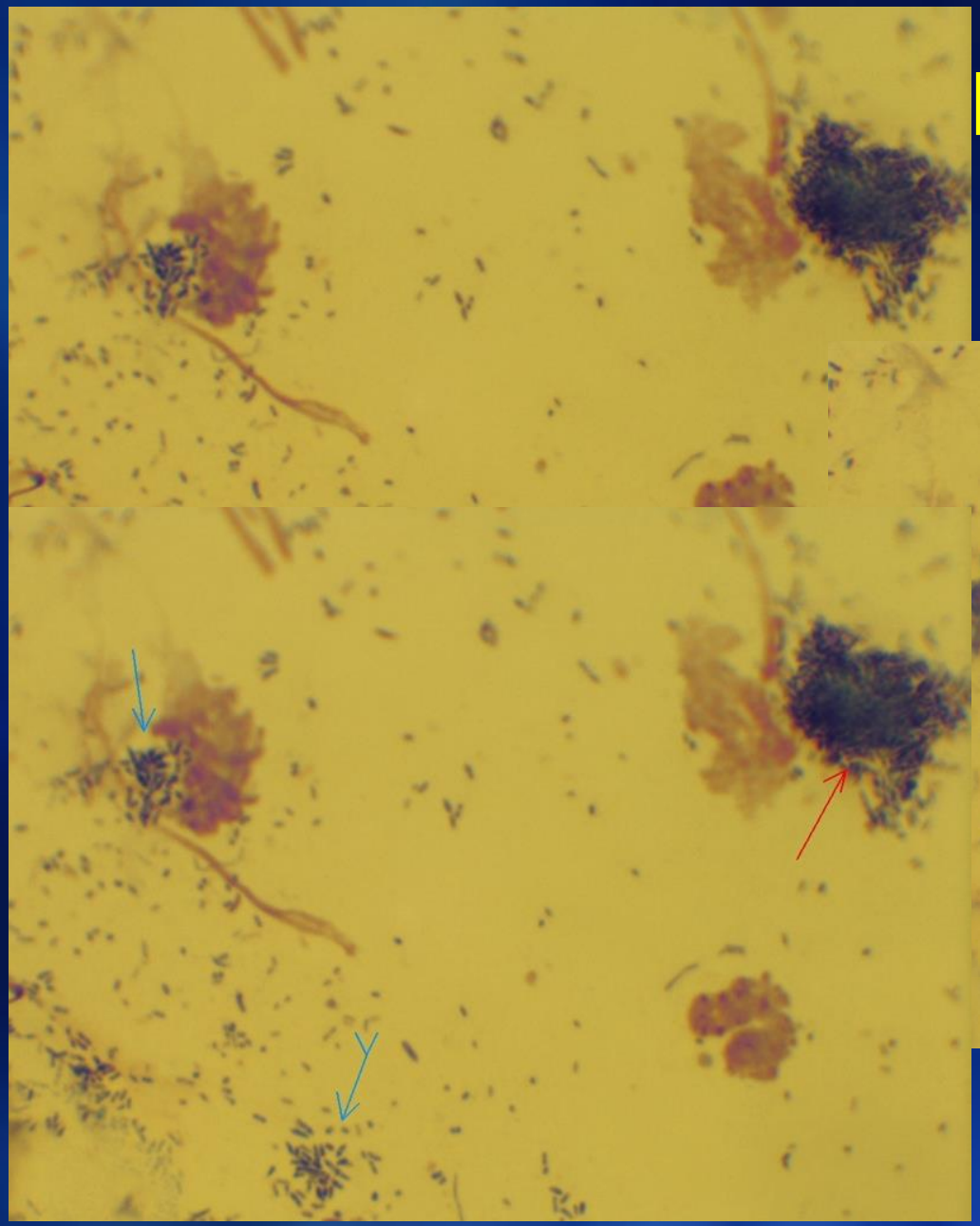
Recognizing Biofilm
C Griffin Criteria

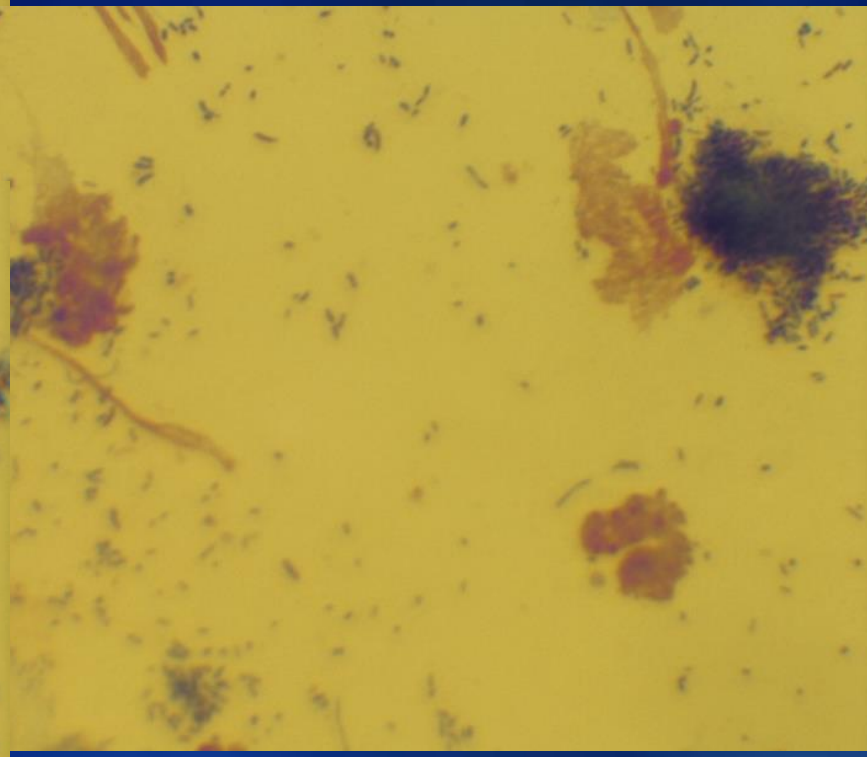
- May be slimy and odor but not all with those meet my current criteria
- Aggregates of bacteria, one type or mixed (three dimensional organisms > 1 micron) with an amorphous blue to reddish blue material in the aggregate

Of course I may be underdiagnosing biofilm which would be worse if not treat for it!?!

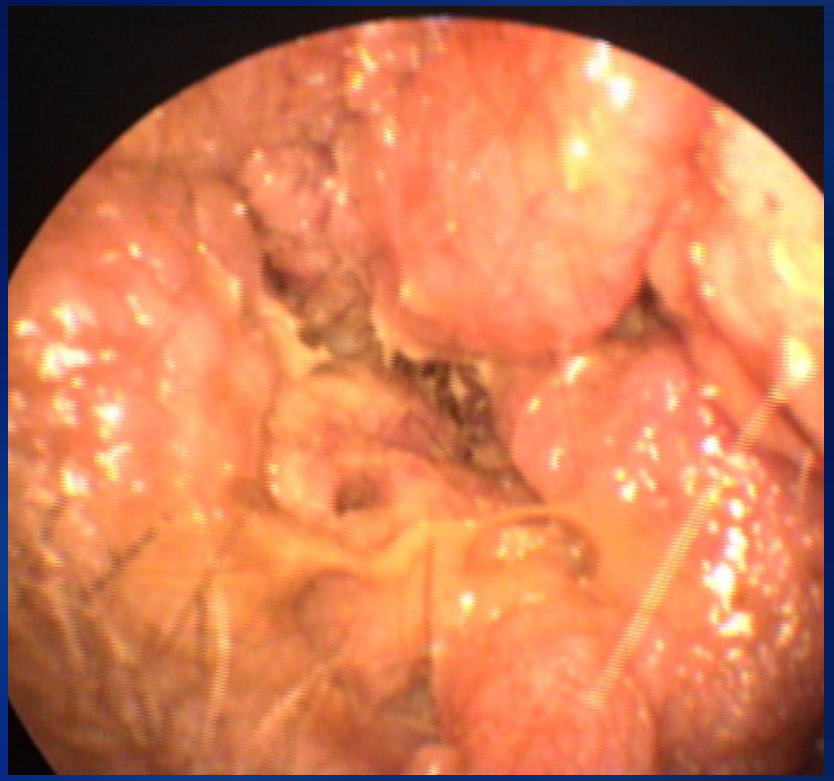
[1] Nuttall, T. (2016). In Practice Focus: 17-21

Biofilm Aggregates





Oso's Ears Up Close



What Else Do You See?

Did It Cause the Otitis?

Factor

An influence that contributes to a result or outcome

Making A Complete Diagnosis and Prognosis

Perpetuating factors

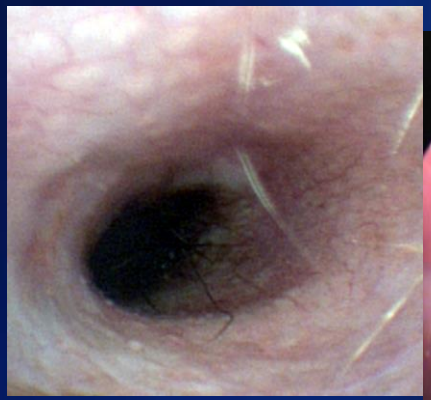
- PSPP Factors
- Agents or elements of the disease or pet that contribute to or promote ear disease
  - May inhibit response to treatment or promote recrudescence of secondary causes

Anatomic Site	Changes/Examples
Epithelium	Excessive production of debris Altered migration Failure of migration
Ear canal	Edema Proliferative changes Stenosis
Tympanum	Acanthosis Dilation Diverticulum or pocket Rupture
Glandular	Apocrine blockage and dilation Hidradenitis Sebaceous hyperplasia
Pericartilaginous fibrous tissue	Calcification
Middle ear	Filled with debris Otitis media Osteomyelitis

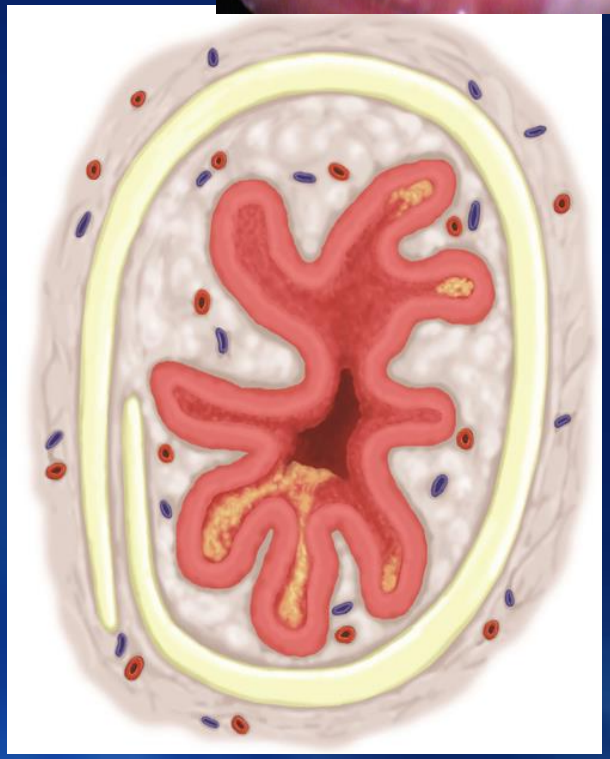
Anatomic Site	Changes/Examples
Conformation	Excessive hair growth in canals Hairy concave pinna Pendulous pinna Stenotic canals
Excessive moisture	Environment (heat and high humidity) Water (swimmer's ear, grooming)
Obstructive ear disease	Feline apocrine cystadenomatosis Neoplasia Polyp
Primary otitis media	Primary secretory otitis media; otitis media due to neoplasia, respiratory disease, or sepsis
Systemic disease	Catabolic states Debilitation Immune suppression
Treatment effects	Altering normal microflora Trauma from cleaning

Likely why Oso is not responding to treatments

Perpetuating*



- Result from inflammation and the pathologic responses of the aural skin and structures
  - Alter anatomy or physiologic function of the ear
  - Are not disease specific
  - Very common in chronic cases



Pfizer Atlas of Infection in Dogs and Cats

*Modified from August 1986 August, JR. (1986). Diseases of the ear canal in *Complete Manuel of Ear Care*,

Proliferative Changes [1]

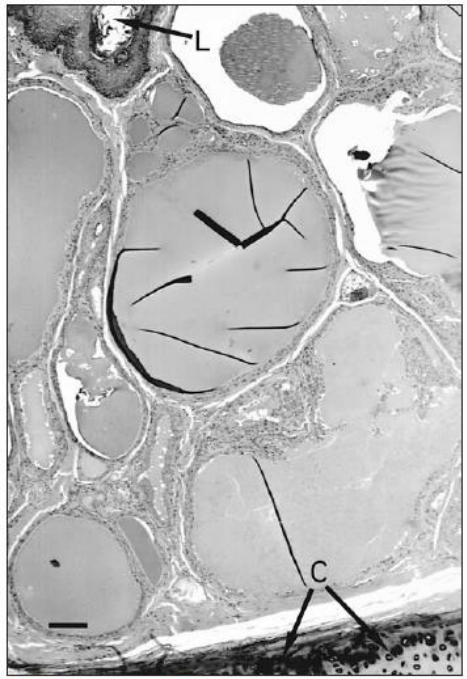


Figure 2—Photomicrograph of transverse section of horizontal ear canal with a predominant ceruminous gland tissue response pattern in a dog with chronic severe otitis externa. Notice thickened epidermis and displacement of normal tissue by severe cerumen gland hyperplasia and ectasia. The stenotic lumen (L) is visible at the top margin of the photograph. C = Cartilage. H&E stain; bar = 100 µm.

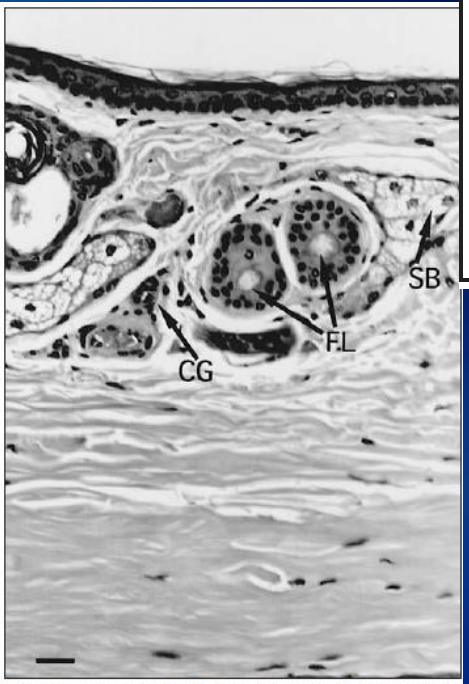


Figure 3—High magnification photomicrograph of transverse section of a normal horizontal ear canal in a dog. Notice the normal hair follicles (FL), sebaceous glands (SB), and cerumen glands (CG). H&E stain; bar = 20 µm.

Tissue response pattern	Cocker Spaniel		Other breed		
	No.	%	No.	%	Odds ratio
Ceruminous	35	72.9	9	28.1	$P < 0.01$
Sebaceous	9	18.8	2	6.3	$P > 0.1$
Fibrosis	4	8.3	13	40.6	$P < 0.01$
Other	0	0.0	8	25.0	$P < 0.01$

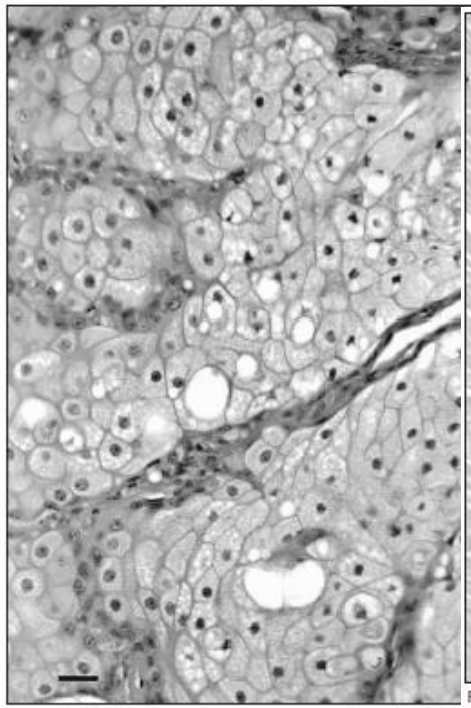


Figure 5—Photomicrograph of transverse section of horizon ear canal with predominant sebaceous gland tissue respon pattern in a dog with chronic severe otitis externa. H&E sta bar = 20 µm.

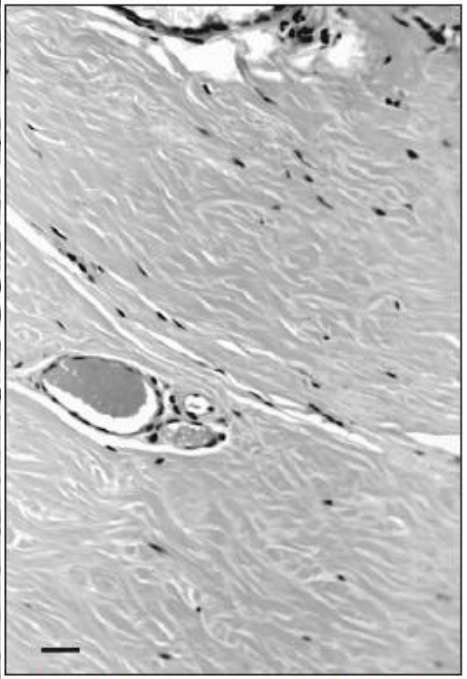


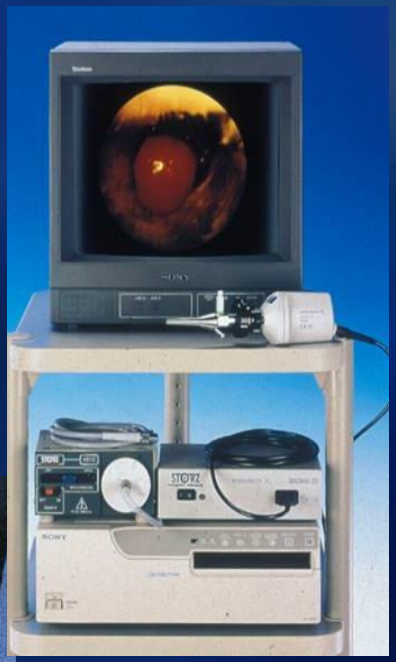
Figure 6—Photomicrograph of transverse section of horizontal ear canal with predominant fibrosis tissue response pattern in a dog with chronic severe otitis externa. Most of the tissue is composed of organized collagen, with less prominent glandular activity than observed in Figures 4 and 5. H&E stain; bar = 20 µm.

[1] Angus et al (2002) J Am Vet Med Assoc **221**(7): 1000-1006.

Making A Complete Diagnosis and Prognosis

Otoscopic examination

Equipment
Otoscopes



BR Guide Oto

10 Best Otoscopes - Dec 2

70 Reviews Scanned

1. Depstech USB Otoscope, Digital Ea
Lights, Otology Inspection Camera
By DEPSTECH

2. Dr Mom LED PRO Otoscope - FULI
with our largest diameter
By Dr Mom Otoscopes

3. HARD Case - Third Generation Dr
Stainless LED Pocket Otoscope
By Dr Mom Otoscopes

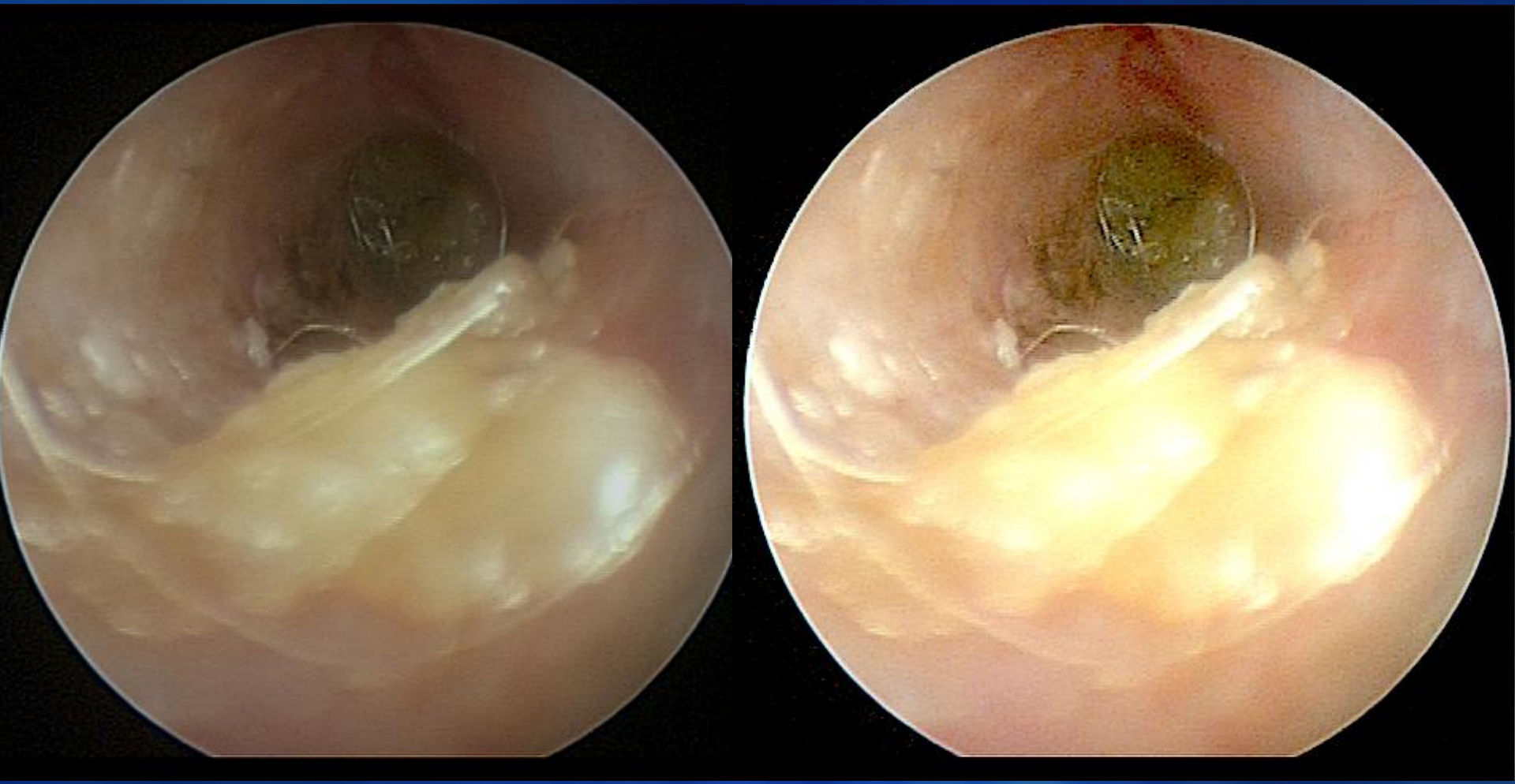
4. Welch Allyn 22820 PocketScope O
Handle
By Welch Allyn

5. Third Generation Dr Mom Slimline
Pocket Otoscope now includes True
By Dr Mom Otoscopes

6. Otoscope Kit- Professional Diagnos
Examination Otoscope Tool with 2
By Luismia

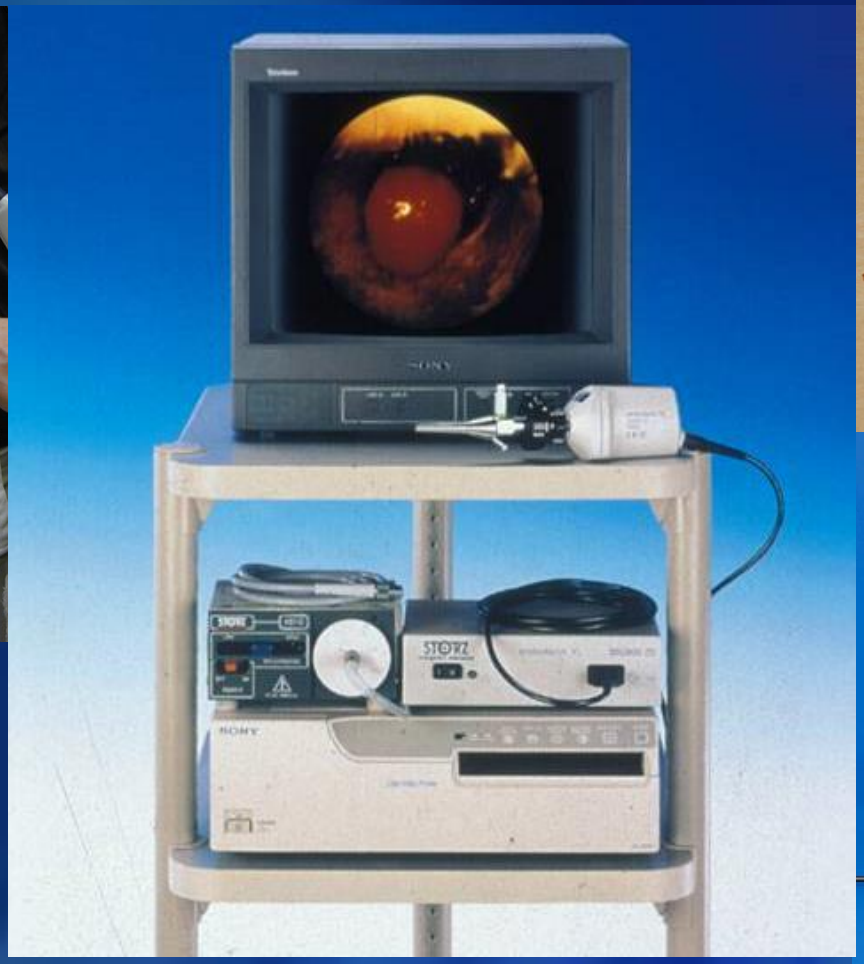
Light and More Light

Light



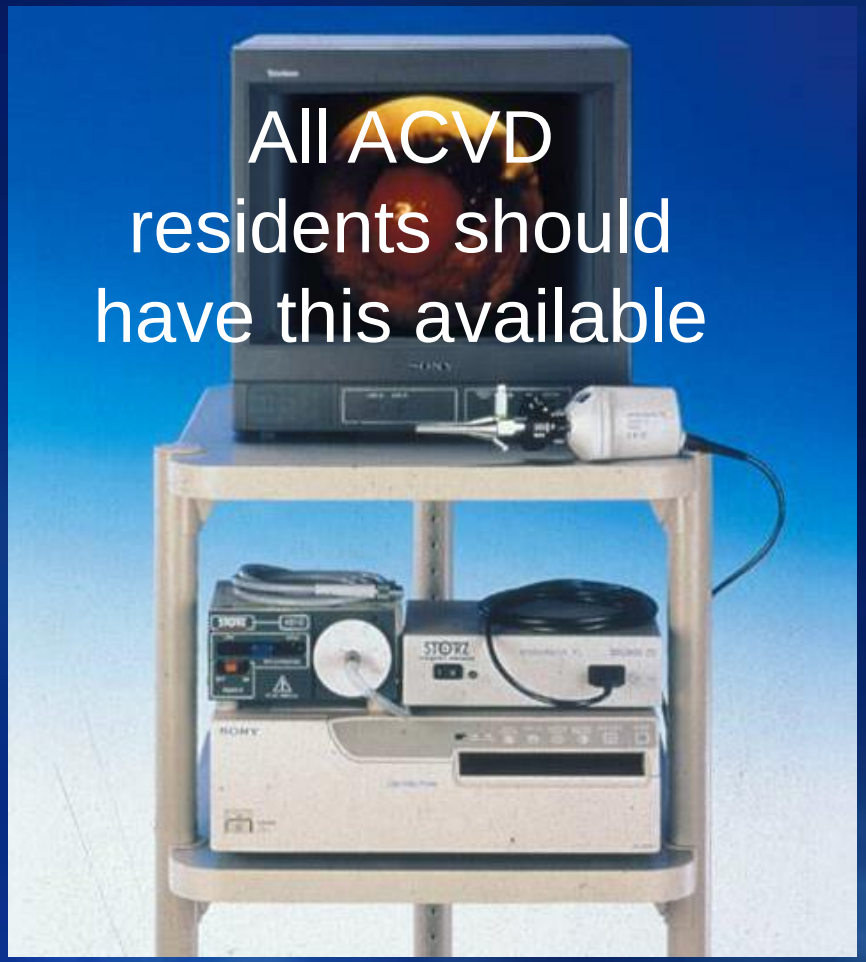
Video Otoscopy

- Equipment changes



Fiber Optic Video Enhanced Otoscopy

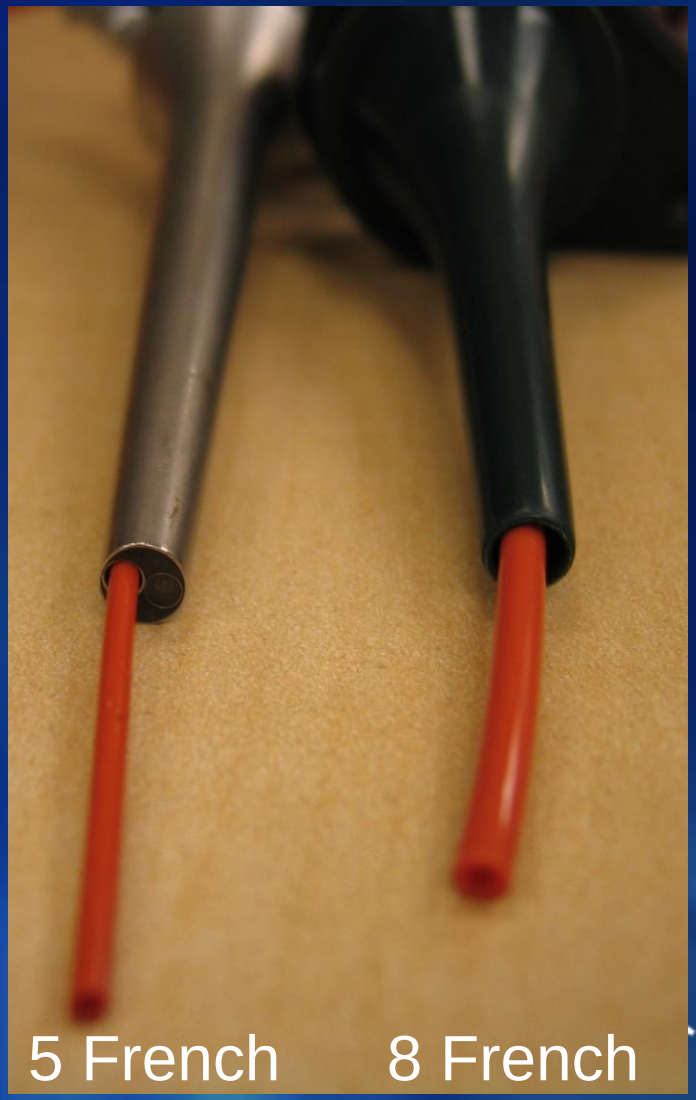
- Advantages
  - Better light, magnification, visualization
  - Pet owners can see what is in ear.
    - Improves procedure approval and compliance ?
  - Improves Procedures –
    - ear cleaning, biopsies, intra-lesional injections, myringotomy
  - Record keeping if digital photographs, movies



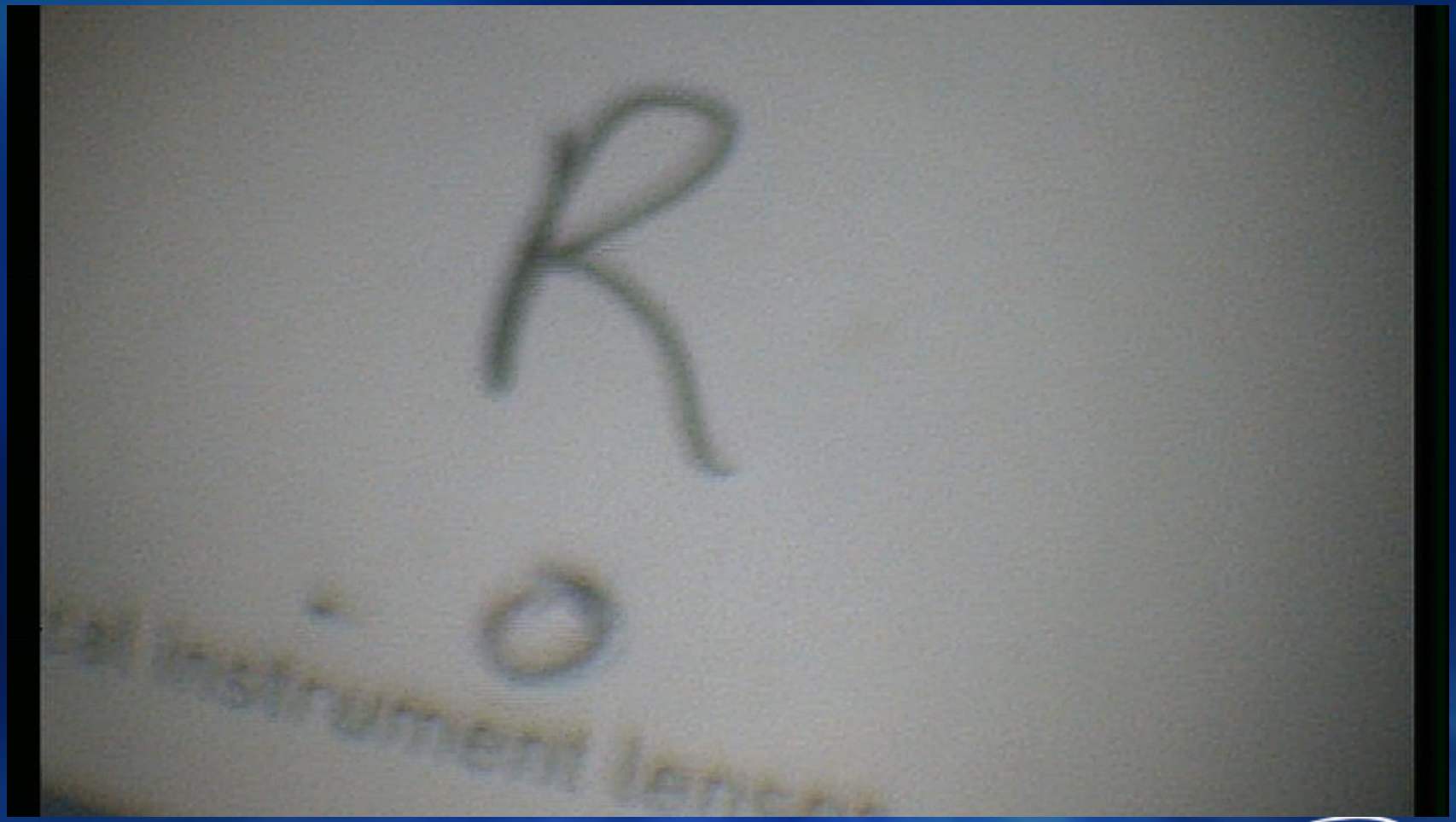

S3
HOPKINS
II


S3

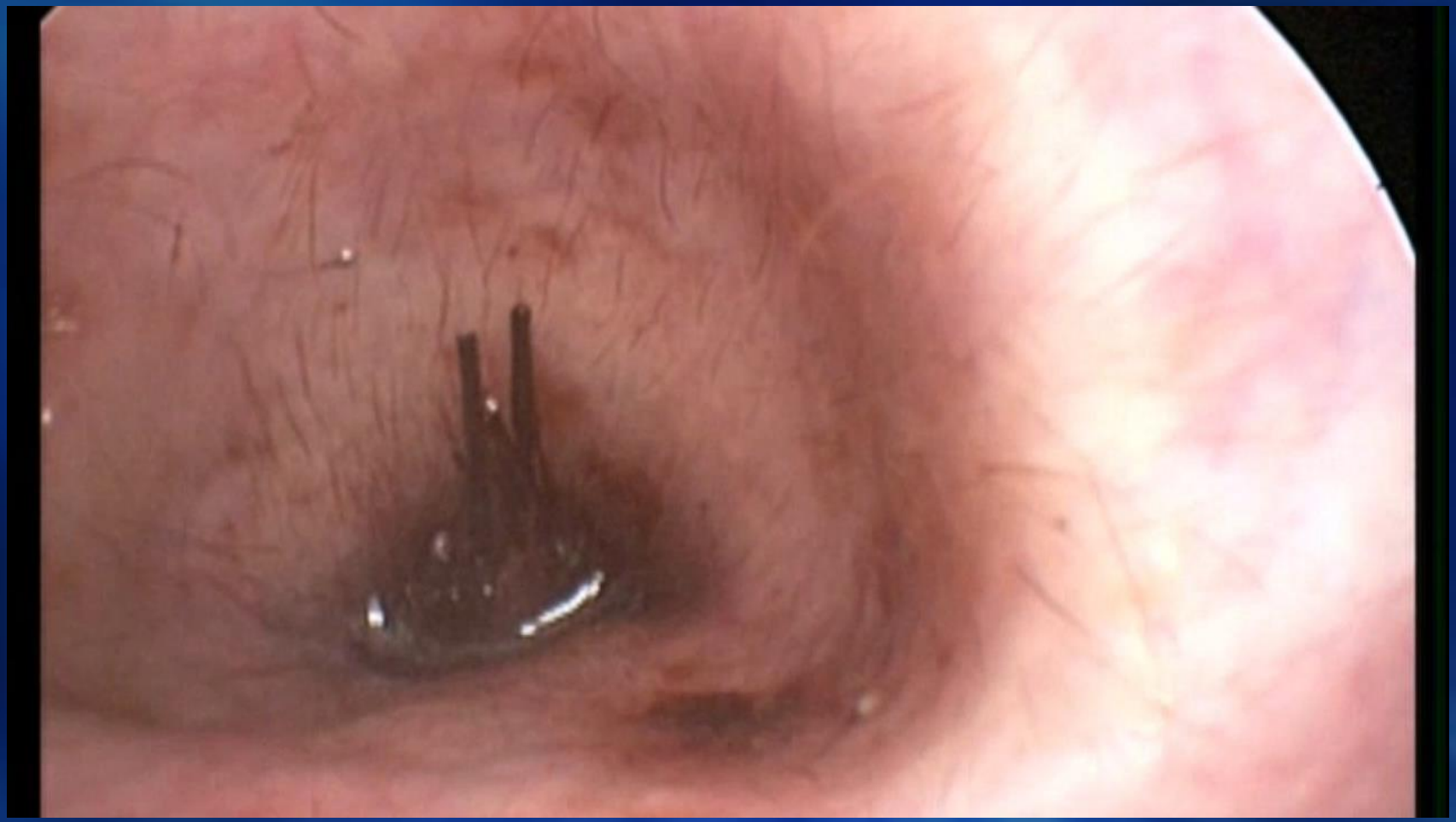
Video Otoscope
Port versus Standard 3mm Cone



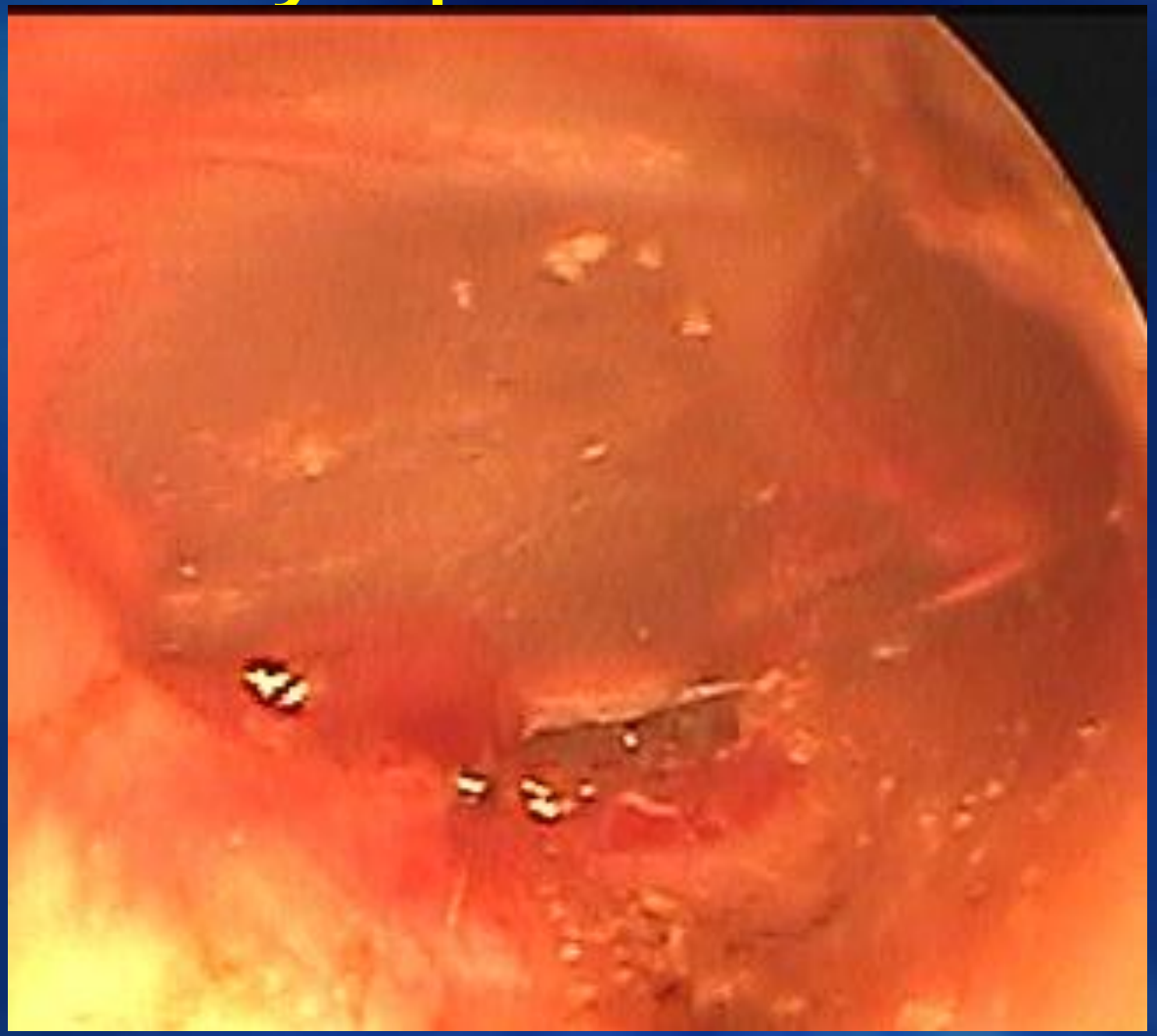
FOVEO Case Example



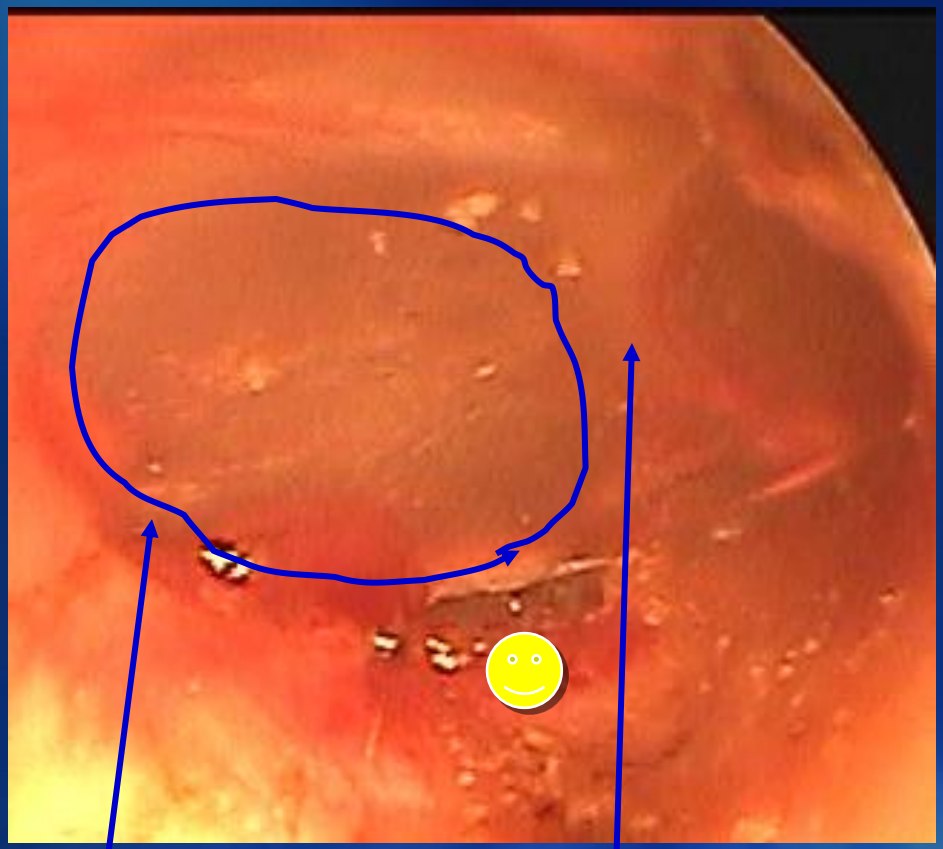
FOVEO Case Example



Is this a tympanic membrane?



Yes but with small tear



Pars Tensa

Manubrium

Is this a tympanic membrane?

Is this a tympanic membrane?

Is this a tympanic membrane?

Is this a tympanic membrane?

Is this a tympanic membrane?

Is this a tympanic membrane?

Thank You
?Questions?