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vet 360

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Editor's Note



I am sure I am not alone in sometimes being unsure of what exactly the best next step in a case is. And the same conditions where I dither, crop up again and again and I think it is because there is no exact answer. In this issue we have articles covering a few of these.

Chronic otitis cases in dogs is one of these - but just remember - it is a skin case - follow the basic steps and don't skip diagnostics if at all possible.

Consistency and records are important here. If it was easy to fix - we wouldn't all be seeing them all the time!

Our CPD accredited article is a very comprehensive article by Dr de Cramer on the canine breeding cycle, with special reference to the use of progesterone concentrations to time breeding for maximum yield and estimate the time of parturition more accurately. A must read for all practitioners with clients who breed dogs.

There is also an article explaining remarkably simple idea for the provision local anaesthesia to wounds, which can supplement existing pain control modalities in our patients. This is the last edition for 2019. I wish everyone a safe holiday season and I hope everyone finds some time to relax with family and friends.

Liesel

vet360 Advisory Board

VET360 aims to be a leader in the field of continuing veterinary development in Southern Africa by providing veterinary professionals from diverse disciplines with tools to help them meet the challenges of private practice. The magazine aims to make information accessible, both paper and electronic, and provide clinical, business and other veterinary information in a concise form to enable the practitioner to rapidly acquire nuggets of essential knowledge.

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The Importance of Saying *"Thank You"*



Eric Garcia
IT Expert. Digital Marketer. Industry Thought Leader.

In a world that's moving this quickly, who really has the time to say "please" and "thank you"? We might think that our world is so constantly filled with stimuli, that maybe nobody would hear it if we said, "Thank you", just a little more often.

It may feel like these tiny, syllable-sized gestures are antiquated or meaningless in our modern day environment. However, this couldn't be further from the truth. In fact, those precious two little words might be more important now than ever before. Scarcity solicits demand, right? We might be busier than ever before, but perhaps our need to express gratitude is also more prominent than ever. At Simply Done Tech Solutions, we believe this to be true.

Our need to express a heartfelt, "Thank you", has never been more relevant or imperative, than it is right now.

Despite what you might have been told, this simple phrase is emblematic of a whole lot more. It can make or break a friendship, or even a relationship with your own clients. In the wide world of veterinary medicine specifically, we are so dead-set on acquiring new clients, we hardly designate enough attention to tell our existing clients how much we appreciate them, and thank them for coming in. Now why would we work so hard to build our practice, market effectively, provide stellar service, and stop short of giving thanks?

A few simple phrases can help you to retain your clients, but even more importantly, create an ongoing, genuine bond of solidarity and trust. I recommend that you make saying the following few sentences a habit. You'll thank us later:

"Thank you for bringing your pet in to see us. Thank you for being a wonderful pet parent, and most of

all, thank you for choosing to trust us with your pets health care needs."

This type of response to a new or established client may only take seconds to say, but can literally make a world of difference. Of course, it's got to be genuine, and of course you're busy and of course the phone is ringing again. Still, you can't overlook the importance of gratitude as a cornerstone of building any healthy relationship.

The central point here is this; the effort really matters, because we really matter. Simply taking the time out each day to thank your clients and let them know explicitly of your appreciation and their importance can be surprisingly rare.

I used to work closely with a widely respected veterinarian, Dr. Eddie Garcia (no relation, I promise) who would call each and every one of his clients within 72 hours of their initial visit. He would do this with no ulterior motive or hidden reasoning. He would simply call to say "Thank you for visiting our practice. If there is anything we can do for you we are only a phone call away." He strongly encouraged both positive and negative feedback, in whatever form it came. He would use this feedback to learn about the wants, needs and fears of his clients, and thank them if their visit was sub-par as well.

I can hear you asking, "Wouldn't this level of openness leave him vulnerable to hours of time-consuming critique?"

While that's a fair question, the kicker is this: A majority of phone calls were left on an answering machine (well, voicemail box now days). People were so excited about the calls they called him back just to thank him for him calling them. Dr. Garcia boasted a 90% success rate of retaining upset or displeased clients.

I watched Dr. Eddie Garcia make this type of phone call everyday for over 10 years. Yes, he really made these calls each and every day, and yes, they really did make a difference. Calling both new and existing clients is equally important, and can't be emphasised enough.

Most of the time clients might simply express their grievance or general feedback to a spouse, or not at all. Dr. Garcia...

...used their direct feedback to forge a bond, improve his practice and retain his clients in a single call.

When I used to ask Dr. Garcia what motivated him to go above and beyond to make these phone calls, he had quite a simple explanation: to stay true to his mission. In his mission he outlined that his veterinary practice "will meet and exceed expectation". These phone calls were his little way of making sure that he exceeded his client's expectations of what an attentive and caring veterinarian looked liked. And it did.

From phone calls to "Thank You" emails, there are plenty of ways to effectively implement gratitude into your veterinary practice. Here is a 3-step-solution to implementing 'Thank You' into your practice today:

3 Steps to Saying Thank You

Implement a protocol to have your team print two reports at some point, consistently, each day. These should consist of two parts:

New client report from the day before.
Appointment schedule report from the day before.

Decide in your practice who the appropriate person is to make the call. I usually recommend that associates call their own clients in order to create a genuine bond. If associates do not have the time to do so, the practice owner or medical director may make the call. I've recently heard the idea of practices delegating this responsibility to a receptionist or technician.

The reason they do this is because they believe that pet owners are more likely to share a negative experience with the receptionist vs the owner or associate. Choose the person who you feel would be great at taking this task on (there is no one better person than another in my opinion).

Begin by calling all new clients and only choosing 3-5 existing clients from the appointment schedule report from the previous day. You don't need to call back every existing client to say thanks, but spot-check and call a few.

Optional Recommended Step

You may also choose to include a 'Thank you' email as an automated method to supplement the phone calls (check out how it works). This email can add a wonderful touch to a follow up phone call and coincides with my line of thinking:

You can never be too thankful.

I hope that these tips will help you implement new and improved techniques for your practice, now and into the future. Thanks for reading, and until next time

The New Client Concierge

A Personal Point of Contact for your Practice

For veterinary practices across the country and even around the globe, competition is everywhere. Whether it's a new local business opening up or an online service launching, pet owners have more choices now than ever. Building brand loyalty takes time, consistency and providing the extra qualities that your competitors just don't have.

When I provide consult to veterinary practices and study the latest marketing techniques during my digital sabbaticals (yes, I love reading up even in my off-time), I'm always looking for that extra edge to provide practices. For this article, I'm excited to share with you what I've discovered as a new and incredibly powerful tool for your veterinary practice.

The New Client Concierge is essentially a personal point of contact for your veterinary practice that reaches out directly to clients and makes sure that their first engagements with your veterinary practice are a major success. Your concierge will gently usher prospective clients through the process of becoming a new client such as scheduling and obtaining necessary paperwork in advance. This helps to make sure the first visit goes off without a hitch, so it's much easier to create loyalty toward your practice and keep your new clients coming back to you in the months and years to come.

But when it comes to the New Client Concierge, can you guess what the funny part is? I actually discovered the power of this technique by accident.

Yes, this epiphany actually came about when I was searching for a new dentist. When searching for my dentist, I first submitted separate requests online for at least 5 separate dentists in my local area. Surprisingly, I didn't receive a single response from those requests! I thought to myself, "Well, the dentists here must not be hungry for new business!"

But of course, I still needed a dentist...

So, I went back to work and with a trusty Google search found another 2 or 3 dentists in my area. All of these dentists had great online reviews and looked like a good fit for my needs. I went ahead and submitted another round of form requests, but this time I was surprised by what happened next.

I received a text message shortly after submitting the forms to one of the dentists. Not a call or an email, but a simple text message.

This was my New Client Concierge coming to save the day!

Not only was it thrilling to finally make a point of contact after searching and searching for the right dentist, but now there was a personal point of contact to instill trust into the process. The client concierge mentioned that she had received my request online and that she would love to help me schedule an appointment. Of course, I was delighted to move ahead, since I had been diligently searching for a dentist and was in need of my next appointment!

We proceeded to schedule the appointment, which was incredibly convenient directly through text. I was also able to send across all of my dental insurance information to verify ahead of the appointment, which would go on to save me time on the actual visit.

Even when everything around me was extremely hectic, including a looming Hurricane Irma hovering toward Florida, I got another friendly text from the dentist's office offering to reschedule. These extra measures to make sure the appointment could go as planned after the hurricane and that I was squared away with all of my questions answered, while seemingly minor, made a lasting impression and truly enhanced my interactions with the dentist's office in a meaningful way.

Eventually, I did receive a call back from one of the other dentist's offices, but by then, it was far too late. Not only is time of the essence when it comes to winning new business, but so is ushering the new client through the process to make sure they feel at ease. While she didn't actually call herself a "new client concierge," I found that this was the experience I was receiving!

I've shared this experience with veterinary practices in my talks. I talk to practices about the importance of **pro-actively texting interested new clients**, as well as suggesting that practices send out a mobile-friendly new client registration form via text once interest from the client has been established. This new client registration was the only step that my New Client Concierge was actually lacking, as I would have filled it out before my appointment and saved even more time during the visit.

The real essence of the New Client Concierge is that these extra steps make your client feel special, because they are! Every new client is different and has different needs. Reaching out is more than just a personal touch, it's a commitment to their experience and making sure it's as fulfilling as possible.

There are existing tools that can help you to integrate your own New Client Concierge service quickly, easily

and affordably. Zipwhip is the tool that I recommend for this above all else, as it's a platform explicitly dedicated to bringing businesses "closer through texting."

Since the amount of texts sent on an average monthly basis has increased 7,700% over the last decade alone (<https://www.statisticbrain.com/text-message-statistics/>), the importance of texting simply can't be ignored. This is a vital tool that's becoming increasingly prevalent and it's something that you can take advantage of early and often.

The New Client Concierge is a solution that can win new business, enhance client engagement and help to instill brand loyalty. When something showcases itself to be a winning proposition so clearly, it's always my choice to get onboard ahead of the curve!

Google even allows prospective clients to text you right from your Google Listing (more at: <https://searchengineland.com/google-begins-rolling-messaging-feature-within-google-business-278790>) and is adjusting to accommodate the popularity of texting to engage prospective clients and patrons in meaningful ways.

While the New Client Concierge can answer general questions that arise before the visit, any questions about the actual pet should wait until the appointment itself, where a veterinarian can address any questions directly.

If your practice has a mobile app, the New Client Concierge can also prompt a download and allow the pet owner to get further involved in your veterinary ecosystem by downloading. Medical questionnaires can be shared directly via text and even surveys too!

The possibilities are truly endless when you open up dialogue in meaningful ways and increase client engagement with new tools like Zipwhip.

Whether you wish to boost business, enhance the client experience or simply integrate the latest technological solutions, the New Client Concierge technique is one that you should consider as an invaluable and forward-thinking feature of your veterinary practice.

Standing out in a saturated marketplace has never been more important, yet it's never been easier to do.

If you're ready to get started with Zipwhip and creating your own New Client Concierge, following these simple tips will help you to get started:

01

Be sure to prepare a contact form exclusively for new clients who are interested in engaging in business with you. This form must include permission to text. If prospective clients fill this out on the web, you can then follow-up directly with a text message to get the conversation started...

02

Consider signing up for web-based texting tools to text prospective clients after permission is given. Zipwhip has an incredible track-record and is quickly emerging as the go-to source for businesses that wish to text their clients successfully. Zipwhip allows you to manage text messages via the web instead of a mobile phone and comes directly from your main practice's telephone number instead of a random cell phone.

03

Consider using your whole team with this and having fun with it too! You don't have to make an individual hire or assign one person to manage your account all the time. Rotating the person responsible can help your staff to achieve a new skillset and come together around a new job function that provides a boost to business!



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Fortunately, KahmaVet now offers you two new tools for these difficult cases.

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For advanced degenerative joint disease, Aquamid, an inert polymer molecule can be injected into a joint where bone is touching bone, Aquamid forms a gel cushion that keeps the bones apart.

Both V-PET platelet therapy kits and Aquamid gel are available to all registered veterinarians in South Africa, giving you additional options for helping your patients. KahmaVet also provides free delivery throughout the country and training for you, your team and your pet owners.

If you think V-PET or Aquamid could benefit one of your patients, please contact KahmaVet for more information at info@kahmavet.co.za and give your patients a new leash on life.



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Diagnosis and Management of Otitis



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The external ear consists of the external acoustic meatus which collects and locates the origin of sounds. The middle ear consists of the tympanic membrane, the ossicles, the auditory tube, and the tympanic cavity. It serves to transducer incoming airborne sound waves into waves in a liquid medium. The inner ear consists of the cochlea, the vestibule, and the semicircular canals. These structures relate the head to gravity, allowing the visual system to compensate for movement and to perceive both linear and rotational acceleration.

The tympanum is a thin, semitransparent membrane with a rounded elliptical outline. The shorter dimension is nearly vertical. The long axis is directed ventral, medial and cranial. The feline tympanum is more circular and smaller. The majority of the external surface is rough, thin and glistening (the pars tensa) with the outline of the manubrium of the malleus being clearly visible. The manubrium exerts tension on the tympanum giving it a concave shape as seen from the outside (like the speaker cone of a loudspeaker). The pars flaccida is more opaque, pink, or white in colour. It is confined to the upper quadrant of the membrane. (Fig. 1)

Otoscopy

When evaluating the ear, one should note the condition of the ear canal (erythema, stenosis, proliferation, ulceration); look for any foreign bodies or masses; note the presence, consistency, and color of any exudate; and evaluate the patency of the tympanic membrane.

Inflammation of Ear Canal

Inflammation as a result of any primary cause of otitis externa can result in oedema and erythema. The swelling caused by the oedema appears clinically as stenosis of the ear canal. There is gross enlargement and hypersecretion of sebaceous glands. A mixed infiltration of inflammatory cells migrates into the epidermis and dermis.

With clinical persistence of the ear disease, the ear canal continues to narrow. Clinically, there are variable degrees of nodular proliferation of the epidermis. With time, the continued inflammation can lead to fibrosis of the soft tissue and calcification and ossification of the auditory cartilage. Once these severe changes have occurred, it is usually not possible to resolve

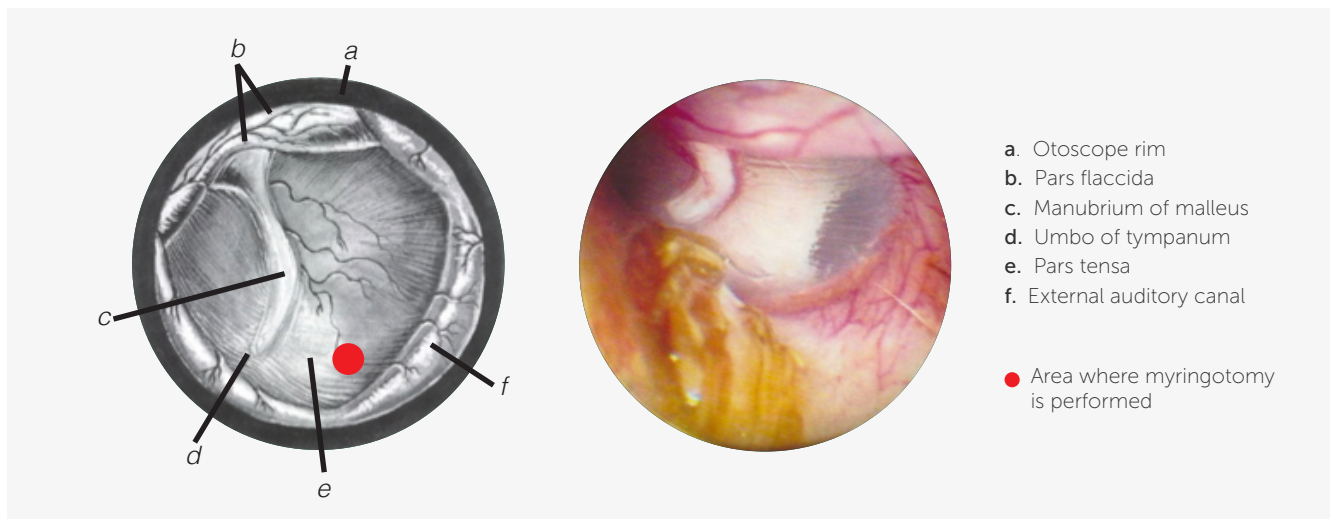


Fig 1. Anatomy of the normal canine tympanic membrane and Area where myringotomy is performed.

them even with anti-inflammatory drugs; in many cases, surgical intervention is necessary.

A recent study documented that the changes that occur in the external ear canal in chronic otitis may be breed related, with moderate to severe hyperplasia and dilation of the apocrine glands occurring in more than 70% of Cocker Spaniels, whereas these changes were present in only 31% of the other breeds evaluated.

Ulceration of the ear canal is uncommon and when present is usually associated with a gram-negative bacterial infection, such as *Pseudomonas aeruginosa*. Inappropriate cleaning of the ear canal with cotton tipped applicators, especially in an infected ear, can also result in ulceration.

If the ear is infected, oral and topical treatment is determined based on otic cytology and bacterial culture and antibiogram testing. In addition, glucocorticoids may be necessary to decrease the pain and inflammation associated with the ulceration. Topical ear cleaners containing alcohol should be avoided until the ulcers begin to heal.

Neoplasia of the Ear Canal

An animal with a tumour in the ear canal may present with clinical signs similar to any patient with chronic otitis externa. Any tumor in the ear canal needs to be biopsied for identification. This may be accomplished using alligator forceps through the handheld otoscope, although it is best performed using the biopsy forceps through the working channel on the video otoscope under guided visualisation.

In some instances, there is a secondary infection, and the exudate may prevent visualisation of the mass. It may be necessary to clean the ear before the examination. Depending on the amount of exudate, the animal may need to be anaesthetised to clean the ear completely. Once the ear canal is clean and a tumour is identified, a biopsy may be obtained.

Tumours of the ear canal can arise from any of the structures of the ear canal, such as the squamous epithelium, glandular structures, and mesenchymal tissues. The tumours may be benign or malignant. The most common tumour found in the ear canal of the dog and cat is a ceruminous gland tumour. There is a greater tendency for malignancy and aggressive biologic behavior of these tumours in the cat than in the dog. Other tumours of the ear canal include squamous cell carcinoma, papillomas, sebaceous gland tumours, and mast cell tumours.

Non-neoplastic diseases that can mimic tumours of the ear canal, including hyperplasia of the ceruminous glands, inflammatory polyps, ceruminous gland cysts, and nodular hyperplasia of the sebaceous glands.

Foreign bodies of the Ear Canal

Foreign bodies can cause an acute, painful, unilateral otitis externa. Rarely, they may cause a bilateral otitis externa. Some of the more common foreign bodies include plant awns, impacted wax, and inspissated otic preparations. The animal should be placed under general anaesthesia to remove foreign bodies, especially if they are in close proximity to the tympanic membrane. With the aid of the video otoscope, grass awns may be removed using the grasping forceps through the working channel on the oto-endoscope. Impacted wax and otic concretions should be dissolved with a ceruminolytic agent and then gently flushed out of the ear canal. In some instances, a curette is used to dislodge the obstruction.

Ear Flushing

In most cases of chronic otitis externa, the tympanic membrane is difficult, if not impossible, to visualise otoscopically on the initial examination.

Ear flushing is necessary to clean the ear to allow visualisation of the tympanic membrane. If the ear canals are ulcerated or stenotic, however, administration of oral and topical glucocorticoids for

2 to 3 weeks is needed to decrease the inflammation and open the ear canals to allow for a proper ear flush.

For a deep ear flush, the animal should be placed under general anaesthesia and intubated. In this way, if a myringotomy is required or if the tympanic membrane is ruptured, the airway is protected to avoid aspiration of any fluid that may pass from the middle ear into the oral pharyngeal region via the Eustachian tube.

In dogs with acute otitis externa, the incidence of otitis media is only 16%, whereas in dogs with chronic otitis externa, up to 88.9% may have concurrent otitis media. An intact tympanic membrane does not rule out otitis media and is present in up to 72.5% of dogs with otitis media. In addition to allowing visualisation of the tympanic membrane, the ear flush removes exudate that is irritating, masking a foreign body or tumour, serving as a nidus for infection, or capable of inactivating medications (eg, gentamicin, polymyxin B).

Otitis Media

If the tympanic membrane is ruptured, the animal has otitis media. Samples should be obtained from the middle ear for bacterial culture and antibiogram (C/B) and cytology.

Using a handheld otoscope, a sterile otoscopic cone is inserted into the horizontal ear canal and a sterile tomcat catheter is passed into the middle ear cavity. Half to one millilitre is instilled and aspirated for each sample. The first sample is used for culture and antibiogram and a second sample for cytological analysis.

If the video otoscope is used, an open-ended 3.5-French tomcat catheter attached to a 10-mL syringe is placed through the working channel of the endoscopic otoscope. One millilitre of sterile saline is flushed into the middle ear cavity and aspirated back. The fluid is then cultured. A second sample is obtained for cytologic evaluation.

The middle ear is flushed repeatedly with saline using an open-ended 3.5-French tomcat catheter attached to a 10-mL syringe passed through an otoscopic cone or through the working channel on the endoscopic otoscope to remove any ear cleanser from the middle ear completely so as to reduce the chance of ototoxicity.

Myringotomy

If the tympanic membrane is abnormal (eg, haemorrhagic, bulging, opaque, brown, grey), a myringotomy should be performed to obtain samples for bacterial culture and antibiogram and cytology and to allow flushing and drainage of the middle ear cavity. It is important to make the myringotomy

incision in the caudo-ventral portion of the pars tensa to avoid damaging the delicate structures in the middle ear (Figure 1). Using a handheld otoscope, an otoscopic cone is inserted into the horizontal ear canal and the tympanic membrane is visualised. Using a sterile tomcat catheter, an incision is made into the caudoventral quadrant of the pars tensa. The sample collected is submitted for bacterial culture and antibiogram. A second sample is used for cytologic analysis.

If the video otoscope is used to perform the myringotomy, an open-ended 3.5-French tomcat catheter is placed through the working channel of the endoscopic otoscope, and under direct visualisation, the catheter is used to make the incision into the caudoventral quadrant of the pars tensa. One millilitre of sterile saline is flushed into the middle ear cavity and aspirated back using a 10-mL syringe attached to the catheter. The fluid is then cultured. A second sample is obtained for cytologic evaluation. Once the samples have been obtained, the middle ear is flushed gently with saline through the catheter until the fluid aspirated back is clear.

The normal tympanum has been shown experimentally to heal in 21 to 35 days. Therefore, if the membrane is already ruptured, if the ear is kept free from infection after the myringotomy procedure, the tympanic membrane should heal. Possible complications of ear flushing and myringotomy are Horner's syndrome, facial nerve paralysis, vestibular disturbances, and deafness. Owners should understand these complications and sign a consent form before the procedure.

Once the ear canal has been evaluated otoscopically, samples obtained for cytology, culture and antibiogram, the ear flushed, and a myringotomy performed (if necessary), it is important to address the primary causes as well as the predisposing and perpetuating factors associated with the otitis. Additional diagnostics may be required to determine these causes and factors. Specific treatment for any infections should be implemented immediately.

Cytology

The principal value of otic cytology is identification and characterisation of microbial overgrowth or infection that contributes to clinical signs and perpetuates inflammation. This information strengthens interpretation of culture and susceptibility data, guides rationale therapeutic decisions, and permits more accurate monitoring of response to treatment.

Veterinarians are encouraged to view cytology as a mandatory test for every patient presenting for clinical signs of otitis, to be performed AFTER thorough otoscopic examination of the ear canal

Otodectes cynotis is classically associated with dry, grainy, black discharge, sometimes described as “coffee grounds.” In contrast, yellow or light brown discharge is reported to indicate bacterial infections, whereas waxy honey-coloured or brown exudate is associated with *Malassezia*. Unfortunately, these observations are not consistent or reliable.

Separate cytologic specimens should be prepared from each ear canal, even if the patient presents for unilateral disease. This permits comparison between the diseased ear and the normal ear as well as early recognition of bacterial or yeast overgrowth in the less obviously affected ear. Without independent evaluation, documentation, and monitoring of each ear separately, veterinarians may fail to make appropriate management decisions.

Sample collection should always be performed before introduction of any cleaning agent or therapy. The sample can be most easily obtained using a clean cotton-tipped ear bud or Cytobrush™ introduced gently into the external canal. In most cases, material obtained from the deeper horizontal canal is more clinically relevant than material obtained from the superficial vertical canal. To obtain consistent samples without causing undue risk to the patient’s tympanum, veterinarians should aim for the junction of the vertical and horizontal canal, where the cartilage bends at an angle of 75°.

In the case of otitis media, systemic therapy should be directed at organisms colonising the tympanic cavity rather than the external canal. In one study, isolates from the tympanic cavity differed from isolates from the horizontal canal in 89.5% of cases. In the same study, the tympanic membrane appeared to be intact in 71.1% of the ears with proven otitis media.

Sample preparation

Once the sample is collected, roll the swab onto a clean glass slide, evenly distributing a thin layer of material. Care should be taken to identify which ear was sampled by labeling the slide. Because cerumen has high lipid content, briefly heat the slide to fix material to the glass, preventing loss of valuable information in the stain solvent. Avoid overheating the slide, because this may distort cells, bacteria, or yeast. Most morphologically coccoid bacteria found in the ear canal are gram positive organisms and most rod bacteria are gram-negative.

Slide Evaluation

The high-dry x40 objective (x400 magnification) is adequate for identification of leukocytes, red blood cells, cornified epithelium, yeast, and larger bacteria. The high-magnification oil immersion lens (x100 objective, x1000 magnification) is used for detailed evaluation; otherwise, additional smaller or lightly stained bacteria may be missed. Higher magnification also permits better visualisation of morphologic characteristics of bacteria as well as evaluation of

the cytoplasm of neutrophils and macrophages for phagocytosed bacteria.

Evaluate each cytologic preparation for the number and characteristics of three specific features: yeast, bacteria, and leukocytes. To estimate the numbers, evaluate 5 to 10 areas; record the average count per high-powered field. A complete and consistent record of cytologic findings is necessary to monitor progression of disease or response to therapy. These details allow the primary clinician or any colleague following the case to determine if the infection is resolving, changing, or worsening.

Normal cytology

Microscopic examination may demonstrate normal cornified squamous epithelial cells seen as sheets of lightly stained basophilic keratin. These cells may roll up on themselves during smear preparation, resulting in deeper staining and a shard-like appearance. Desquamated keratinocytes may contain melanin granules, which appear as tiny yellow to brown ovoid or round structures, often misidentified as small cocci.

The external ear canal of dogs and cats contains small numbers of normal resident bacteria. Differentiating bacteria from debris or stain precipitate can be challenging if there are only a few organisms per field. With the exception of *Corynebacterium*, rod-shaped bacteria are rarely found in normal ear canals. Any bacteria found in the presence of leukocytes should be considered abnormal.

Another finding on normal otic cytology is basophilic staining yeast. Characteristically, these organisms exhibit unipolar budding, which creates the commonly described “peanut,” “snowman,” or “footprint” shape easily recognizable as *Malassezia* (Fig. 2C). Although these organisms are normal residents of the canine and feline ear canal, under the appropriate circumstances, *Malassezia* can become important opportunistic pathogens contributing directly to severity of clinical signs as well as to progression and perpetuation of disease.

Abnormal cytology

1. *Malassezia* yeast

M pachydermatis is present in 15% to 49% of normal canine ear canals and in up to 83% of dogs with otitis externa. Although more commonly isolated in the external canal, *Malassezia* may also colonise the tympanic cavity. In one study, *Malassezia* was recovered from 65.8% of external ear canals and 34.2% of middle ears of dogs with chronic otitis. When otitis media is suspected, cytologic evaluation of debris from the tympanic cavity should be performed. Because *Malassezia* can be found in normal patients or mixed in with predominantly bacterial infections, veterinarians need to determine the clinical significance of *Malassezia* for individual patients.

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Unlike bacterial infections, suppurative inflammation is not a common feature of *Malassezia* otitis and thus cannot be used to determine a pathologic state.

Cytology is the most useful tool for differentiating between normal resident colonisation and overgrowth. A recent study by Ginel *et al* proposed using semi-quantitative criteria for the diagnosis of significant yeast otitis. By comparing cytologic specimens from normal and diseased ears, the authors concluded that 2 or fewer yeast organisms per high-dry field (x40 objective, x400 magnification) in the dog and cat was normal. Mean counts of 5 or more yeast organisms per field in dogs and 12 or more yeast organisms per field in cats were abnormal. The intermediate values were considered a grey zone. Using these values to diagnose otitis externa, cytology had a specificity of 95% in dogs and 100% in cats. The sensitivity was only 50% for dogs and 63% for cats because of the fact that some cases of otitis externa were exclusively bacterial with minimal yeast involvement.

Semi-quantitative estimation of numbers provides a guideline for the clinician, but, ultimately, the decision to treat or not to treat *Malassezia* depends on a combination of cytologic findings, severity of clinical signs, past history of yeast otitis, and previous response to therapy in the individual patient.

2. Bacteria

The most common pathogens associated with otitis externa are coagulase-positive staphylococci, B-hemolytic streptococci, *Pseudomonas* spp, and *Proteus* spp. (Fig 2 A,B). In a study comparing isolates from the horizontal canal and the tympanic cavity of dogs with chronic otitis externa and media, there were differences in the species or antimicrobial susceptibility of bacteria isolated in 89.5% of the cases.

Therefore, samples for cytology and culture should be obtained from the tympanic cavity rather than from the external canal in cases with otitis media.

The distinction between bacterial “overgrowth” and “true infection” is subtle but clinically important. In general, overgrowth of bacteria in the debris and on the epithelial surface of the external canal does not warrant culture and susceptibility testing or expensive systemic therapy.

Systemic therapy is not necessarily more effective for these cases, because the concentration of antibiotic achieved by topical medications can far exceed that achievable by systemic routes. In contrast, with bacterial infection of the tissue of the external canal or within the tympanic cavity, high-dose long-term systemic antibiotic therapy is necessary for successful resolution.

Another important piece of evidence aiding a diagnosis of infection versus overgrowth is the presence of abundant leukocytes on cytology.

Leukocytes are not found in the normal canal, nor are they frequently present during overgrowth of organisms on the surface of the external canal.

Based on the results reported by Ginel *et al*, five or less bacteria per high-powered dry field (x40 objective) should be considered normal, whereas 25 or more bacteria per field suggests an abnormally increased population, with the intermediate numbers in a grey zone subject to interpretation. For cats, four or fewer bacteria per field was consistent with normal and 15 or more bacteria per field was abnormal. Using these mean count criteria to differentiate normal from diseased ears yielded 95% specificity and 50% sensitivity in dogs and 100% specificity and 63% sensitivity in cats.

The best method for diagnostic evaluation of bacterial otitis is cytology in combination with culture and susceptibility testing. Cytologic evidence is available immediately, allowing the veterinarian to initiate rational empiric therapy while awaiting susceptibility results. When the laboratory report arrives later, knowledge derived from cytology determines which organisms are most relevant, directing alterations in the initial plan.

3. Leukocytes

In addition to evaluating cytologic preparations for bacteria and yeast, otic exudate must be carefully examined for white blood cells (Figure 2B). Although yeast and bacteria are normal findings, leukocytes should not be present in otic cytology from normal patients. Neutrophils, macrophages, and other inflammatory cells only gain access to the lumen of the canal as the result of exudative inflammation, ulceration of the epithelial lining, or extension from the tympanic cavity during otitis media.

Thus, finding leukocytes on cytology suggests a more severe disease process. If the immune system is responding to an infection with suppurative or pyogranulomatous inflammation, systemic antibiotic therapy is almost always indicated. In many patients with otitis externa, the only evidence of concurrent otitis media during the initial evaluation is extension of purulent exudate from the tympanic cavity into the external canal.

Because otitis media is present in 16% of dogs with acute otitis externa and in up to 82% of dogs with chronic disease, any cytologic evidence of leukocytes in the external canal should increase the clinician's suspicion for concurrent otitis media, warranting specific diagnostic evaluation.

Causes of otitis externa

Primary causes

These are defined as processes or factors that directly initiate the inflammation of the external ear canal.

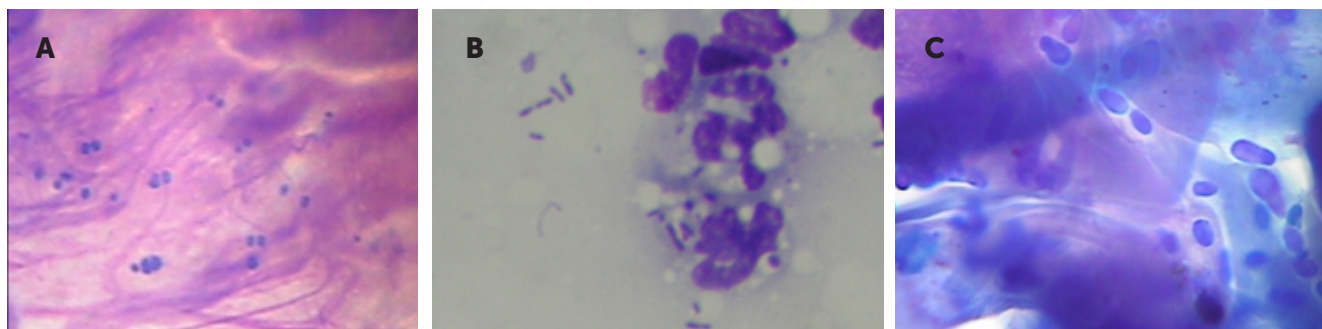


Fig. 2 A-C Abnormal ear smear cytology. (A) bacterial cocci (B) bacterial rods with necrotic neutrophils (C) *Malassezia*

The successful treatment of the patient thus requires specific identification and treatment of this process.

1. Allergic skin disease

In dermatology referral practice, more than 90% of the cases presented for chronic/recurrent bilateral otitis externa, and occasionally unilateral disease only, are a result of the presence of atopic dermatitis or food allergy in dogs (Fig. 3). In most instances, the history and physical examination indicate the presence of inflammation and pruritus on other areas of the body associated with the potential problem of atopic dermatitis or food allergy.

2. Foreign bodies

Plant awns can be a cause of otitis. Plant awns are capable of migrating into the deepest portion of the horizontal ear canal and rupturing the tympanum, resulting in a concurrent otitis media. Less frequently observed foreign body reactions may be induced by dirt, sand, dried otic medications, broken/loose hairs, and dead insects.

3. Parasites

Otodectes cynotis (ear mite) has been reported to account for up to 50% of cases of otitis externa in cats and 5% to 10% of cases in dogs. Initially, the exudate is usually a dark brown to black colour; however, chronic cases may become secondarily infected with bacteria or yeast; at that time, the exudate may develop more ceruminous or purulent characteristics.

Demodex canis may infrequently cause a ceruminous otitis externa in dogs (with or without concurrent skin lesions of demodicosis), and *Demodex cati* may infrequently cause a ceruminous otitis externa in cats.

These areas include the face (especially the muzzle and peri-orbital regions), feet, inguinal/ventral abdominal region, axillary region and flexural surfaces of the foreleg (elbow and carpus). It has been reported that up to 55% of dogs with atopic dermatitis have concurrent otitis externa, with 3% to 5% of cases exhibiting otitis externa as the only clinical sign. Additionally, up to 80% of dogs with food allergy have concurrent otitis externa, with 25% of cases exhibiting otitis externa as the only clinical sign.

4. Keratinization disorders

Endocrine disorders, such as hyperadrenocorticism, hypothyroidism and sex-hormone imbalances, may alter keratinization and cerumen gland secretion in the external ear canal, resulting in an initial ceruminous and seborrhoeic form of otitis externa. A similar form of otitis externa may occur in cases of sebaceous adenitis and idiopathic seborrhoea.

5. Autoimmune disease

The autoimmune skin diseases that may affect the pinnae or the external ear canals include pemphigus foliaceus, discoid lupus erythematosus, cutaneous vasculitis, bullous pemphigoid, and mucous membrane pemphigoid (Fig. 4). These are all relatively rare causes of otitis externa, and, invariably, there are skin lesions at other locations of the body or lesions on various mucous membranes.

Predisposing causes

These causes are defined as processes or factors that increase the risk of developing otitis externa and work in concert with the primary or perpetuating causes of otitis externa to cause clinical disease. It is important to recognize and possibly control these problems as a part of the complete therapeutic plan.

1. Anatomic and conformational factors

These factors include dogs with long pendulous ears, stenotic ear canals, and excessive hair in the external ear canal. It is controversial as to whether or not such conditions alone can cause otitis externa.

2. Excessive moisture

An excess accumulation of water from frequent swimming or bathing can lead to maceration of the stratum corneum lining the external ear canal. This removes the protective barrier to secondary infection, and the normal resident microflora of the external ear canal can become opportunists, causing a subsequent otitis externa. This frequent wetting of the ear canal may also stimulate the activity of the ceruminous glands, causing a ceruminous otitis externa.

3. Iatrogenic factors

These factors include the use of cotton-tipped swabs for ear cleaning, traumatic removal of hair from the ear canal, inappropriate topical or systemic



Fig. 3. (A) A young adult Boerboel with obvious hyperpigmentation and erythema of the pinna and a ceruminous otitis externa and severe ear canal stenosis. (B-C) Note the obvious signs of allergic skin disease on the flank and neck. Allergic skin disease is by far the most common primary cause of otitis externa. Failure to control this will eventually result in irreversible damage to the ear and the need for a total ear canal ablation. Figures courtesy of the Department of Companion Animal Clinical Studies, University of Pretoria.

antibacterial treatment predisposing to resistant strains of opportunistic bacteria, and the use of known irritating solutions.

4. Obstructive ear disease

Inflammatory polyps and tumours of the ear canal prevent exudate drainage, which predisposes the ear to secondary infection.

Perpetuating causes of otitis externa

These causes are defined as processes or factors that are not responsible for the initiation of the otitis externa but do cause the disease to continue once established.

Once present, these causes must be specifically treated, but always in conjunction with treatment of the associated primary and predisposing causes.

1. Bacteria

It is important to emphasise that the external ear canal has a low number of resident as well as transient bacteria present under normal circumstances. Culture of the normal external ear canal has been reported to include *Staphylococcus pseudintermedius*, *Pseudomonas* spp, *Streptococcus* spp, and *Proteus* spp. Once overcolonisation of the external ear canal occurs, the most commonly isolated bacterial pathogens include *S. pseudintermedius*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Escherichia coli*, *Corynebacterium* spp, *Enterococcus* spp, and *Streptococcus* spp. In cases of chronic or recurrent bacterial otitis externa, the most common problematic opportunistic pathogen is invariably *P. aeruginosa*.

2. Yeast

It is important to emphasise that the external ear canal has a low number of resident yeast present under normal circumstances and that culture of the

normal external ear canal may reveal the presence of *Malassezia pachydermatis*. Once overcolonisation of the external ear canal occurs, the most commonly isolated fungal pathogen is *M. pachydermatis*, with the occasional isolation of *Candida* spp.

3. Otitis media

Inflammation and infection of the middle ear cavity often play an important role in cases of chronic or recurrent otitis externa. Such infection usually develops as an extension of otitis externa through a ruptured tympanic membrane but may also be present in instances where the tympanic membrane is noted to be intact. Inflammation and infection of the middle ear cavity may also occur from potential pathogens in the nasopharynx via extension through the auditory tube (Eustachian tube) or, rarely, via haematogenous spread.

Investigating chronic otitis

"Chronic" is defined as otitis present for more than 2-months or as recurrent disease over a period of 6-months or more.

- The primary factors must be identified and managed. If they are not the end result will inevitably be total ear canal ablation (TECA) normally with a lateral bulla osteotomy (BO). The old so called "Zepps" operation is no longer used or indicated.
- The perpetuating factors will prevent resolution of disease and will need to be addressed in the immediate and short term (these include bacteria, yeast and otitis media).

The first step in investigating the chronic ear is to make the distinction between a "SURGICAL ear" and a "MEDICAL ear". This is a fundamental step and in any chronic ear, making this distinction early saves time, suffering and money.

The indications for surgery are:

- Severe calcification of the ear canal cartilages
- Irreversible soft tissue pathology
- Bony changes in the tympanic bulla
- Persistent infection of the middle ear
- When a dog has become completely averse (aggressive) towards the owner applying topical treatments, this would normally also indicate a surgical ear.

Calcification and bony changes are determined on radiographs and/or (preferably) computed tomography scan (CT). Irreversible soft tissue changes cause ear canal stenosis that is unresponsive to 4-weeks of anti-inflammatory treatment. The degree of stenosis is regarded as severe if the tympanic membrane is not easily visualised, if you cannot perform cytology and culture of the middle ear and if the ear canal cannot be cleaned and treated. Severe hyperplastic changes should be treated with between 1-4 weeks of glucocorticoids topically and systemically. Systemic prednisolone can be given on a tapering dose starting at 1mg/kg bid for three days, then 1 mg/kg oid for five days then 0.5 mg/kg oid for a week and then on an alternate day basis.

Topical glucocorticoids can be used with commercially available 'poly-pharmacy' otic preparations or dexamethasone can be made up in a 1:1 dilution (2mg/ml dexamethasone mixed 1:1 with saline). Topical Cortavance® (Virbac) used 2 – 3 x a week (0.2ml per ear canal) has also been shown to be effective and is the authors preferred means of treating an ear canal topically with a cortocosteroid.

Daily cleaning can be considered if the animal will tolerate it. It is crucial that any cleaning procedure not become painful as the animal will become too head shy to treat and that will then almost certainly necessitate surgery.

A typical 'plan' for a case of chronic disease would look something like this:

Day 1:

- ALWAYS consider the skin as a whole and never just focus on the ear disease alone. Almost all allergic skin disease that affects the ears will also show clinical disease on the skin (axillae, groin, feet, palmar surfaces). The owner will usually complain of pruritus elsewhere besides the ears. The skin as a whole will need to be managed (antibiotics, shampooing) and assessing response to treatment or diagnostic trials will involve the owner scoring the skin disease as a whole, not just the ears.
- The author will typically perform a CT of the head to rule out calcification of the ear canal and/or bony changes to the bullae. If these are present it is not usual to proceed any further with medical treatment but a TECABO recommend straight away. Sadly, because few otitis cases are worked up well to start



Fig 6. A cat (top) and a dog (bottom) with pemphigus foliaceus induced otitis. This is a rare primary cause of otitis in dogs and cats. Figures courtesy of the Department of Companion Animal Clinical Studies, UP.

with, the majority of chronic ears seen in the authors practice are beyond salvaging.

- Determining the reversibility of ear canal swelling (if the imaging provides no evidence of a "surgical ear") requires a course of high dose glucocorticoids (7-10 days) followed by reassessment. If oedema or proliferative changes preclude visualisation of the entire canal to the level of the tympanum, topical therapy should be initiated based on cytologic findings, and the patient should be discharged on an anti-inflammatory regimen or oral prednisolone.
- Determining the PRIMARY cause in a chronic ear that is going to be medially managed is absolutely mandatory.
- Always start with a novel protein dietary trial at this point (lasting 8-weeks with strict instructions on how to conduct this). Emphasise to the owner that a well conducted dietary trial, will always provide useful results. 'Failure' of the diet trial simply means food allergy is not playing a significant role. Partial success means food allergy is playing some role – and atopy is more than likely the remaining contributing factor.

It is the authors experience that it is frequently necessary to extend the period of time a

hydrolyzed diet trial runs in cases of chronic otitis. Often initial improvements are seen as a result of proper treatment of the perpetuating factors. It is necessary to extend the diet trial to be sure that the allergic inflammation of the ear canal is indeed due to a food allergen and not just proper management of the infectious agents. Should the ear disease relapse after the clearance of infectious agents and while the animal is on the hydrolyzed diet, one can assume that a dietary allergen is playing an unimportant role in the ear disease. This may well take longer than 8 weeks to establish if only the ear canals are involved.

Day 14-28:

If the ear canal is still not open, it is safe to assume that the stenosis of the canal is irreversible and due to scarring and not just allergic inflammation. At this point a general anaesthetic is given and the ears are imaged (radiographs, CT) if imaging has not already been performed. Imaging and ear canal examination will determine at this point whether or not this is a surgical case or not. If it is surgical, proceed no further medically, perform a total ear canal ablation and osteotomy (TECABO). If it is not a surgical candidate, cytological samples should be collected for culture and antibiogram, the external ear canal should be cleaned (flushed) and the middle ear evaluated by myringotomy.

- Repeated myringotomy procedures require special equipment and skill and end up being as costly as TECABO surgery. The outcome is also frequently poor. For these reasons careful consideration should be

given to medical management of recalcitrant middle ear infections. In most of these cases, a surgical approach will have a more reliable (and possibly even a cheaper) and better outcome.

- Treatment with second-line or third-line antimicrobials may be indicated depending on the history of prior therapies. The client should be prepared for longer term topical therapy (at least 4 weeks in duration). In extremely chronic cases, several months of rigorous topical therapy may be necessary to return the external canals to their normal state.
- Systemic antibiotics may be indicated if there is extensive tissue swelling (potentially indicating deeper infection), ulceration, or significant periaural dermatitis. Rechecks should be scheduled every 2 to 4 weeks for cytologic and otoscopic examination until complete resolution is achieved.

Day 60:

At this point the effect of the diet trial to control ear canal inflammation must be established. Should the food trial diagnose atopy, a discussion with the owner around the long term control of atopy will be necessary. The options are typically: occasional short term, lowest possible dose glucocorticoids (as long as the dog remains side effect free, life-long oclacitinib, cyclosporine or allergen specific immunotherapy, regular ear cleansing (2 – 3 x a week) should usually form part of the long term routine, and in some cases a topically applied steroid (2 – 3 x a week after cleansing) will also be needed.



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Shaping the future of animal health



Progesterone Concentration Simplifying Canine Reproduction



Clinicians with clients who breed dogs and occasionally need to perform caesarean sections will find value in performing progesterone assays.



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Most veterinary practitioners don't deal much with bitches in oestrus and may lack experience and skills to interpret reproductive examinations such as appearance of the vaginal mucous membranes on vaginal speculum examinations and vaginal smears. Progesterone concentrations (PC) may aid both experienced and less experienced practitioners in reproductive consultations of the bitch. Although progesterone assays have been locally available for some years, the turnaround time impedes its usefulness in cases where immediate decisions need to be made. Point of care progesterone assays in South Africa are now a reality with one product currently available and various others soon to become available.

The use of progesterone assays should be considered within the scope of the small animal general practitioner. Clinicians with clients who breed dogs and occasionally need to perform caesarean sections will find value in performing progesterone assays as experienced dog breeders are well aware of the value of progesterone results. It is known that in the dog up to 75% of failures to conceive can be attributed to

incorrect timing of breeding. The ability to accurately time breeding is of practical and economic importance for breeders. Optimal timing benefits breeders in the following ways:

- Maximises pregnancy rates (semen and stud fees are expensive)
- Maximises litter sizes (semen and stud fees are expensive)
- Allows the breeder to plan travel for matings
- Allows optimising time for assisted breeding techniques
- Allows optimising time for breedings where access to the stud is limited to one or two matings
- Allows optimising time for breeding bitches that remain unreceptive or show silent heats
- Ovulation timing gives fair estimates of expected whelping dates

Endocrine events in the domestic dog's oestrous cycle

Endocrine control of the oestrous cycle in the dog is similar to that for many of our domesticated species. Gonadotrophin releasing hormone (GnRH)

is secreted by the hypothalamus resulting in the secretion of follicle stimulating hormone (FSH) and luteinizing hormone (LH) by the pituitary gland. During anoestrus there appears to be a decreased sensitivity of the pituitary gland to the effects of GnRH which changes to an increasing sensitivity as late anoestrus approaches. An increased pulsatility and amplitude of GnRH follows this period, resulting in increases of FSH and LH, also in a pulsatile fashion.

At about the same time as the LH peak, the pre-ovulatory surge of FSH occurs and may last three times longer than LH surge. These two hormones respectively stimulate the granulosa cells to produce oestrogen and theca interna cells to form a corpus luteum (CL) and produce progesterone.

In late pro-oestrus, peak levels of oestradiol are reached but levels may vary considerably between oestrous cycles within and between individual bitches. Oestradiol seems to have a positive feedback effect on LH contributing to the LH surge and subsequent ovulation. Following the LH surge there is a decrease in oestradiol levels and they return to basal after 80 hours.

The duration of the LH surge in the bitch is variable and ranges from 1-5 days. The LH peak remains a pivotal or key event in the canine oestrus cycle in experimental studies where it is used as chronological landmark, but it remains unavailable in clinical practice because it is difficult to assay. Studies have illustrated that the initial rises in LH and progesterone cannot be dissociated and therefore the pre-ovulatory rise in progesterone concentration (PC) as well as LH

are synonymous. The concept of estimated versus confirmed LH surge originated from this link and PC is widely used, remains unchallenged to date and is perceived as more accurate in timing ovulation than direct LH assay.

Coinciding with the fall in oestrogen and LH surge, progesterone concentration begins to rise from basal levels due to pre-ovulatory luteinisation of follicular cells and this signals the onset of behavioural oestrus or standing heat in the bitch, sometimes referred to as receptivity.

The four stages of the canine oestrous cycle

Domestic dogs are monoestrous, typically non-seasonal, polytocous and spontaneous ovulators. The reproductive cycle of the bitch is also referred to as the "heat, sexual or oestrous cycle" in the bitch, with oestrous cycle being the preferred term. The oestrous cycle of the bitch consists of four successive stages; pro-oestrus, oestrus, dioestrus and anoestrus. The term metoestrus is not used in the bitch anymore.

- Pro-oestrus is defined as the period from onset of vulvar bleeding to the first acceptance of copulation and its duration averages 9 days but may range from 1–27 days. Oestrogen dominates in pro-oestrus and leads to opening of the cervix, oedema of the vulva and vaginal folds, increased blood supply to the uterus, uterine bleeding due to diapedesis which is seen as a bloody vaginal discharge and secretion of pheromones leading to attraction of males.

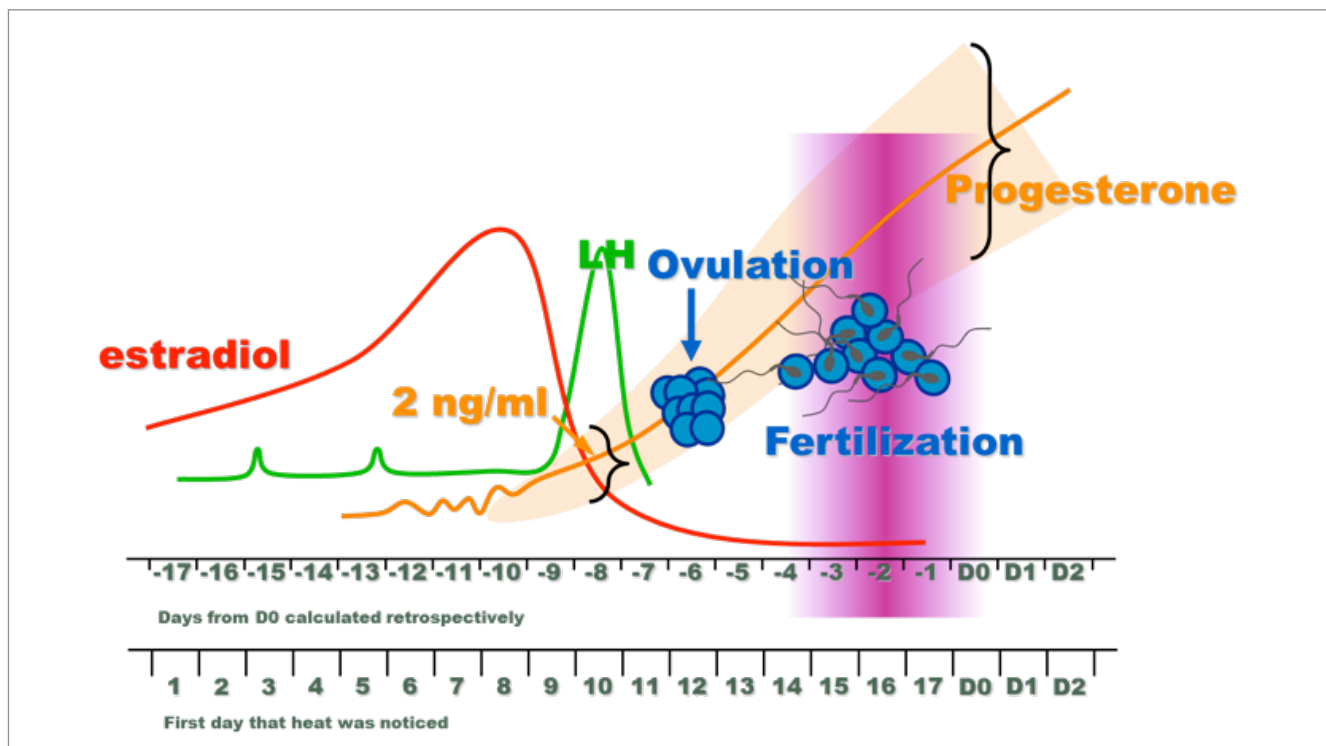


Fig. 1. Endocrine events in the oestrus cycle of the bitch (Image courtesy of Kurt De Cramer)

- Oestrus refers to the outward signs of receptivity that leads to mating and the stage during which the bitch allows mating. Oestrus averages 9 days but may range from 3-21 days
- Dioestrus begins when there is an abrupt fall in superficial cell index (SCI) as seen on vaginal cytology, following which progesterone continues to rise, dominating the full extent of dioestrus and finally declining until it reaches basal levels at the end of dioestrus. Dioestrus is approximately 63 days in the pregnant bitch and 70 days in non-pregnant bitch.
- Anoestrus is the phase between the end of the dioestrus and the beginning of the next pro-oestrus. The duration of anoestrus is variable and may range from 2-10 months

From this discussion it is clear that with the exception of dioestrus, there is a large range in duration of the various stages of the canine oestrous cycle. In addition, there may be huge overlap between behavioural oestrous and endocrine events. For these reasons the canine oestrous cycle may be referred to as elastic, which may complicate optimisation of mating.

It is also a popular misconception by breeders that an individual bitch will have successive oestrous cycles in which the durations of pro-oestrus and oestrus is comparable, enabling accurate prediction of key events based on information obtained from her previous oestrous cycle.

It has been shown that significant variations of the day of ovulation may occur among successive heat periods in the same bitch. It is particularly the normal variability and wide ranges in the duration of pro-oestrus and oestrus that leads to errors in optimising the timing of breeding in the bitch. In cases where assisted reproductive techniques are employed or stud access is limited, accurate timing is essential.

Methods used to monitor the oestrus cycle in order to optimise the time of breeding in the bitch

The methods employed in determining the time of ovulation in the canine oestrous cycle include assessment of behavioural changes, vaginoscopic observation of physical changes in turgidity (turgor) of the vaginal vestibulum, changes in the vaginal fluid, assessment of cytologic changes of the vaginal epithelium (SCI), changes of vaginal folds (angularity of folds) and hormone assays.

Behavioural signs of oestrus

Behavioural oestrus may not coincide with the fertile period and correlates poorly with endocrine events during oestrus. The average bitch may ovulate anytime from 2 days before to 6 days or more after onset

of behavioural oestrus. There is also considerable variation in the time of ovulation in relation to the onset first signs of pro-oestrus bleeding. The latter is frequently used as landmark in timing events by breeders.

Matings are then often performed on days 9, 11 and 13 or longer following first sign of pro-oestrus. This approach lacks precision, may often fail and is wasteful on the use of the stud or semen. Failure to breed in the fertile period and poor ovulation timing is considered one of the most common cause of failure to conceive. Furthermore, dominant bitches may never exhibit standing heat whilst some bitches in confirmed peak oestrus may indeed resist mating by an individual male whilst accepting another. Some submissive bitches on the other hand may allow mounting even when not in oestrus. The notion which breeders have that their stud can smell out a bitch that is in "optimum heat" and thus in the optimum fertile period, is untrue.

The outward signs and physical changes during oestrus

Physical changes described in bitches include decreased vulvar turgidity at the onset of oestrus, decreased vulvar width at the time of the LH surge, change in colour of the vaginal discharge from serosanguinous to straw coloured at the onset of standing heat and changes in vaginal fluid pH, electrical resistance, glucose content and ferning patterns of the vaginal mucus all have limited clinical usefulness.

Vaginal cytology

Because there is poor correlation between onset of cytologic oestrus and ovulation it is concluded that cytology is not useful in breeding management to determine the optimal mating period. Vaginal cytology may be useful in confirming that the bitch suffers from a vaginitis or is in oestrus in cases of bitches exhibiting silent heat or sub-oestrus characterised by bitches exhibiting vaginal cornification with little else outward or behavioural signs of oestrus.

Vaginal cytology is however very useful in determining the onset of cytologic dioestrus (D0). This is the day on which the anuclear and superficial cells combined, decrease by at least 20% and the small intermediate cells and para-basal cells combined, increase to at least 10%. D0 is clinically significant as it occurs 6 days after ovulation with little variation. However, D0 only has retrospective value and is therefore of no use in optimising the timing of breeding in the bitch.

Vaginal speculum examination

Vaginal speculum examinations can be used to differentiate the oedematous, pillowy, rose pink vaginal mucosa of pro-oestrus from the dehydrated sharp-edged blanched mucosa of oestrus. The first sign of angularity of the vaginal folds occurs 2-4 days

after the LH peak, thus coinciding with the time of ovulation. Researchers have however alluded to the variable correlation between results of vaginoscopy and ovulation and therefore it is not considered accurate enough to time ovulation for use in frozen semen inseminations.

Despite this variability the main advantage of vaginoscopy is that it allows the clinician to identify the stage during which the bitch has oedematous folds, allows matings but could not have ovulated as yet. This may considerably reduce the length of time between first breeding and dioestrus and is even more useful in bitches with exceptionally long cycles. Therefore, to the experienced operator, vaginoscopy may be a useful tool to time breedings when fresh good quality semen is used. It is also very useful in guiding the experienced clinician when to start collecting blood samples for PC assay and when to stop doing so.

Although viewing images obtained by endoscopic photography or videos can aid in the interpretation of vaginoscopy, true competence is achieved by practice and guidance by a skilled operator. The normal variation observed in the fluid content and debris may confuse inexperienced observers.

Hormone assays

Hormone assay remains the most accurate measurement of ovulation time in bitches. The two hormones assayed are LH and progesterone. These hormones may be assayed using semi-quantitative commercial assay kits. Semi-quantitative assays narrow down the time of ovulation but for accurate results, quantitative results for progesterone are preferred.

LH assay by quantitative assay is not practical as few laboratories perform the test and it is difficult to assay. There is a semi-quantitative LH tests kit available locally which exhibited correlation with the estimated time of ovulation based on PC.

The short shelf life of the kit and short duration of the LH peak necessitates daily or even twice daily sampling and confirmation with PC. PC has been adequately correlated with significant key events in the canine oestrous cycle and is the most useful means to determine the optimum breeding time (fertilisation period).

Chronological relationship between key events in the canine oestrous cycle

Maturation of ova

In bitches, oocytes are ovulated as primary oocytes, which still need to undergo further maturation and expulsion of the polar body before they become secondary oocytes capable of being fertilized. This maturation process take approximately 48 hours.

Duration of fertility of dog ova and the fertilisation period versus the fertile period

The secondary oocytes, ready for fertilisation, remain viable for 48 – 72 hours before they degenerate and the cervix closes. The latter period is termed the fertilisation period and when sperm penetration does occur during this critical period fertilisation is complete.

The fertile period on the other hand is the time during which a mating or insemination can result in a pregnancy. In strict academic terms it may be stated that the fertile period is somewhat longer in cases where insemination takes place via direct intra-uterine means. This is so because some ova are still sometimes available for fertilisation after cervical closure. Insemination at this time is however not routinely advised because by then there are many aged ova and fertilisation of aged ova results in high rate of embryonal death and resorption.

The length of the fertile period may also vary depending on longevity of the semen used. Fresh semen of good quality has a longer life span (several days) whereas when frozen semen is used the sperm lifespan may be measured in hours. Poor quality fresh semen and chilled semen may also have shorter longevity and this will affect the duration of the fertile period and thus optimum time of breeding.

The longevity of the semen used as well as the accuracy of ovulation timing method used may also influence the number of breedings required to result in maximum conception rate. Incorrect timing may not only reduce pregnancy rate but also litter size hence reference to the more appropriate term "conception rate" which refers to fertilisation of all the available viable oocytes.

Longevity of fresh sperm in the reproductive tract of the bitch

Although sperm can remain alive in the reproductive tract of the bitch for 4–6 days and longer, they do so in diminished numbers. In contrast, large numbers of spermatozoa are consistently found in the oviducts (where fertilisation takes places) between 20–40 hours from breeding. Furthermore, for many stud dogs, their sperm may survive no longer than 1 or 2 days in the female tract. This is important because it gives us an indication that breeding should occur at the beginning of the fertile period and that intervals between matings should ideally be 48 hours (two days), even when good quality fresh semen is used.

Longevity of frozen sperm in the reproductive tract of the bitch

Frozen semen has a short survival time, probably not exceeding 12 hours, in the female genital tract following artificial insemination. This is important because it gives us an indication that breeding should occur at the beginning of the optimum time of

fertilisation with an interval of one day when using frozen thawed semen.

Capacitation of dog sperm after entering the female genital tract

Sperm capacitation in dogs occurs within four hours in dogs and sperm are therefore ready for fertilisation almost immediately. This is important because it shows that there should be no delay allowing for sperm capacitation in the dog necessitating breeding before the ova have matured.

Synchrony of ovulation

Ovulation in the dog is a synchronous affair and it may be concluded that ovulation in the bitch occurs over a period of not more than 24-36 hours with most completing ovulation within the first 12 hours. This is important because it shows that ovulation should be considered a single event and that there should be no delay allowing for the completion of ovulation.

Using progesterone to determine optimum time of fertilisation

Since freshly ovulated canine oocytes need to mature before fertilisation can take place and this process takes around two days and the mature ova remain viable for 48–72 h, it is evident that the start of the fertile period is at around 96 hours after the estimated LH surge or 48-hours after ovulation and that this period should last for around 3–4 days.

Since PC is correlated to these key events, it follows that PC can be used to time these critical events. PC can thus be used to determine the optimum time of fertilisation using absolute values or counting a finite number of days following the progesterone concentration having reached a specific threshold.

- **PC range at the day of the LH surge**

It is widely reported and accepted that the pre-ovulatory LH surge is associated with a progesterone concentration of 6.4 nmol/L. This time point has been used in a variety of ways to time managed breeding or insemination. It is important to note that following progesterone having reached the threshold of 6.4 nmol/L (rounded off to 6 nmol/L by many) there should be a continued rapid rise of progesterone in the days following this initial rise in order to confirm that ovulation is indeed imminent or has taken place. It is therefore very important that practitioners do not limit the number of progesterone assays to a single assay (see notes on number of assays performed).

- **PC range at the time of ovulation**

Ovulation is estimated to occur two days after the LH surge with PC ranging from 15.9 to 25.4 nmol/L at the time of ovulation. These results have been confirmed in studies using direct means of ovulation detection which found that progesterone reached 19 nmol/L and 16 nmol/L when ovulation occurred and that the

optimum time of fertilisation commences two days thereafter.

- **PC range at the onset of the fertile period**

The optimum time of fertilisation according to some authors is on the day and following the days that the progesterone has first reached 19–25 nmol/L. Another suggested that the optimum time of fertilisation was when progesterone concentrations increase to at least 32.0 nmol/L. It was suggested that to assure maximal chances of conception, using only one breeding or insemination with fresh semen, the best optimum time of breeding is two days following ovulation or two -days after progesterone reaches a concentration of 12.7–32 nmol/L. When using fresh semen of good quality, breedings should be continued every 48 hrs. Under these circumstances two or three breedings can be expected.

From the above ranges it is evident that the problem with using absolute values of progesterone in estimating the optimum time of fertilisation is that there may be considerable variation in the progesterone rise following the pre-ovulatory LH surge. This phenomenon is best borne out by the work performed by Kutzler et al (2003) that showed that the slope of the rise in mean PC after LH surge was significantly different between small and large body weight groups. Figure 1 below demonstrates the large variation of progesterone at diestrus.

Large individual variations in PC following the initial rise were also reported by others. For these reasons some workers suggest that critical breedings or inseminations should be planned between 4-6 days after the progesterone concentration exceeds, or is likely exceeded 6.4 nmol/L rather than using absolute values.

What is also evident from Figure 1 is that the onset of dioestrus cannot be clearly delineated by a specific progesterone value. It can be seen in Figure 1 that at d7 to d8, which coincides with onset of dioestrus, the PC can vary considerably. [Note that in Figure 1, PC is expressed as ng/ml. The conversion of progesterone units: 1 ng/ml = 3.18 nmol/L (rounded off to 3.20 in most publications), thus 2 ng/ml = 6.4 nmol/L].

Using the day that progesterone first exceeded 6 nmol/L to estimate the optimum time of fertilisation

Possible reasons for increased accuracy when using the day that progesterone first exceeded 6 nmol/L to estimate the optimum time of fertilisation, is because there is a better agreement in the literature as to the estimated concentration of progesterone at which the LH surge is estimated to occur.

Progesterone assays also have greater intra-assay and inter assay CV at values above 6.4 nmol/L. There is considerable diurnal variation in progesterone concentrations with levels being twice the value in the

evening as opposed to morning values, which may also play a more significant role at higher levels.

The first day of the oestrous cycle on which the concentration of progesterone exceeds 6 nmol/L was reported in a multiple sire trial that allows one to predict the days on which the highest fertility should be expected with the use of frozen thawed spermatozoa. These days were at d5, d6 and d7 after progesterone exceeds 6 nmol/L, with d6 and d7 being better.

Number of PC assays required to assess the oestrous cycle and decision making

Clinicians are often limited in the number of assays they are permitted to perform in order to monitor the oestrus cycle because the bitch owner may be concerned about cost, inconvenience and time constraints to keep on presenting the bitch. Also, some breeders will often deliberately or by happenstance present a bitch too late to allow for serial blood sampling and plotting a PC curve. In these cases, PC is still of value to stage the cycle and time events albeit somewhat less reliably. Experienced practitioners that are familiar with vaginoscopic examinations are also better equipped to correlate single progesterone results with clinical events. One of the most important reasons why a number of progesterone assays are required is to circumvent the following error.

Clinical experience shows that some bitches have a spurious rise of progesterone (sometimes as high as 6–9 nmol/L) occurring during oestrous followed by several days where the progesterone remains low (well below 6 nmol/L). This spurious rise may then be followed by a second but true rise above 6 nmol/L and subsequent immediate and steep continued rapid rise in the days thereafter. If the practitioner for instance had noticed the progesterone rising to say 8.4 nmol/L in such bitch and had only taken one single blood sample, their timing will be incorrect.

When the value of a single progesterone is around 20 nmol/L during oestrus or thereabouts, then the timing is likely to be more reliable and good results may be obtained when using fresh semen breeding. However, even under these circumstances, a single progesterone reading is generally not advised. For critical breeding's (compromised semen, chilled or frozen semen), the proper estimation the optimum time of fertilisation is best achieved using 3–4 progesterone assays or more that cover the key events of the LH peak, ovulation and onset of the fertile period. Again, experienced practitioners familiar with vaginoscopic examinations will be better able to delineate the time within the oestrous cycle wherein progesterone assays should be performed.

Interval between progesterone assays to monitor the oestrous cycle

The number of blood collections and days on which

these should occur is influenced by experience of the practitioner. Experienced practitioners are more likely to identify the stage of the cycle where the progesterone is likely to rise (and continue to rise) than less experienced practitioners. Less experienced practitioners are therefore advised to start collecting blood earlier in the oestrous cycle rather than later. During pro-oestrus and early oestrus, the progesterone level may remain close to basal up to around 3 nmol/L for many days (10 days or longer). At this stage the interval between collection may be extended to around four days. However as soon as the bitch starts to exhibit authentic signs of oestrus, then blood collection and assay should be performed no less than every second day. As soon as the progesterone has risen above 6 nmol/L then the practitioner may elect to collect blood daily or at least every second day to confirm a sharp and continued rise to 20 nmol/L or above.

Progesterone and pregnancy

The progesterone concentration increases to 47–286 nmol/L at 15–30 days after the LH surge and then gradually declines until it falls abruptly just prior to parturition or the end of dioestrus in the non-pregnant bitch. The progesterone profile of pregnant and non-pregnant bitches does not differ significantly. This excludes PC as a marker for pregnancy diagnosis in the bitch. However, progesterone is required for initiation and maintenance throughout the entire pregnancy in the dog. In dogs, a PC of 8.3 nmol/L is considered just above the threshold necessary to maintain a pregnancy in the bitch with 6.4 nmol/L being the threshold).

Although hypoluteodism is often suspected and treated based on history or suspicion, there are no conclusive case reports on luteal insufficiency during gestation in the bitch. Hypoluteodism is characterized by insufficient secretion of progesterone by the corpora lutea during pregnancy which may lead to loss of pregnancy (foetal resorption or abortion depending on whether it occurs in first half or second half of gestation). Serum progesterone should be monitored every 1 to 2 weeks in bitches with a history of pregnancy failure or luteal insufficiency. Supplementation of progestogens should be done with caution and discontinued before the expected parturition date to avoid prolonged gestation and foetal demise.

It is however interesting to note that although there is not an appreciable difference in serum progesterone concentrations between pregnant and non-pregnant bitches, there is a likely twofold or greater increase in progesterone production by the corpora lutea of pregnancy. This does not result in significantly higher serum progesterone than in non-pregnant bitches because of a large increase in plasma volume of distribution, increased metabolism of progesterone

by increased uterine, placental and mammary masses and increased liver clearance and excretion of progesterone and progesterone metabolite. There is however a significant increase in faecal progesterone metabolites during pregnancy which facilitates clear differentiation of pregnant versus non-pregnant animals after the second semester. It is noteworthy that this difference also occurs in other species of carnivores and is used to monitor and diagnose pregnancy.

Monitoring and or examining for the decline in progesterone can be an important tool in managing bitches with an apparent or presumed prolonged gestation.

Progesterone and parturition

Progesterone concentrations in the peri-ovulatory period has value in estimating predicted whelping dates. In one study it was found that the date on which PC first exceeded 5.7 nmol/L (approximately 6 nmol/L), predicted the day of parturition within ± 1 d, ± 2 d and ± 3 d with a precision of 67%, 90% and 100% respectively.

Gestation lengths based on time of the LH surge (synonymous with PC of ≈ 6 nmol/L), ovulation (15.9–25.4 nmol/L) and fertilisation (≈ 32 nmol/L) are respectively 65 days, 63 days, and 61 days with the latter two being less accurate.

It has been established that PC decreases prior to parturition. Identifying a threshold of PC below which all bitches are within a consistent and definable interval prior from the onset of spontaneous parturition is useful. Various studies report a PC of below 6.4 nmol/L indicated that most of the bitches studied were within 48 hours of onset of parturition. More recently it was found in a study including 25 bitches, that if PC is below 8.7 nmol/L, there is a 99% probability of the bitch reaching onset of spontaneous parturition within 48 hours and if the level is below 3.18 nmol/L the probability is 100% of reaching onset of spontaneous parturition within 24 hours.

There are however exceptions where some bitches may have levels below 6.4 nmol/L many days before parturition. It is these possible exceptions that act as an impediment to using a categoric progesterone threshold value as sole determinant in determining readiness for caesarean sections in the absence of clinical signs of impending parturition. This is because current knowledge suggests that fetuses born naturally or by CS within 48 hours prior to the expected time of spontaneous parturition, do survive without special assistance but survival beyond this 48 hour period is unknown and speculated to be impaired. Controlled studies that are sufficiently large to be convincing are required to confirm that it is safe to routinely perform a CS when the PC has

decreased to below a threshold such as 6.4 nmol/L or 3.14 nmol/L.

A PC threshold that alludes to the likelihood that a bitch is not within 12 hours of onset of spontaneous parturition is helpful in the management of parturition and risk assessment. Such threshold helps both breeders and clinicians to determine whether a bitch in late gestation is likely or not likely to enter spontaneous parturition or not and helps determining the need to observe the bitch overnight or not. In a small study of 25 bitches it was found that if PC was 15.8 nmol/L or above, the probability of onset of spontaneous parturition within the following 12 hours was less than 2%.

Paradoxically, there may be an unusually high PC at the onset of spontaneous parturition concomitant with a spurious very high rise in parturient cortisol in some bitches. It is speculated that such bitches would be easily identified as they would likely be obviously parturient with a dilated cervix but this phenomenon requires confirmation and further investigation.

Other uses of progesterone in the bitch

Progesterone and ovarian remnant syndrome

Ovarian remnant syndrome is defined as the presence of functional ovarian tissue in a previously ovariectomised bitch or queen. Ovarian tissue left in situ as a result of surgical error is the most common cause. A rare cause may be caused by revascularization of a piece of ovarian cortex dropped into the abdomen during surgery. This would constitute iatrogenic ectopic ovarian tissue and may be difficult to find during exploratory laparotomy. True ectopic congenital ovaries have not been reported in dogs and accessory ovaries have only been reported in cats, cows and humans.

A bitch or queen with ovarian remnant syndrome will show typical behavioural signs of oestrus. The canine adrenal gland does produce progesterone in response to ACTH but this is at insufficient concentrations to be detectable on routine hormonal assays and in spayed bitches the resting progesterone concentration is ≤ 0.7 nmol/L. When clinicians are presented with a spayed bitch in apparent oestrus, this should first be confirmed using vaginal cytology by demonstration of vaginal cornification. This should be done to exclude other causes of male attraction to the bitch erroneously leading the owner to believe that the bitch is in heat.

PC is considered to be simplest test to confirm the presence of active luteal tissue in the bitch. In ovarian remnant syndrome the progesterone should be measured when the bitch is considered to be in late oestrus or dioestrus, levels of 6.4 nmol/L or above are indicative of functional corpora lutea. However, for bitches with suspected ovarian remnant syndrome in

other stages of the oestrous cycle, assays for anti-Müllerian hormone (AMH) and LH should be used.

Failure to resolve ovarian remnant syndrome following exploratory laparotomy by even experienced surgeons is usually caused by failing to identify the functional ovarian tissue in the ovarian stump which may be either hidden or very small. In these cases it might be advised to remove the stump surgically and submit it for histopathology. If the source of the progesterone is ovarian tissue that transplanted itself during surgery it may be speculated that this may present a huge challenge to the surgeon as it may hide anywhere. Fortunately, this cause is exceptionally rare. GnRH agonists may also be used to treat ovarian remnant syndrome and has the advantage that it does not require anaesthesia or surgery.

If vaginal cytology confirms oestrogenisation but progesterone later fails to confirm active luteal tissue other sources of oestrogen should be considered. The possibility of oestrogen supplementation for post sterilisation urinary incontinence should be excluded as possible cause. Accidental ingestion of the owner's hormone replacement therapy, pregnancy prophylaxis medication or oestrogen containing creams may be a less obvious source of iatrogenic oestrogen leading to signs of oestrus.

Other miscellaneous uses of PC

PC may also be used to investigate; failure to cycle, cystic ovarian disease, pregnancy loss, anovulation, aberrant oestrous cycles, incomplete pre-parturient luteolysis, adrenal tumours, facilitate embryo transfer and other experimental work. These applications are considered rarer and outside the scope of the average clinician and will not be discussed.

Supplementary notes on interpretation of progesterone results in the bitch

The onset of dioestrus is best defined by vaginal cytology by determining the first day of cytological dioestrus often denoted as D1 or preferably D0. The onset of dioestrus cannot be delineated by a specific progesterone level (concentration) in the blood because the levels of progesterone varies too much at that time.

PC interpretations can become tricky when attempts are made to interpret single values with little or no clinical history prior to the day of sampling. This typically happens when bitch owner presents a bitch late in their oestrous cycle.

Assuming such bitch had a PC of 46 nmol/L there would be numerous plausible possibilities in this case.

- the bitch may be in overt early dioestrus and have a closed cervix and be no longer receptive.
- the bitch may be in the midst of the fertile period and ready for breeding. The experienced clinician however should not have a problem in distinguishing the two from another. The one bitch will have a vaginal cytology smear consistent with dioestrus and not show any vaginoscopic features or outward signs of oestrus, whilst the other will.
- the bitch may be in the midst of pregnancy or dioestrus with PC starting to decline. The onset of dioestrus is clinically important because it can retrospectively show that the breedings occurred at the correct or incorrect times, it provides an accurate date of the expected whelping date but

Summary on interpretation of progesterone results

Reference table for progesterone interpretations for bitches in heat or apparent reproductively quiescent bitches

Progesterone (nmol/L)	Likely events	Action
<3.2	Anoestrus or pro-oestrus.	<ul style="list-style-type: none"> • Retest in 3–4 days
3.2 – 6.4	Pro-oestrus and early oestrus Pre-LH surge	<ul style="list-style-type: none"> • Retest in 2 days
6.5 – 9.6	LH surge	<ul style="list-style-type: none"> • Retest in 2 days to confirm continued rise in progesterone • Aim for breeding 4–7 days after the rise above 6.4
9.7 – 15.9	Post-LH surge, pre-ovulation	<ul style="list-style-type: none"> • Retest in 2 days to confirm continued rise in progesterone • Aim for breeding 3–5 days after this date
16 – 25.4	At or near ovulation	<ul style="list-style-type: none"> • Retest in 2 days to confirm continued rise in progesterone • Aim for breeding 2–4 days after this date
25.5 – 32 and above	In fertilizable period	<ul style="list-style-type: none"> • Aim for breeding on this day and for another 2–3 days hereafter

Reference table for progesterone interpretations around the preparturient period in pregnant bitches

Progesterone (nmol/L)	Likely events and Action
> 15.8	<ul style="list-style-type: none"> Onset of parturition is likely 12h or longer away. Less than 2% of pregnant bitches with this PC are likely to enter spontaneous whelp within the following 12 h Places bitch at low risk for need for overnight parturition observation
<6.4	<ul style="list-style-type: none"> Most of the bitches will be within 48 h of onset of parturition Bitch owners have to be on high alert for next 48h
<3.2	<ul style="list-style-type: none"> All bitches are very likely within 24h of onset of spontaneous parturition Bitch owners have to be on high alert for next 24h

most importantly, it indicates that the bitch is no longer within the optimum period for fertilisation to take place.

It is common for clinicians to be sceptical about results as new assays emerge. Such clinicians will understandably compare the results of the new assay with one they are accustomed to. Upon discovering that there may not be perfect concordance, the clinician automatically deduces that the new test may be at fault. The error in this reasoning is that there may indeed not be a fault at all. With all assays there will be a degree of variation. This variation may be attributed to biological variation, diurnal variation, intra-assay variation on the same sample, and true inter-assay variation. The best way to test this is to run replicates for both assays on the same sample. This will highlight the variation in both tests and in many cases put their mind to rest.

Even when using so called "gold standard" progesterone assays to estimate the time of ovulation, there will still be some variation. This variation may be attributed to a variety of factors such as normal biological variation, intra-assay variability and imperfect correlation of ovulation to PC. This may be the reason why some workers concluded from their own work and that of others, that the pregnancy rate was higher if the bitch was bred more than once even when PC were used to time the fertilisation period. From this it may be speculated that there is possibly a margin of error to determine optimum time of fertilisation of around one day using hormone assays. A similar speculation is made in another review of the literature. For this reason, when using compromised semen, two inseminations with a 24 hour interval and each with an adequate number of progressively motile sperm is advised in order to get optimal results.

References available online: www.vetlink.co.za

CPD Questions AC/2274/19

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1. Which one of the statements regarding the reason breeders request timing of ovulation in their bitches using progesterone assays is INCORRECT?

- They believe it increases litter sizes and pregnancy rates
- It allows them to plan travel arrangements to distant studs
- It allows them to identify bitches that remain non-receptive to studs despite being in oestrus
- It provides estimates of the expected whelping dates
- It provides the breeder with an exact date when to have the C-section performed

2. Which one stage of the oestrus cycle listed below has progesterone as the dominant hormone?

- Pro-oestrus
- Oestrus
- Met-oestrus
- Dioestrus
- Anoestrus

3. Which of the following statements regarding the duration of the stages of the canine reproductive cycle is least correct?

- Pro-oestrus may range from 1 – 27 days
- Oestrus may range from 3 – 21 days
- Anoestrus may range from 2 – 10 months
- The oestrus cycle of the domestic dog is elastic
- Normal oestrous cycles are of equal duration

4. Which one of the statements listed below regarding the optimum time for fertilisation is CORRECT?

- Vaginoscopy combined with progesterone trend
- Observing the response of the stud to the bitch in oestrus
- Observing the response of the bitch in oestrus to the stud
- Counting the number of days starting at the first day that pro-oestrus bleeding was observed
- Vaginal cytology – SCI

5. Which one of the statements below regarding timing of ovulation is the CORRECT answer?

- a. Determining the LH surge
- b. Determining the oestrogen concentrations in the blood
- c. Determining the FSH
- d. Determining time that progesterone concentration exceeded 6 nmol/L and continued to rise thereafter
- e. Determining anti müllerian hormone levels in the blood

6. Which one of the following statements listed below is CORRECT?

- a. Canine oocytes are ready for fertilization immediately following ovulation
- b. Fresh and frozen sperm can be expected to survive equally long once in the female genital tract
- c. Freshly ejaculated dog sperm are ready for fertilization almost immediately
- d. Ovulation can occur over numerous days accounting for puppies of different sizes in litters
- e. Longevity of fresh sperm is so long that it negates the necessity to time breedings

7. Which one of the following lists of progesterone concentrations in the blood of the bitch correlates to key events in the domestic dog's oestrous cycle i.e. LH surge, ovulation and start of period where fertilisation is most likely, respectively?

- a. 6.4 nmol/L, 16 nmol/L and 30 nmol/L
- b. 16 nmol/L, 6.4 nmol/L and 30 nmol/L
- c. 30 nmol/L, 6.4 nmol/L and 16 nmol/L
- d. 30 nmol/L, 16 nmol/L and 6.4 nmol/L
- e. <1 nmol/L, 1–2 nmol/L and <6.4 nmol/L

8. Which one of the following statements regarding progesterone concentration and dioestrus in the bitch is CORRECT?

- a. Once the progesterone has exceeded a concentration of 32 nmol/L it can be safely assumed that the bitch is in dioestrus

- b. Progesterone concentrations at the onset of dioestrus vary too considerably to accurately ascertain a threshold above which will or will not be in dioestrus
- c. Progesterone concentrations in the blood during dioestrus can be used to determine pregnancy in the dog
- d. Progesterone concentrations have no value during dioestrus
- e. Progesterone concentrations in the blood are basal during dioestrus

9. Which one of the following statements regarding progesterone concentration in the blood during the preparturient period is INCORRECT.

- a. Threshold values for progesterone concentrations exist which allow us to categorically determine that a bitch is ready for caesarean section in the absence of other clinical parameters
- b. Progesterone thresholds have predictive value in the preparturient period in the sense that it gives the probability of onset of spontaneous parturition in bitches
- c. Parturient stress may influence progesterone concentrations
- d. Progesterone concentrations show a steady but variable decline towards onset of parturition
- e. Progesterone is essential in maintaining pregnancy in the bitch

10. Which one of the following statements regarding ovarian remnant syndrome in the bitch is INCORRECT

- a. Ovarian remnant syndrome cannot be diagnosed using progesterone concentrations
- b. Anti-müllerian hormone is useful in diagnosing ovarian remnant syndrome
- c. Progesterone concentrations of 6.4 nmol/L or above are indicative of functional corpora lutea and confirm ovarian remnant syndrome
- d. Progesterone assay may only aid diagnosis of ovarian remnant syndrome when the bitch happens to be in dioestrus.
- e. LH is useful in diagnosing ovarian remnant syndrome

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Lauren Sawyer, Golden Retriever breeder

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Placing Wound Soaker Catheters in Dogs

Marc Hirshenson, DVM, DACVS

A collaborative column between the American College of Veterinary Surgeons (ACVS) and dvm360 magazine

Not familiar with wound soaker catheters? You'll want to be. They are easy to place and remove and can simplify your local pain control regimen for some surgical patients. There's no doubt that the implementation of appropriate analgesic protocols is a vital component of both routine and specialised veterinary surgical care. Traditional nerve blocks with local anaesthetics are beneficial in decreasing systemic analgesic requirements of opioids and non-steroidal anti-inflammatory medications frequently used in the peri-operative and post-operative period. Local nerve blocks require technical expertise and additionally, these medications, namely lidocaine and bupivacaine, have relatively short durations of action.

Enter wound infusion catheters (also known as wound soaker or diffusion catheters), which deliver local analgesia to or around a surgical site by using repeated or continuous infusion. The use of these catheters in veterinary medicine has increased with better understanding of and focus on pain management in our patients. Wound soaker catheters are easily placed during surgery, assist in providing local analgesia for a prolonged period, and potentially decrease the need for systemic medications.

Instrumentation

In its simplest form, a wound soaker catheter is a pliable (often polyurethane) catheter that consists of a closed distal tip with small openings along the catheter length, allowing for diffusion of medication along a wound bed (Figure 1). An injection cap or intravenous (IV) administration set can be attached to the proximal end for drug administration.

You can make wound soaker catheters from red rubber or other polyurethane catheters, but other options are commercially available.



Figure 1: This commercially made wound soaker catheter consists of a closed distal tip, small openings along the catheter length, and a butterfly at the proximal tip.

Commercially available catheters are calibrated, allowing surgeons to know the volume of fluid retained within the catheter. Commercial wound soaker catheters are available in different lengths, allowing for placement in variably sized wound beds.

Indications

In my experience, wound soaker catheters are used most commonly during forelimb and hindlimb amputations. However, other procedures in which wound soaker catheters are used include thoracotomies, large mass removals and total ear canal ablation.¹

Placement

Step 1: Insert the catheter during wound closure (Figure 2). Place the distal tip of the catheter at the deepest layer of closure or desired layer of local anaesthetic administration.

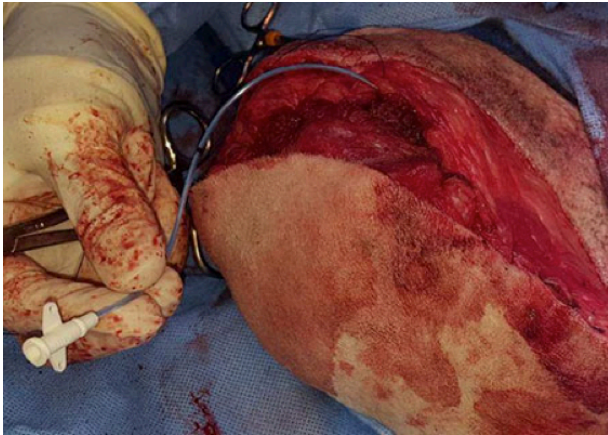
Step 2: Continue to close around the catheter, ensuring that all slits are below the skin surface (Figure 3). Pay attention not to suture the catheter to deeper layers.

Step 3: Secure the catheter using a purse string suture and finger trap suture pattern. Commercially available wound soaker catheters have a butterfly at the proximal tip to allow for suturing to the skin and additional support.

Step 4: Cover the exit site with an adherent bandage or soft padded bandage, depending on the placement site.

Step 5: Place an injection port to allow for easy administration of medication. Administer a priming and filtering volume at the time of placement (per specifications supplied with each manufactured catheter).

Step 6: Place an Elizabethan collar on the dog.
Tip: I strongly recommend labelling the patient chart, as well as the cage or run, with reminder signs to



Step 2: Continue to close around the catheter, ensuring that all slits are below the skin surface (Figure 3). Pay attention not to suture the catheter to deeper layers.

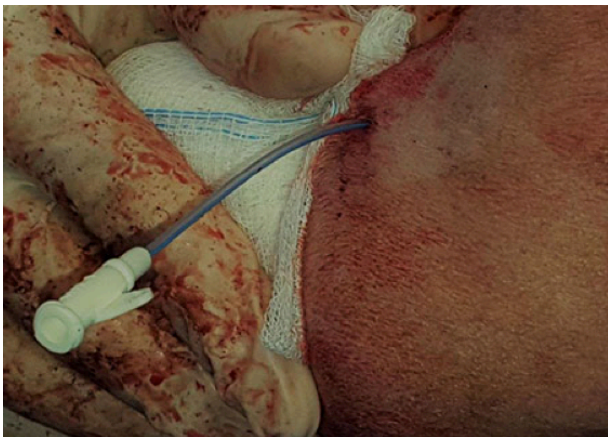


Figure 3. Close around the catheter, ensuring that all slits are below the skin surface.

ensure that administration of local anaesthetic is through the catheter and not the IV.

Analgesia administration

Local anaesthetics can be administered through intermittent (bolus) injection or constant-rate infusion. I prefer intermittent injection with bupivacaine, but lidocaine can be given as a constant-rate infusion (approximately 2 mg/kg/hr).

I recommend approximately 1-1.5 mg/kg bupivacaine every 4 to 6 hours for dogs. That dose can then be diluted to 0.25% with saline or sterile water to allow for increased volume. Small patients may require

additional dilution of drug to ensure all medication exits the catheter or covers the entire wound bed. Limb amputations typically require dilution to ensure adequate dispersion across the wound bed, while thoracotomy procedures may require minimal dilution. Local analgesic can be administered through the catheter for at least 24 hours or longer as indicated. *Note: Wound soaker catheters can be placed in cats. I recommend giving 0.5 mg/kg bupivacaine intermittently for feline patients.*

Removal

Removing a wound soaker catheter is simple. Just cut the skin sutures and apply gentle traction.

Complications

Potential complications of wound soaker catheters include seroma, edema, local anesthetic toxicosis, infection or accidental premature removal. One study found no increase in incisional infections in patients receiving wound soaker catheters.²

Conclusion

Wound soaker catheters may provide an additional means of analgesia for surgical patients. They can be placed easily with minimal additional surgical time, while potentially decreasing the need of high doses of systemic medications, especially in patients where these medications are contra-indicated.

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The ABCs of Veterinary Dentistry

'T' is for Treatment

While therapy for oral health problems can be challenging, it's also very important for patient wellbeing. A good place to start? The four Rs: recheck, remove, repair or refer.

Jan Bellows, DVM, DAVDC, DABVP, FAVD

Halitosis, malpositioned teeth, oral tumours, fractured teeth, oral ulcers, swellings under the eyes—what to do? For many veterinarians, treatment is the most challenging aspect of dentistry due to the needs for client consent, specialised equipment, time and training.

It's often simpler to overlook dental pathology—but it's not right for the patient, client or practice. We became veterinarians to relieve suffering, and providing dental therapy followed by prevention ensures the best for our patients. In addition, seeing our patients' lives improve and sharing the bliss of their owners' appreciation contributes to the joy of veterinary dentistry.

A straightforward approach to dental treatment is well within the scope of general veterinary practice. Most dental therapy strategies fall into one of four buckets, or the four Rs: Recheck, remove, repair or refer.

Let's look at each of these in turn.

1. Recheck the patient

It can be hard to do nothing when you discover an abnormality, but sometimes it's in the patient's best interest.

The decision to follow up and recheck an oral health problem rather than actively treat it should be based on whether the abnormality is nonfunctional (actively treat) versus functional (recheck), progressive (actively treat) versus nonprogressive (recheck), and painful (actively treat) versus nonpainful (recheck).

2. Remove teeth or oral masses

Fortunately, domesticated dogs and cats do not need teeth to survive. What they need is a healthy, pain-free mouth. In addition to dental scaling and polishing, extractions are the primary treatments we provide to dental patients. Often by the time we see dogs and cats with advanced dental disease, the teeth should not be saved; removing them usually resolves the problem effectively. Oral masses, including gingival enlargement, can also be treated through complete or partial removal. Benign masses generally will not recur after at least 1-cm clean surgical margins in all directions have been achieved. With malignant masses, 2-cm margins are recommended.

3. Repair the lesion

Some oral lesions can be repaired rather than being removed. Examples include sealants used to treat enamel hypoplasia, light-cured acrylic resin to repair enamel defects, and CO2 laser treatment of oral ulcers.

4. Refer to a veterinary dentist

Patients requiring advanced dental procedures can be referred to a dental specialist. Before you make the referral, it's best to call the dental specialist personally to explain what the patient is being referred for, whether preanaesthetic laboratory results and radiographs will be accompanying the patient, if it's OK for the specialist to evaluate (and treat) the entire oral cavity in addition to the specific referred issue, and whether you prefer to handle the follow-up rechecks

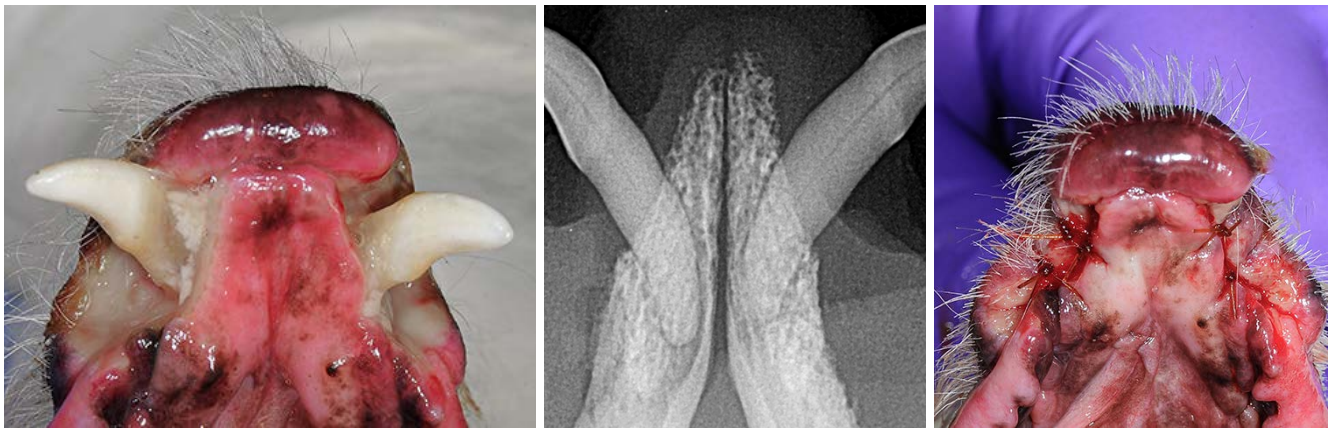


Figure 1. (A) Stage 4 advanced periodontal disease affecting the mandibular canines in a dog. Extractions are indicated. (B) Radiography confirms advanced periodontal disease. (C) The dog's postoperative appearance. (All photos courtesy of Dr. Jan Bellows).

or wish the specialist to do them both in the short and long term. This phone call also makes the client feel more comfortable about the process.

Be specific. For example:

- You want the specialist to treat the immediate problem and not address any other dental issues. You want to see the patient back as soon as possible. Or ...
- You want the specialist to treat all dental issues found and follow up until they are completely resolved. You expect to see your patient back to continue all future routine dental care. Or ...
- You want the specialist to take care of all current and future dental issues. You do not have the necessary equipment or are not comfortable performing dental procedures.

The four Rs in the trenches of daily practice

Here's how the four Rs might play out with some of the common oral health scenarios veterinarians face in general practice.

Periodontal diseases

Periodontal diseases are the most common maladies affecting dogs and cats. They are more common than gastrointestinal, dermatologic and orthopedic diseases combined. The treatment decision can be funneled down to one concept—if a tooth does not have at least 50% solid bone and/or gingival support as evidenced by mobility, probing, intraoral radiographs or some combination of the above, it's best to remove it (see Figures 1A to 1C).

Teeth with greater than 50% support and periodontal pockets can be repaired with root planing plus or minus locally applied antimicrobials (see Figures 2A and 2B) and stringent home care. If gingival recession is the cause of the support loss, locally applied antimicrobials are not indicated.

These treatments should be followed with recommendations for daily preventive care such as

toothbrushing, wiping, and use of products accepted by the Veterinary Oral Health Council (VOHC). If the client cannot commit to daily home care, removal of teeth with less than 50% support loss may be necessary.



Figure 2A. Stage 2 early periodontal disease with bleeding on probing.



Figure 2B. Treatment- Local antimicrobial administration after root planing.

Tooth resorption

External tooth resorption is a common finding in our patients thanks to detection on intraoral radiographs performed during professional oral assessment, treatment and prevention (oral ATP) visits. When the resorption visibly or radiographically extends into the oral cavity, the treatment decision is easy: remove. (see Figures 3A to 3C)

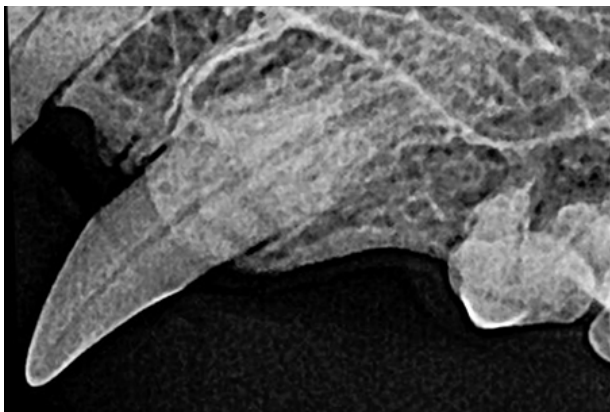


Figure 3A. Marked root resorption affecting a cat's left maxillary canine tooth; extraction is indicated.



Figure 3B. Root resorption of a dog's left mandibular fourth premolar extending to the oral cavity; extraction is indicated.



Figure 3C. Right and left maxillary canine root resorptions extending to the oral cavity; extractions are indicated.

Tooth resorption isolated below the gingiva is not considered to be painful and can be followed through rechecks (see Figure 4) or proactively extracted. Internal root resorptions (Figures 5A-E) are treated either with extraction or root canal therapy. Those rare cases with root replacement resorption (type 2) as evidenced by decreased root opacity can be treated with crown reduction followed by gingival closure.



Figure 4. Root resorption of a cat's right maxillary canine radiographically confined below the gingiva; follow-up is indicated.



Figure 5A. Clinical appearance of a canine tooth with Type 2 root replacement resorption.



Figure 5B. Root replacement resorption (type 2) confirmed radiographically.

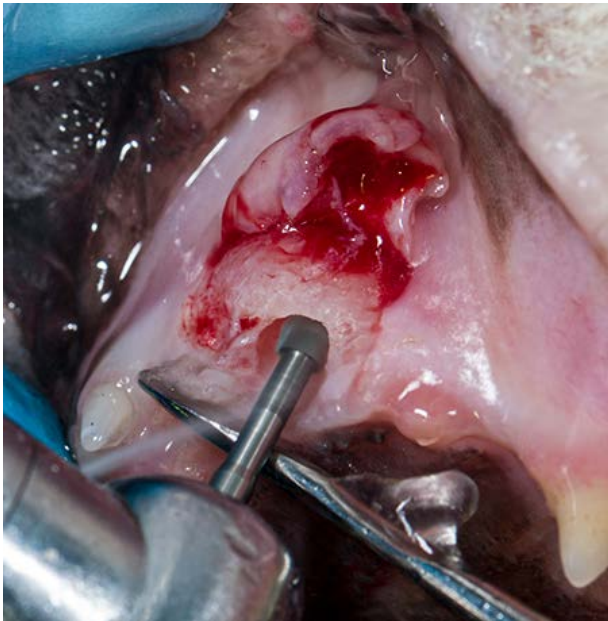


Figure 5C. Type 2 resorption treated by crown reduction.



Figure 5D. Gingival closure.

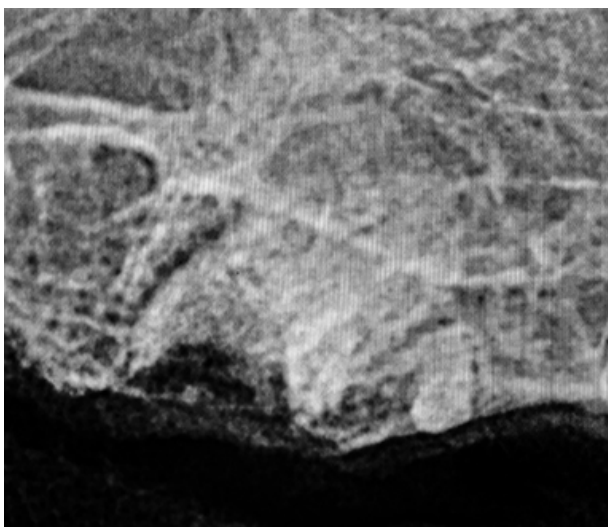


Figure 5E. Postoperative radiograph confirming proper crown reduction.

Orthodontic diseases

Occlusion is the contact between the masticating surfaces of the maxillary and mandibular teeth. Normal occlusion in dogs and cats occurs when the mandibular teeth reside just lingual to the maxillary teeth and the mandibular incisor cusps rest on the cingulum on the palatal side of the maxillary incisors. In addition, the mandibular canine crowns should lie equally between the maxillary third incisor and maxillary canine. The mandibular premolar crown tips should point to the interproximal spaces between the crowns of the maxillary premolars. Each mandibular premolar should be positioned rostral to the corresponding maxillary premolar. Dogs and cats with normal occlusion generally do not have bite-related problems.

Abnormal occlusion is any presentation other than that described above. This concept creates controversy with some breeds in which mandibular mesiocclusion (underbite) is considered normal (for the breed) but is often is not a healthy bite. Mandibular distocclusion (overbite) is never considered normal.

Dogs and cats with abnormal occlusions (even if normal for their breed) need to be closely watched for tooth-to-tooth and tooth-to-gingiva dental trauma (see Figure 6). In cases where abnormal occlusion cause oral trauma, the offending tooth or teeth need to be removed (Figures 7A to 7D) or moved (Figures 8A to 8D).

Ed. note courtesy of Prof. G Steenkamp:

Fig 8(A) shows a deciduous R mandibular canine tooth. There is limited space for the permanent mandibular canine tooth between the maxillary canine tooth and the 3rd incisor tooth. The permanent R mandibular canine will be medial to the deciduous tooth. Fig 8(C) orthodontic movement of the R maxillary canine caudally in order to create space for the mandibular canine tooth.



Figure 6. Left maxillary canine located rostral to the mandibular canine--abnormal but functional occlusion; rechecks are indicated.



Figure 7A. Left mandibular second incisor positioned in front of the maxillary incisor; removal of offending tooth is indicated.



Figure 7B. Removal of the mandibular incisor, eliminating malocclusion



Figure 7C. Marked mandibular disocclusion resulting in the mandibular incisors and canines impinging on the maxilla.



Figure 7D. Appearance after healing.

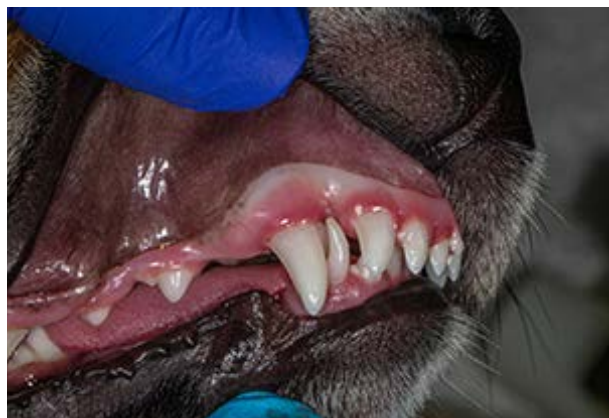


Figure 8A. Right maxillary canine penetrating the maxilla



Figure 8B. Palatal penetration from the malpositioned right mandibular canine.



Figure 8C. Moving the right mandibular canine tooth into functional position with orthodontic buttons and elastics.



Figure 8D. Functional occlusion created in four months.

In some cases of nonfunctional orthodontic disease, instead of removing the entire offending tooth, part of the crown is removed (crown reduction) then restored, which eliminates the local trauma and saves the tooth.

Endodontic diseases. Fractured teeth abound in our canine and feline patients, with the canines and carnassial teeth most commonly affected. When an affected tooth lacks periodontal support, removal is indicated. If an affected tooth has good periodontal support, treatment with either vital pulp or root canal therapy is indicated. Generally, referral to a dental specialist is necessary in these cases.

Endodontic care is largely dictated by the clinical and radiographic extent of disease at presentation, the age of the patient, and the age of the fracture. Here are some guidelines:

- Uncomplicated fractures in young animals: Restore the tooth with light-cured composite or a metallic crown.
- Uncomplicated fractures in older animals. Often no treatment is indicated if the animal is not prone to injure the tooth further.
- Uncomplicated crown-root fractures: Above steps plus care to remove the periodontal pocket; gingivectomy.
- Complicated fractures in young animals: Acute—extract or perform vital pulp therapy; chronic—

extract if root canal therapy cannot be performed with a good prognosis.

- Complicated fractures in mature animals: Acute—extract or perform vital pulp therapy or root canal therapy; chronic—extract or perform root canal therapy (preferred).

Treatment workflow

Now that you know what to do, how can you fit it into the day? Much depends on how many tables and staff you have available. One approach is to perform cleaning, polishing, intraoral radiographs, probing and charting like human dentists and have the patient come back for needed treatment. The benefits of this approach include effective scheduling, discussion with the owner without pressure, and decreased initial anaesthesia time. Disadvantages include failure of client compliance, resulting in patient suffering due to undelivered treatment. At my practice, we do it in one sitting with a client call to explain what needs to be done once our diagnostics are reviewed.

The foundation of companion animal dental care is the tooth-by-tooth examination. Once dental abnormalities are discovered, think about the four R's—recheck, remove, repair and refer. Your patients (and their owners) will thank you.

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