Continuing Professional Development | Business Success | Clinical Skills

vet 360

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CPD Article

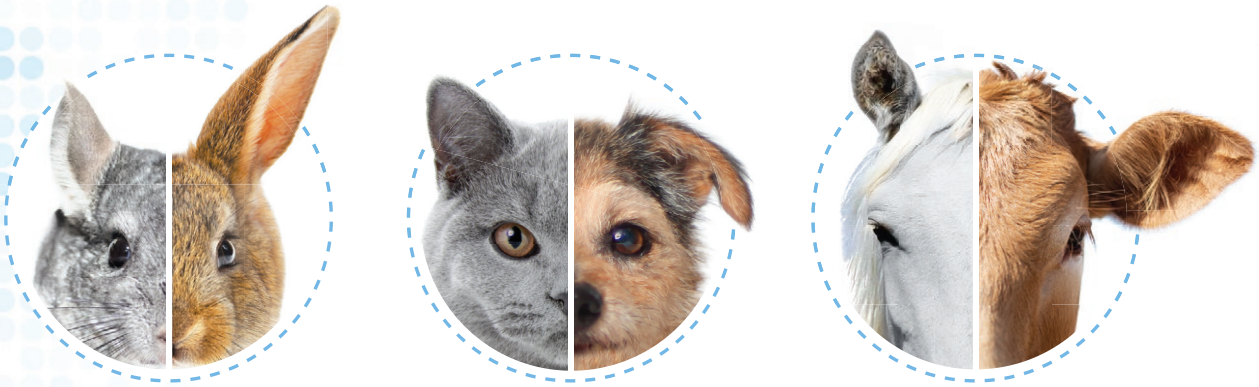
The Malformed Canine Heart

Opthalmology

Therapeutic Approach to Patients with Superficial Corneal Ulceration

HYPOCHLOROUS ACID

ADVANCED INFECTION MANAGEMENT



- Non-cytotoxic – shown to have beneficial effects on fibroblast and keratinocyte migration at low concentrations;[1,2]
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Editor's Note

Well, we are already knee deep into 2021 in the blink of the eye. There is more local talent in this edition with an article by Dr Ross Elliot regarding the choices to make when presented with a pelvic fracture - the "to operate or not to operate" question. I think it is quite clearly laid out for us all as to what the risks and benefits are. Dr Trudie Prinsloo-Van der Heever provided an article regarding restraint of trade and its enforceability, a query I often receive from students entering their first job. It is also really good to have an article from Dr Izak Venter. I wish him all the best for his new venture and even though it wasn't in his long term plan, I hope it is rewarding.

I would also like to propose a new offering in this magazine - where we publish one or two questions from the readers and I will get answers from experts in the field. This way I hope to address some of the problems you may be experiencing or questions you may have - which are always shared by other people as well . This will not be in "real time" so is not to be used to help solve a current case.

Looking forward to your feedback and all the best for 2021

Liesel

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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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How Baby Boomers and Millennials View Leadership

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> **The key to successful leadership today is influence, not authority**
>
> *Ken Blanchard*

Today's workforce looks different than it did twenty or thirty years ago. Maybe even drastically so. The ubiquity of the digital revolution, including omnipresent Wi-Fi, smartphones, social media and yes, even emojis, has forever changed the way that we communicate with each other and the way that we communicate with other generations as well.

While you might consider these changes a natural or even inevitable byproduct of accelerating technology, it's important to understand what these changes mean to the United States two largest populations, and thus, the core of your veterinary practice's business.

Only recently, Millennials (those falling into the age range between 18 and 34) have surpassed Baby Boomers (those falling into the age range between 51 and 69) in overall population. It's important to remember that these numbers are consistently in flux, based on a myriad of factors such as population projections, mortality and even immigration. But regardless of changing figures, this ultimately means that more Millennials and Baby Boomers are encountering each other in the workplace, and perhaps viewing the same exact scenarios in very different ways, according to their worldview. This post aims to tackle the complicated topic of intergenerational gaps and leadership in the workplace, hoping to shed more light on how these two demographics view the concept of leadership, and how important this theme is to them in the first place.

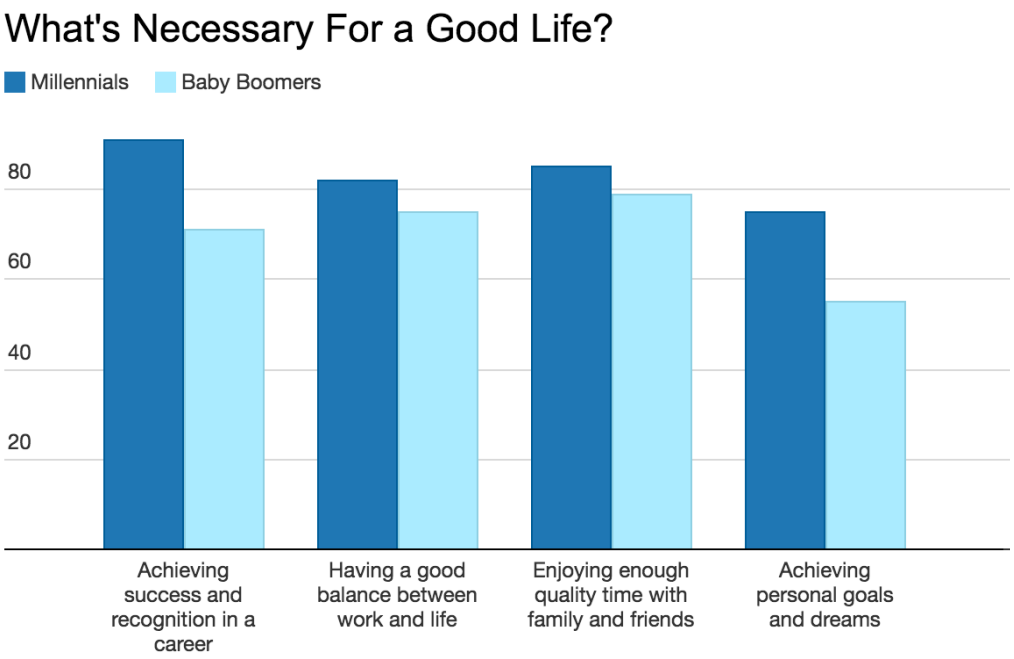
A study from the Leadership and Organization Development Journal describes Baby Boomers as hard working, loyal to their employer and generally accepting of the established chain of command. This short but revealing description shows us a more traditional view of the workforce, where consistency and employer loyalty leads to a satisfying career.

Millennials on the other hand, no longer see this path as clearly-cut as previous generations did. A sponsored study published by The Atlantic showcases that Millennial populations may actually have the exact opposite mentality on workforce loyalty. This study cited that 60 percent of Millennial workers leave an employer within three years of being hired. It also provides the following quote to summarise its findings:

"Millennials do not believe that productivity should be measured by the number of hours worked at the office, but by the output of the work performed. They view work as a 'thing' and not a 'place'. [...] Long hours at the office and status quo work-life tradeoff weren't working for young workers; they wanted more flexibility, so they went looking for it."

It's clear that the flexibility awarded by the Internet has rubbed off on the Millennial populace, whereas Baby Boomer generations maintain their notions of the workplace from the height of their careers, before the 'online' reality was quite as ubiquitous as it is now. Just take a look at the poll below, which helps to rank both Millennial and Baby Boomer perspective on what's necessary for living a "Good Life" (which within itself, is likely to be perceived very differently from one person to the next, let alone generation). While the results don't seem to be extremely different at first glance, the trend of Millennial importance on themes of self-actualization and self-fulfillment is consistent throughout and outweighs Baby Boomer's desire for self-gratification across each category.

But regardless of the flexibility Millennials desire, it looks like their own preferences often puts them at odds with the independence they crave. In fact, a study by the INSEAD Business School based in Fontainebleau, France found that 74 percent of Millennial professionals cite stress as negatively associated with leadership.



Source: National Journal-Allstate Heartland Monitor Poll

This correlates to similar data they found while polling younger populations in Italy.

This means that while Millennials may crave independence and even seek this above actual compensation, they may be averse to positions of leadership that could actually grant them this same independence. Associating leadership with stress may give us some insight into the Millennial perspective, where hierarchy once thought of as common now may skew toward themes of agitation. The notion of being toward the top of the chain of command, and thus a leader, is viewed as too stressful by the majority of Millennials polled in the study's findings from over 18,000 working professionals and students internationally.

This is especially notable when juxtaposed with a study published in the Journal of Diversity Management, which finds that Baby Boomers tend to have positive associations regarding authority and hierarchy, and also tend to be optimistic, driven and team-oriented. Baby Boomers also have traits that have been heavily influenced by the Civil Rights movement, Vietnam, and other significant political and cultural events of their time. Often, this results in a demographic that is willing to respect authority, as long as their opinion is considered within the decision-making process.

It seems that while there are real differences between these two particular generations, the real task may lie in not simply identifying the distinctions between Millennials and Baby Boomers, but instead by bridging the gaps between them. The INSEAD study concludes with the following sentiment:

"Most importantly of all, leaders should make an effort to unearth intergenerational gaps. Not only do these gaps highlight potential fissures across the generations, they also uncover insights that can help organizations lead their workforces more effectively and compete for the next generation of talent."

The intelligence of this conclusion is twofold.

First, the ideological differences between generations are the collective result of massive differences in worldview, compounded with the exponential change in technology and modern living that each generation has experienced. It's simply more productive to place the emphasis on bridging the gap and easing potential fissures in style, communication and interpersonal differences that may arise as a result, than to pretend they don't exist.

Second, these differences aren't going anywhere. Instead, they will change. Soon enough, Generation Z, the generation born from 1994 onward, will become an increasingly prevalent force in the workplace, and with it, they'll bring their own nuances, preferences and set of expectations.

The best thing that we can do for each other, and perhaps for ourselves, is to bring an open mind to intergenerational scenarios and work to smooth communication wherever possible.

The fact that the needs and wants of new generations are evolving and changing may even be looked at as advantageous. Some might ask, for our society to truly progress, shouldn't tomorrow's future always look different than yesterday's?

NOTE: The IVPD will welcome Eric Garcia back in October 2021 (Virtual). Date and more information to be given through in the next issue.

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The Malformed Canine Heart

Joan Capuzzi, VMD

Congenital defects that affect the canine heart have hallmark signatures traceable on puppy examinations. Understanding the subtle differences in how they present enables the veterinarian to bring clarity and hope to a dog born with a faulty heart.

Understanding normal cardiac anatomy and physiology is the foundation for flagging heart defects in young dogs, according to Kelly Wiggen, DVM, a cardiology faculty member at the University of Missouri Veterinary Health Center in Columbia. During a recent Fetch dvm360® virtual conference session, Wiggen reviewed the normal structure and function of the canine heart, described the clinical fallout of mishaps in its formation or maturation, and addressed treatment plans for afflicted dogs.

The pumping mechanism

The left and right sides of the heart each have 2 chambers—the atria and the ventricles. The left atrium collects oxygenated blood from the pulmonary veins and directs it into the left ventricle through the mitral valve. The left ventricle pumps this fresh blood through the aortic valve into the aorta and out into general circulation.

The right heart handles deoxygenated blood. The cranial and caudal vena cavae return used blood to the right atrium, which then directs it through the tricuspid valve into the right ventricle. From here, it is pumped into the pulmonary artery through the pulmonary valve and then into the pulmonary vasculature, where it picks up more oxygen.

Normal systemic blood pressure is 120/80 mm Hg. The systolic number, 120, represents the pressure generated by the left ventricle to deliver fresh blood out to the body. What enables the cardiac pump to function are pressure differentials between the heart and great vessels, as well as between the cardiac chambers themselves. Blood is pumped down pressure gradients through valves that open and snap shut, correlated with the heart sounds.

Heart murmurs

The pulmonic and aortic valves are atop the heart, near its base. The tricuspid and mitral valves reside closer to the sternum, at the apex. To listen for their normal sounds, as well as murmurs associated with blood regurgitation or turbulence from inborn heart defects or damaged valves, Wiggen recommends auscultating 5 regions on the dog:

Left axilla: Continuous murmurs associated with patent ductus arteriosus (PDA)

Left heart base: Normal sounds from pulmonary and aortic valves; systolic murmurs associated with pulmonic stenosis (PS) and subaortic stenosis (SAS), tetralogy of Fallot, and physiologic variations from fever, anaemia, or excitation; diastolic murmurs, usually due to a leaky valve

Left cardiac apex: Normal sounds from mitral valve activity; systolic murmurs associated with mitral valve dysplasia (puppies) and degenerative mitral valve disease, endocarditis, or dilated cardiomyopathy (older dogs); diastolic murmurs connected to mitral valve stenosis

Right heart base: Systolic murmurs from ventricular septal defect (VSD)

Right cardiac apex: Normal sounds from tricuspid valve activity; systolic murmurs associated with tricuspid valve dysplasia (puppies) and degenerative

Heart murmur grades

Grade 1:	May be intermittent, heard only in quiet setting
Grade 2:	Subtle, focal murmur with no radiation
Grade 3:	Audible in multiple spots, has point of maximal intensity
Grade 4:	Radiates, no point of maximal intensity
Grade 5:	Has a palpable thrill
Grade 6:	Audible even with stethoscope off chest

mitral valve disease, endocarditis, or dilated cardiomyopathy (older dogs); diastolic murmurs connected to tricuspid valve stenosis

Murmurs, if found, are graded from 1 to 6.
To match a murmur to the pathology, investigate the location where it's loudest, its cardiac cycle phase, and related femoral pulse quality. For instance

- PDA advertises itself with a continuous murmur that is loudest at the left axilla, and bounding pulses.
- SAS and PS are linked to systolic murmurs loudest at the left heart base. PS typically has normal pulses, whereas pulses can be weak in patients with SAS.
- A VSD would be loudest at the right heart base, and congenital defects of the mitral and tricuspid valve would be heard at the left and right apex, respectively.

A murmur does not always mean a heart defect; some murmurs are innocent. How do you tell them apart? Benign murmurs, typically can be heard only at one small spot, are usually limited to early or mid-systole, and can change with excitement.

Likewise, she added, a heart defect doesn't always mean a murmur.

The physical exam combined with the signalment can steer the practitioner toward the disease process. For instance, a 6-month-old golden retriever with a murmur likely has SAS. A 6-month-old Chihuahua, on the other hand, is a strong candidate for PDA.

The most common heart defects

PDA

The most common congenital heart defect in dogs is a PDA. Here, the ductus arteriosus—a vessel that connects the pulmonary artery and aorta in the foetus, enabling blood to bypass the non-functional lungs—fails to close at birth. As a result, some of the oxygenated blood gets dumped back into the pulmonary artery rather than into the systemic circulation. This left-to-right shunting causes left-sided volume overload and subsequent left-sided congestive heart failure (CHF).

PDA often affects smaller breeds, particularly Havanese, toy poodles, Maltese, Yorkshire terriers, and Chihuahas. However, it can also be seen in larger breeds, such as shelties, collies, and German shepherds. It also occurs more commonly in females than males and more in dogs than cats.

Puppies with PDA are often asymptomatic, although they may be smaller and quieter than their littermates. They typically have low diastolic pressures, causing bounding femoral pulses, and a continuous murmur.

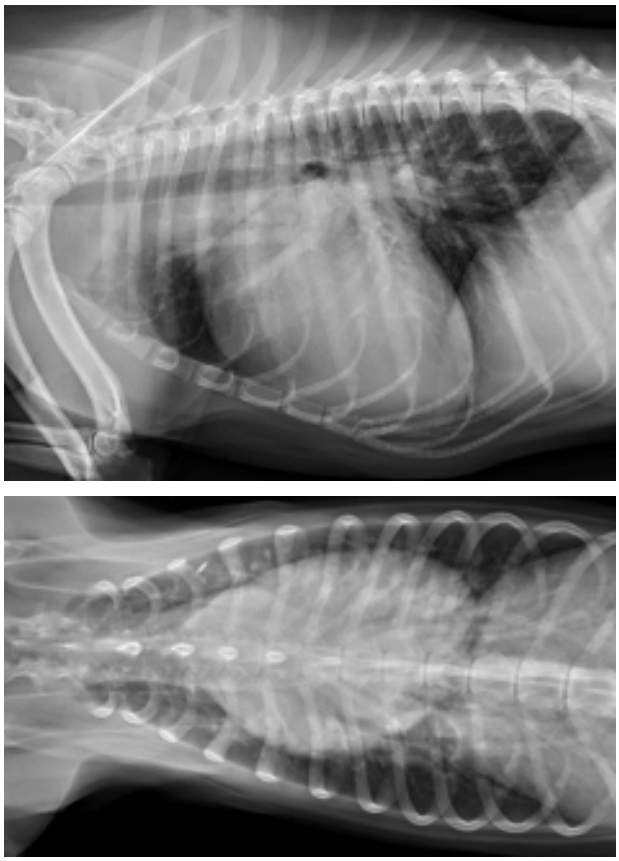

Fig. 1 - Patent ductus arteriosus

Electrocardiography can reveal evidence of left-sided chamber enlargement. Radiographs often show left atrial and ventricular expansion, as well as dilated pulmonary arteries and veins and a bulging aorta, main pulmonary artery and auricles (Fig. 1).

Suspected PDA cases are best referred to a cardiologist for confirmation of the diagnosis.Other potential heart defects must be ruled out because they may change the prognosis or the ability for the PDA to be fixed.
Two treatment options exist for PDA.

Option 1 is to close off the vessel with an occluder device, which carries a lower risk for embolisation and infection. Option 2 is surgical correction via Later diagnosis thoracotomy, which risks fatal haemorrhage and persistent flow through the PDA. Wiggen prefers the occluder device but noted that it is only available for patients with an average weight of about (2.7 to 3 kg), and for PDAs of certain structure.

Whatever method is chosen, early closure carries an excellent prognosis. PDA is one of those congenital diseases where we can actually fix the cardiac problem rather than just palliating their disease,

Later diagnosis produces poorer results, however. By age of 1 – year two-thirds of affected dogs have developed left-sided CHF. Nevertheless correcting PDAs in these patients is still recommended because doing so still often extends their life by years.

Subaortic stenosis (SAS) and pulmonic stenosis (PS).

The next 2 inborn cardiac flaws, SAS and PS, are tied for second most common. SAS occurs at the left side of the heart, below the level of the (aortic) valve. PS happens on the right, at the level of the (pulmonary) valve. Despite their different locations, the pathologies are similar.

"It's the same phenomenon as if you take a garden hose and started moving your finger over the end," Wiggen explained. "The more you move your thumb over it, the faster that water is going to have to flow. That's what's happening in the heart."

The greater the narrowing, the worse the obstruction, and the harder the heart must pump. The chambers thicken in response, yet the myocytes outgrow their vascular supply, leading to myocardial ischaemia and fibrosis, conduction disturbances, and eventual CHF. With pulmonic stenosis, the valves themselves can be dysplastic as well.

SAS is more common in large breeds. Because it is progressive up to when a dog is fully grown, a murmur may not be present at the first puppy visit. PS usually affects small breeds and bulldogs, is not progressive, and is more likely to manifest at the initial puppy exam. Both conditions are usually asymptomatic, but dogs with SAS may display left-heart failure signs, such as coughing and respiratory distress. Dogs with PS show right-heart sequelae, such as abdominal distention from ascites.

A heart base systolic murmur accompanies both diseases. Femoral pulses are generally weak in dogs with SAS but normal in dogs with PS. Radiographs for the former show left heart enlargement and a prominent aorta (Fig. 2) and, for the latter, right heart enlargement and a dilated main pulmonary artery (Fig. 3). On electrocardiography, dogs with SAS can have wide P waves and tall R waves, indicative of left atrial and left ventricular enlargement, respectively. Patients with PS can have tall P waves and deep S waves, reflecting enlargement of the right heart chambers. For both conditions, echocardiograms may reveal chamber thickening, blood flow obstruction, increased flow velocity leaving the heart, and valves that are leaky. A narrowing is often visible below the level of the aortic valve in the case of SAS, and poorly mobile or abnormal leaflets are visible with PS.

Both diseases are graded based on pressure generated by the affected ventricle, based on echocardiographic measurements of flow velocity Mild and moderate cases are often clinically silent, do not require treatment (except beta blockers in some cases of moderate PS), and carry an excellent prognosis.

Dogs with severe SAS are at risk for left-sided CHF and

Fig. 2 - Subaortic stenosis

sudden death before age 5. They may be prescribed beta-blockers (eg, atenolol), which decrease the rate and force of contractions. Balloon valvuloplasty may improve clinical signs, but neither this nor medication has been demonstrated to improve survival time.
Dogs with severe PS are at risk for right-sided CHF and sudden death. These patients benefit from beta-blockers and balloon valvuloplasty.

Other birth defects

Other heart malformations occur less commonly. Tricuspid valve dysplasia, to which Labrador retrievers are predisposed, boosts right atrial pressure, resulting in jugular vein distention and pulsation, hepatomegaly, and ascites. A right apical systolic murmur may be heard on puppy exam. This condition is usually managed medically. Mitral valve dysplasia, an uncommon anomaly that affects strikes bull terriers preferentially, causes left heart failure. Its attendant signs are respiratory distress, cough, tachycardia, and hypothermia. A left apical systolic murmur accompanies this condition, which also is treated medically.

Puppies born with a VSD, a hole in the septum between the ventricles that allows blood to pass from the left to right side of the heart, experience left-sided volume overload. Auscultation reveals a left basilar systolic

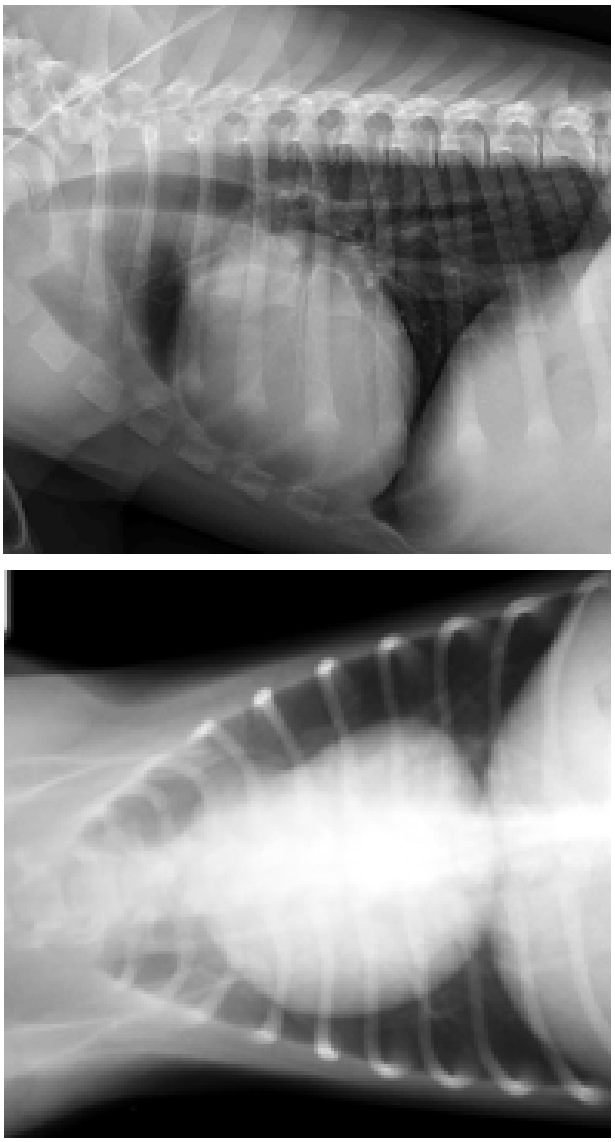

Fig. 3 - Pulmonic stenosis

murmur. The prognosis depends on VSD location and volume shunted. The smaller the VSD, the less chance of volume overload and the better the prognosis.

Small VSDs, which ironically produce loud murmurs, may close over time. Large VSDs cause higher volume overload and carry a poor prognosis. If the defect is not too big and is in an adequate location, it can be managed by surgery or device occlusion.

Silent heart disease

Although the aforementioned cardiac malformations produce murmurs, there also are heart diseases that don't produce murmurs. The most common "murmurless" heart defect is the reverse PDA, which occurs when the left-to-right shunting of a PDA switches direction. As a result, deoxygenated blood is pushed into circulation via the aorta, and the dog becomes hypoxaemic, particularly in the caudal half of the body. The kidney boosts erythropoietin production

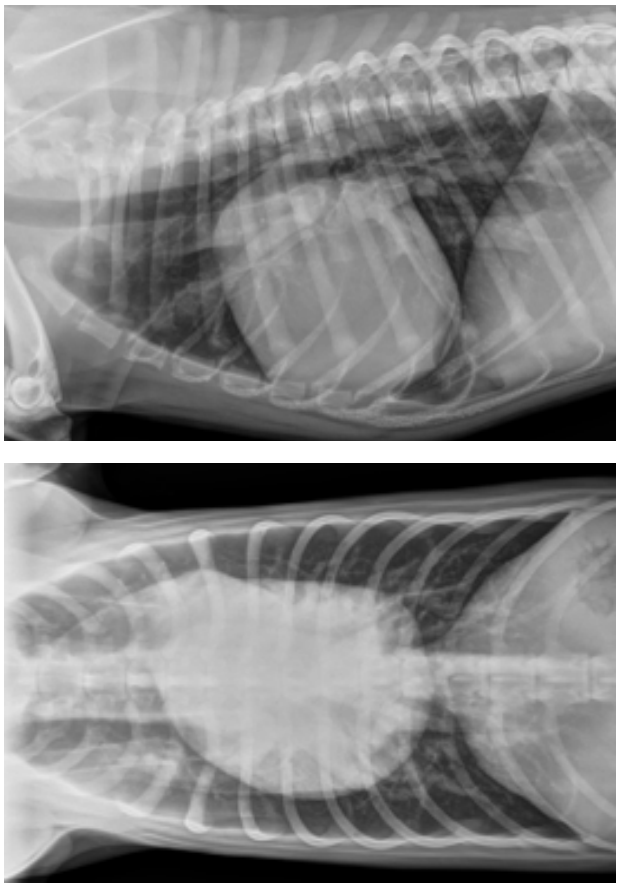

Fig. 4 - Reverse patent ductus arteriosus

in response, and more red blood cells are churned out resulting in an increased haematocrit (polycythaemia). Affected dogs experience multiple clinical signs, such as lethargy, exercise intolerance, respiratory distress, pelvic limb weakness, and differential cyanosis (pink up front, blue at rear).

Blood work shows polycythaemia with a regenerative response. Radiographs and echocardiography reveal an enlarged right heart and prominent main pulmonary artery as well as peripheral pulmonary artery dilation (Figure 4). Phosphodiesterase inhibitors, such as sildenafil and tadalafil, are used to treat pulmonary hypertension, and therapeutic phlebotomy may alleviate blood hyperviscosity and prevent associated seizures. Some cardiologists will also recommend hydroxyurea to also help manage the secondary polycythaemia. The average lifespan of affected dogs is 5 years.

Conclusion

When you hear a heart murmur in a puppy, blend the signalment, history, and physical exam findings to determine what anomaly is most likely present. It's important to remember that a pet may have multiple cardiac defects.

Joan Capuzzi, VMD, is a small animal veterinarian and journalist based in the Philadelphia area.

CPD Questions

Congenital Heart Disease
AC/0477/21

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1. Which of the locations listed below is not associated with a heart murmur

a. Left axilla.
b. Right axilla.
c. Left heart base.
d. Left cardiac apex.
e. Right heart base.

2. Which one of the following pathologies would not be detected when auscultating the left cardiac apex?

a. Normal sounds from mitral valve activity.
b. Degenerative mitral valve disease.
c. Endocarditis.
d. Systolic murmurs from ventricular septal defect (VSD).
e. Dilated cardiomyopathy (older dogs).

3. Which one of the following pathologies would not be detected when auscultating the left heart base?

a. Pulmonic stenosis (PS).
b. Subaortic stenosis (SAS).
c. Tetralogy of Fallot.
d. Murmurs from physiologic variations such as anaemia.
e. Continuous murmurs associated with patent ductus arteriosus (PDA).

To match a murmur to the pathology, investigate the location where it's loudest, its cardiac cycle phase, and related femoral pulse quality. (question 4 – 5)

4. Which of the descriptions below is CORRECT regarding a PDA?

a. PDA advertises itself with a continuous murmur which is loudest at the left axilla, and bounding pulses.
b. PDA advertises itself with an intermittent murmur which is loudest at the left axilla, and bounding pulses.
c. PDA advertises itself with a continuous murmur which is loudest at the right axilla axilla, and pulse deficits.
d. PDA advertises itself with a continuous murmur which is loudest at the left apex axilla, and bounding pulses.
e. PDA advertises itself with a continuous murmur which is loudest at the left axilla, and pulse deficits.

5. Which of the descriptions below, regarding SAS and PS, is correct?

a. Systolic murmurs loudest at the left heart base.
b. Systolic murmurs loudest at the left heart apex.
c. PS is a systolic murmurs with a bounding pulse.
d. SAS is a systolic murmur with a normal pulse.
e. PS is a systolic murmur with a weak pulse.

6. Which one of the following statements regarding a PDA is INCORRECT?

a. Diversion of oxygenated blood from the aorta to the pulmonary artery.
b. Causes a right to left shunt.
c. Causes left sided volume overload.
d. Causes left sided congestive heart failure.
e. May eventually result in a reverse PDA.

7. A Chihuahua puppy with bounding femoral pulses and a continuous heart murmur and left sided heart enlargement most likely has which one of the defects listed below?

a. SAS.
b. PS.
c. PDA.
d. VSD.
e. Tricuspid dysplasia.

8. A Bulldog, 5 year old with a systolic heart base murmur, normal pulses , an enlarged right heart and thickened right ventricle walls on echocardiogram most likely has which one of the defects listed below?

a. SAS.
b. PS.
c. PDA.
d. VSD.
e. Tricuspid dysplasia.

9. A large breed dog, for example a Boxer, with a systolic heart base murmur and which is predisposed to sudden death most likely has which one of the defects listed below?

a. SAS.
b. PS.
c. PDA.
d. VSD.
e. Tricuspid dysplasia.

10. Which one of the following statements regarding murmurs is INCORRECT?

a. A murmur does not always mean a heart defect is present.
b. A heart defect doesn't always mean a murmur will occur.
c. Small VSDs produce loud murmurs with low volume blood shunting.
d. Benign murmurs are general soft and focal and change with excitement.
e. A machinery murmur occurs with a VSD.

Ocular Ultrasonography Part 2: Ocular Abnormalities

Sam Mauchlen MRCVS BVM&S

This article is a continuation of Part 1, published in the Volume 07 - Issue 05 of Vet360, which discussed the ultrasonographic appearance of the normal anatomy of the eye, as well as the standard approach to performing an ocular ultrasound examination.

Ultrasonographic assessment of eye facilitates the examination of intraocular structures in cases where pathology is obscuring the normal anatomy and can aid in the detection and evaluation of intraocular conditions such as neoplasia. Additionally, ultrasound can be used to examine the structures within the orbit and retrobulbar space. This article aims to give an overview of the ultrasonographic changes seen in a variety of ocular conditions.

Whilst ocular ultrasonography is a safe technique, the transducer placement can cause direct pressure to the globe, and ultrasound is contraindicated in patients who have severe globe or corneal trauma, or where ocular surgery has recently been performed.

Although conditions affecting the anterior corneal epithelium would be directly visible on ophthalmic examination, use of higher frequency ultrasound transducers can detect conditions that may be obscured by opacification of the superficial corneal layers. In most cases where corneal pathology is present there will be an alteration in corneal thickness and the normal three-layer structure of the cornea will change as the normally anechoic stroma becomes echogenic (Fig. 1).

Pathological conditions which cause the presence of haemorrhage (hyphema) and/or cellular debris (hypopyon) within the anterior chamber, will appear as echogenic material within the normally anechoic aqueous humour. This material can be mobile and may change position with ocular motion.

Iridocilliary cysts which form from the neuroepithelium of the uveal tract can float from the posterior chamber into the anterior chamber or vitreous body. On ultrasound these appear as round structures with a thin, echogenic wall and an anechoic centre (Fig. 2). Breeds such as Labradors, Great Danes and Golden

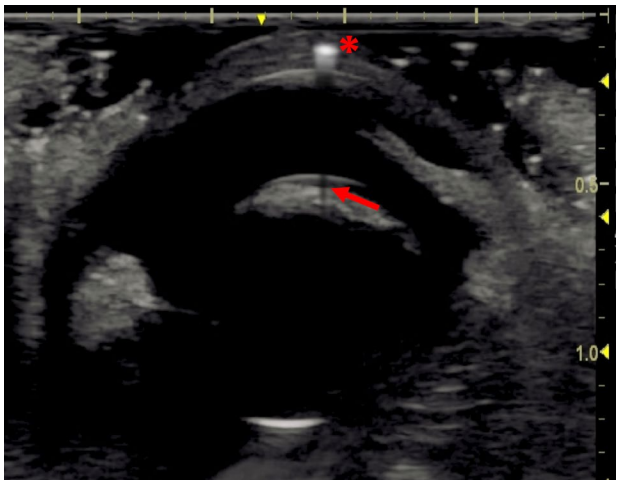

Fig. 1 - In this horizontal plane ultrasound image, a metallic corneal foreign body is present (asterisk). The cornea has become thicker, with the normally anechoic stromal layer becoming echogenic. As the foreign body is very dense, an acoustic shadow artefact is created and is obscuring part of the anterior lens (arrow). (Image provided by Chris Dixon BVSc CertVOPhthal MRCVS, Vet Vision UK).

Retrievers are predisposed to cysts and though usually considered incidental, iridociliary cysts have been associated with uveitis and glaucoma.

Ultrasound is useful in assessing the lens and cataract formation. Cataracts appear as echogenic areas within the normally anechoic internal fibres and nucleus of the lens (Fig. 3). Ocular conditions which lead to stress and eventual rupture of the zonule fibres that support the lens, can cause subluxation or luxation of the lens. By using ultrasound, the lens position can be assessed; in subluxation the lens position may be asymmetric though it will remain posterior to the iris and anterior to the vitreous body. Luxation will allow the lens to move into the anterior chamber or into the vitreous body (Fig. 4).

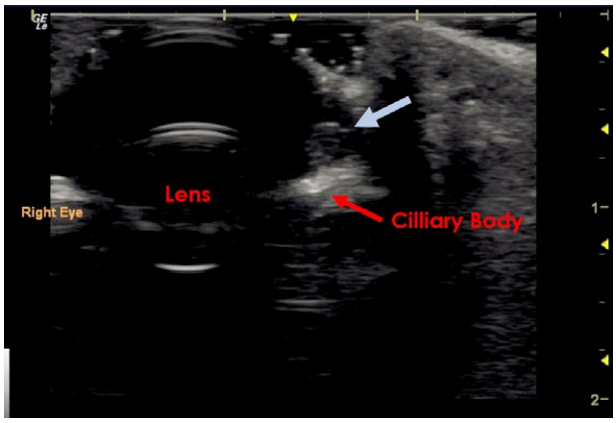

Fig. 2 - In this horizontal plane image of the right eye in a dog, an iridociliary cyst (blue arrow) can be seen adjacent to the ciliary body within the anterior chamber. (Image provided by Chris Dixon BVSc CertVOPhthal MRCVS, Vet Vision UK).

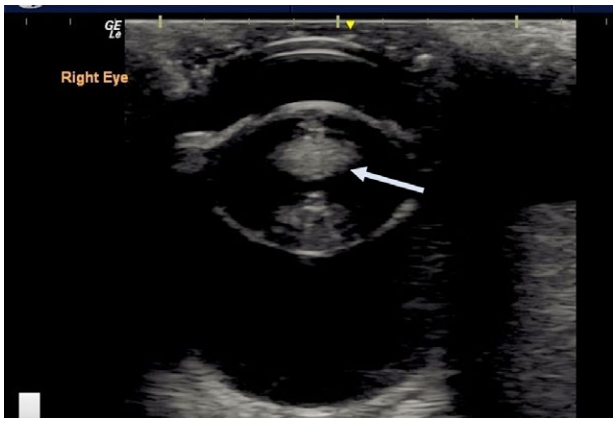

Fig. 3 - In this horizontal plane image, the central portion of the normally anechoic lens has become echogenic indicating the presence of a cataract (arrow). (Image provided by Chris Dixon BVSc CertVOPhthal MRCVS, Vet Vision UK).

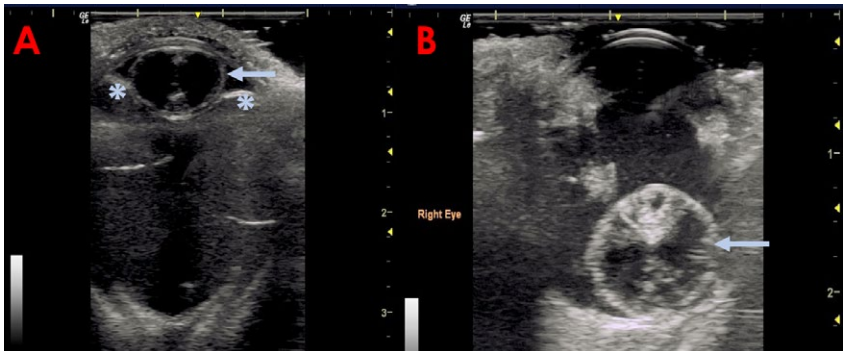

Fig. 4 - A) This image shows an anterior lens luxation. The lens is located within the anterior chamber (arrow) anterior to the iris (asterisks). B) This image shows a patient with posterior lens luxation. The lens, which shows signs of cataractous change, is located within the posterior vitreous chamber (arrow). The surrounding vitreous contains echogenic material due to haemorrhage and inflammation. (Images provided by Chris Dixon BVSc CertVOPhthal MRCVS, Vet Vision UK).

As the vitreous normally appears anechoic, a range of conditions can cause echogenic material to appear within the vitreous. Forms of vitreal degeneration, such as astral hyalosis, can be seen in older patients and those with cataracts. Degenerative conditions of this type cause echogenic opacities within the vitreous. Similarly, infection, inflammation and haemorrhage can cause the formation of vitreous opacities. Organised blood clots within ocular chambers can be difficult to differentiate from neoplastic lesions. However, doppler ultrasonography can be valuable in distinguishing between vascularised neoplastic lesions and the lack of blood flow within an organised clot. Though it is not normally possibly to distinguish the retina from the other layers of the posterior globe wall, retinal detachment can have a characteristic appearance. As the retina remains attached at the optic disc and the ora serrata, complete detachment leads, to the thin echogenic interface of the retina forming a "V" or "Y" shape within the vitreous chamber (Fig. 5).

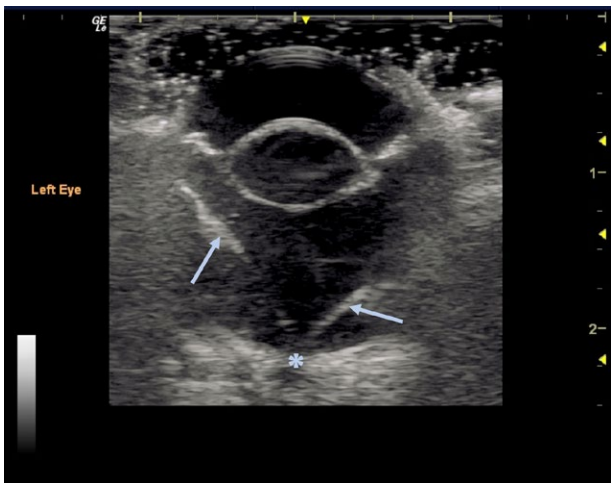

Figure 5. This image shows the "V" shape formed by detached retinal membranes (arrows). The attachment at the optic disc can still be seen (asterisk). (Images provided by Chris Dixon BVSc CertVOPhthal MRCVS, Vet Vision UK).

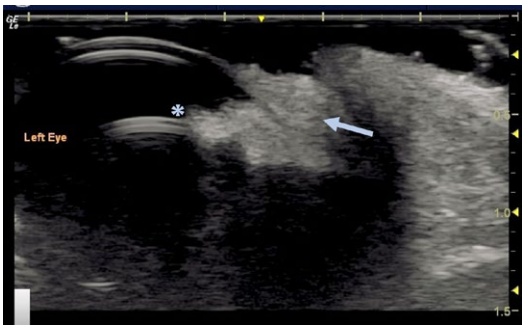

Fig. 6 - In this image an irregular heterogenous mass (arrow) is visible extending from the corneal limbus into the anterior chamber and the anterior lens capsule (asterisk). (Images provided by Chris Dixon BVSc CertVOPhthal MRCVS, Vet Vision UK).

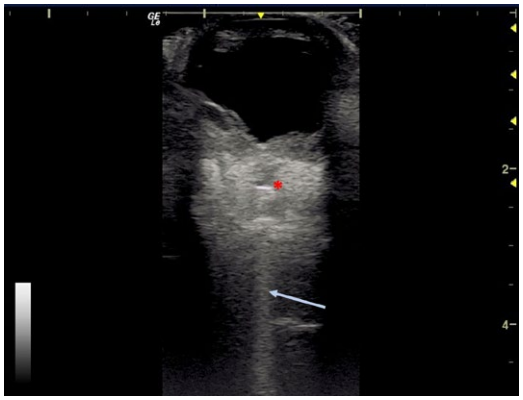

Fig. 7 - This image shows a retrobulbar foreign body which appears as a hyperechoic linear structure within the retrobulbar space (asterisk). As the foreign material is dense, it is creating a reverberation artefact (arrow). The retrobulbar fat surrounding the object is inflamed and appears more hyperechoic and irregular. (Images provided by Chris Dixon BVSc CertVOPhthal MRCVS, Vet Vision UK).

As ocular neoplasia can lead to changes which obscure normal ocular anatomy, ultrasound provides a method of assessing the ocular structures and defining the extent of the neoplastic changes. Ocular neoplasia can be focal (Fig. 6) or diffuse and can also cause intraocular haemorrage, glaucoma and uveitis.

In cases of retrobulbar pathology, computed tomography (CT) and magnetic resonance imaging (MRI) are both valuable in assessing changes in the retrobulbar anatomy. However, these modalities are limited by their availability and expense. Ultrasound offers a rewarding alternative to assess the retrobulbar structures.

As the changes caused by neoplasia or inflammation can vary, it is important to evaluate both eyes as this allows the retrobulbar structures to be compared. Inflammation may cause the retrobulbar fat to appear relatively hyperechoic (Fig. 7), whereas neoplasia can deform the posterior globe and cavitary lesions such as abscesses or cysts may appear as areas with an echogenic rim containing flocculent or hypoechoic content.

Ultrasound offers a safe and versatile modality for assessing the ocular and orbital structures in small animal patients. Using ultrasound, the clinician can gain important information that would not be possible with direct visualisation alone, enhancing our ability to define the extent of pathological changes and reach an accurate diagnosis.

Further Reading

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Veterinarians' Guide to Negotiating Reasonable Restraint of Trade Agreements

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Why are Restraint of Trade Agreements used?

Restraint of trade agreements are usually part of employment agreements. The purpose of these agreements is to protect a business' client base, confidential information, and trade secrets from its competitors or potential competitors. They often provoke negative emotions from employees because it can have far-reaching consequences for ex-employees. However, looking at it from an employer's perspective, it is a necessary and useful tool to protect a business' interests.

Are Restraint of Trade Agreements Enforceable in South Africa?

The short answer to this is "yes." The law acknowledges the right of a business to protect its intellectual property. There are many reported cases dealing with restraint of trade agreements in South African law. These cases confirm the enforceability of restraint of trade agreements and show that they are widely used. However, that does not mean that every restraint of trade agreement will be enforced by our courts. Over time some principles have been developed to determine the reasonableness and validity of the agreements. These principles must be followed to ensure that restraint of trade agreements will be enforceable.

Veterinary Practice Owners: Points to Remember when Drafting Restraint of Trade Agreements

As a practice owner, you must protect your business, and a restraint of trade agreement is a useful tool. However, you should ensure that it is reasonable and not against public policy. The landmark case in South African law in this regard is the case of Magna Alloys and Research (SA) (Pty) Ltd v Ellis 1984 4 SA 874 (A). The two main principles established in this case are:

- Restraint of trade agreements are valid and can be enforced;
- For agreements to be enforced, they may not be against public policy.

This begs the question: "What is against public policy?" Unfortunately, it is not an easy question to answer and will depend on the circumstances of each case. Since the Magna Alloys case, our courts have had to answer this question on numerous occasions. Over time this led to more detailed guidelines being developed. In the case of Basson v Chilwan 1993 3 SA 742 (A), Nienaber JA stated that an agreement would be unreasonable if it prohibits one person from being economically active while the other party does not have an interest worthy of protection. Nienaber JA provided four questions that should be used to evaluate the reasonableness of restraint of trade agreements.

1. Does one of the parties have an interest that warrants protection after termination of the agreement?

Let us look at a hypothetical example. A practice owner has a restraint of trade agreement with an employee veterinarian preventing the employee from practicing within 20km from the practice for 5 years after termination of employment. The employed veterinarian resigns. The practice owner decides to retire and completely close the practice. If the ex-employee decides to open a practice within the 20km in the next year, would the restraint of trade agreement be upheld by a court? It is very unlikely that the agreement would be enforced by a court. When the employer decides to close practice, he or she would have difficulty proving the existence of an interest worthy of protection.

2. Is the protectable interest threatened in some way by the other party?

To illustrate the point, we will look at a scenario where a veterinarian is employed in a small animal veterinary practice. There is a restraint of trade agreement in place stipulating that she may not practice within a radius of 30km from the employer's practice for a period of 3 years after leaving her employment.

The veterinarian resigns and opens her own practice 20km away, but she only does equine work. Would the original employing practice's interest be threatened? The answer is most likely "no". However, one must look at specific circumstances. If the small animal practice owner had been planning to expand the practice by doing equine work, there will be an interest that is threatened, and the restraint will likely be upheld.

3. If there is an interest which is being threatened, how does this weigh up against the other party's right to be economically active and productive?

The protection sought should not go further than necessary. If a general practitioner employs a veterinarian in a practice in Durban for example, it might be reasonable to limit the person from practicing within a radius of 20km for a period of 3 years. However, a restraint seeking to prevent the person from practicing in Kwa-Zulu Natal for a period of 3 years will likely go further than necessary.

4. Is there any other facet of public interest that has no bearing on the relationship between the parties, but which would determine whether the restraint of trade should be upheld or not?

This question casts a wide net and is intended to make provision for any public interest that outweighs the interest of the individual parties. A possible scenario is where there is a valid and reasonable restraint of trade in place between a veterinary practice and an employee veterinarian who resigns. The employee veterinarian has a scarce skill that is much needed in the community and which the original practice cannot provide. If the veterinarian is an ophthalmologist who wants to start a practice only providing an ophthalmology service, and there are no other veterinarians with this skill within a 500km radius. Under these circumstances, the restraint of trade preventing a person to practice in the area might be set aside in the interest of the community.

New Employee Veterinarians: Negotiating a Fair Agreement

Young veterinarians starting a new position are often so excited that they forget to look at the contractual terms of their employment, especially the details of a restraint of trade agreement. One cannot overemphasize the importance of negotiating these terms before the employment contract is finalized, and before starting a new position. Understandably, jobs are sometimes scarce. But you must ensure

that you can survive a restraint of trade agreement financially before you sign it. Please realize that even if everyone would agree that a restraint of trade clause is unreasonable, once you have signed it, the only way to dispute it would be to go to court and have the court rule in your favour. It is an expensive and lengthy process, and there are no guarantees that a court will rule in your favour. Our courts have enforced restraint of trade agreements that have had devastating consequences for the ex-employees but were not against public policy.

Restraint of trade agreements usually deal with the following aspects:

1. Area of restraint

Typically, a restraint agreement stipulates an area such as a town, district, or province as the area in which an ex-employee will be restricted from doing business or being employed. It can also be worded as a radius within which an ex-employee is not allowed to trade. As a new employee, you should look at how it will affect you if your employment is terminated. If it is unreasonable, try to negotiate a smaller radius or a specific part of a city rather than the entire city for example. Make sure that you and your employer have the same understanding of what it includes and make sure that the details are in writing. Do not rely on verbal agreements.

2. Period of restraint

The reasonableness of the period of restraint will depend on individual circumstances, but in most cases, two to five years are reasonable. Do not agree to restrains agreements that prohibit you from working in an area or field for lengthy periods. Never enter into lifelong restraint agreements.

3. Solicitation of clients

There is a trend in the United States to move away from the restraint of trade agreements (called non-compete agreements there) and instead enter into non-solicitation agreements. These agreements prohibit an ex-employee from soliciting any clients of the previous employer. While there are advantages to this, it also has disadvantages. In South Africa, it can be used as part of a restraint of trade agreement. It would be reasonable to accept this as an employee unless it is worded in such a way that it places an unreasonable burden on an ex-employee.

4. Confidentiality

It is reasonable to expect ex-employees to keep trade secrets and other specific information confidential even after they have left the employment.

Final Remarks

A restraint of trade agreement is intended to protect the legitimate interests of an employer. It is best to word it specifically and to avoid any ambiguity. Both parties should carefully consider and discuss the specific terms and conditions of their restraint of trade agreement before finalizing the employment agreement. Proper consideration and discussion beforehand will prevent unnecessary costs and litigation when the employment relationship terminates.

Therapeutic Approach to Patients with Superficial Corneal Ulceration

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Corneal ulceration is one of the most common ocular diseases leading to loss of vision in companion animal practice. An ulcer is a lesion of an epithelial surface with exposure of the underlying stroma or basement membrane.

Corneal ulcers can be classified by the depth of corneal involvement, namely superficial, stromal, descemetocele and perforations. Superficial ulcers can be further subclassified as uncomplicated, progressive, and refractory. Uncomplicated superficial ulcers should heal rapidly, usually within a week with minimal scar formation. If a superficial ulcer has not healed within a week it should be revaluated for an undetected, underlying cause. The most important step in approaching a patient with a corneal ulcer is identifying and removing the inciting cause.

Causes of superficial corneal ulceration include trauma, spontaneous chronic corneal epithelial defects (SCCED), aberrant hairs, such as distichia or ectopic cilia, entropion, eyelid neoplasia, keratoconjunctivitis sicca, chemical burns exposure keratitis and primary corneal pathogens especially Feline Herpes virus.

Clinical signs include blepharospasm, epiphora, photophobia, miosis, ocular discharge, conjunctivitis, and corneal oedema. Corneal vascularization will be present in long standing non healing ulcers. Lastly secondary uveitis may be seen, manifested by aqueous flare and hypopyon.

A complete examination of an eye with a corneal ulcer should include assessment of the corneal and palpebral reflex, Schirmer tear test as well as examination of eyelids, conjunctiva as well as under the third eyelid with good light source and magnification. The diagnosis of an ulcer is confirmed with a positive fluorescein stain.

Fig. 1 - Superficial corneal ulcer in the dorsal aspect of the cornea. Ulcers in this position occur very often secondary to ectopic cilia or distichia, and proper examination with magnification is indicated.

When treating a patient with a corneal ulcer, determining, and treating the initiating cause is crucial. Without this step, ulcers will not heal, or they will heal only to recur shortly afterward. This is especially true in cases with ectopic cilia where the offending hair may spontaneously fall out, only to recur weeks later.

Traditionally superficial ulcers only require analgesic and antimicrobial treatment. For this purpose, a broad-spectrum antibiotic for example triple antibiotic (neomycin and polymyxin B along with bacitracin or gramicidin) fusidic acid or fluoroquinolone preparations are highly effective. The use of later generation fluoroquinolone for example moxifloxacin should be reserved for cases with evidence of bacterial infection namely rapid progression as well

as malacia. 1% Atropine eyedrops are typically used 1 – 2 times daily for maximum of 5 days as the analgesic drug of choice.

Hyaluronic acid is a polysaccharide of repeating disaccharide units. It is abundant in almost all mammalian tissue, including epithelial tissue. Hyaluronic acid possesses unique rheological properties, specifically shear thinning behaviour. This allows hyaluronic acid to exhibit a low viscosity when exposed to high shear stress but regain a high viscosity once the shear stress is reduced. This property results in a prolonged precorneal residence time during the interblink. During blinking, high shear stress is created across the corneal epithelium and hyaluronic acid becomes less viscous, allowing the shear stress of blinking to be tolerated.

Hyaluronic acid has the ability to promote precorneal tear film [PTF] stability. The normal PTF supplies the cornea with nutrients, including oxygen, glucose, electrolytes, amino acids, vitamin A and growth factors. The growth factors include epidermal growth factor [EGF] and transforming growth factor-beta [TGF-β]. Both of these growth factors play an important role in corneal epithelial wound healing. The PTF also act as a source of antibacterial substances, such as immunoglobulins, lactoferrin (a bacteriostatic protein), and lysozyme (an enzyme that attacks bacterial cell walls). Tears also contain protease inhibitors that protect the cornea.

Hyaluronic acid accelerates epithelial cell migration by increasing the expression of Matrix metalloproteinases [MMPs]. MMPs help remodel the extracellular matrix of wounded corneas.

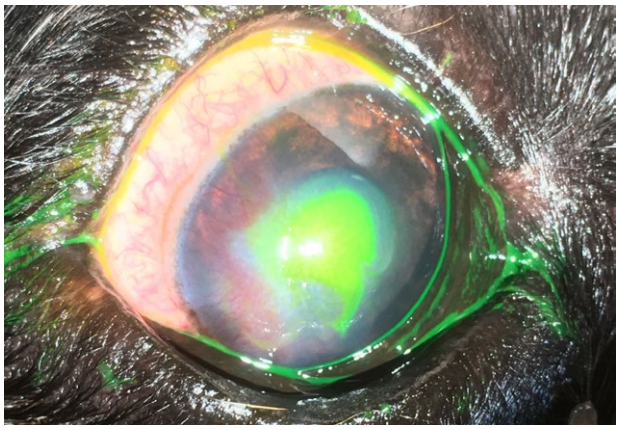

Fig. 2 - Typical long standing superficial corneal ulcer. Conjunctival congestion, superficial corneal vascularization as well as positive fluorescein staining is visible.

Adding hyaluronic acid eyedrops to the treatment protocol of corneal ulcers has definite benefits. However, this is an extra tool in the veterinary surgeon's armour and does not replace any of the existing treatment protocols. Deep ulcers, threatening to perforate should still be treated surgically using one of the various grafting techniques.

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An Approach to Pelvic Fractures in Clinical Practice

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Pelvic fractures account for 16% and 20% of all fractures in dogs and cats respectively. They often occur in younger animals. They require correct decision making as the future quality of life these patients can be negatively affected by poor treatment of these fractures. Pelvic fractures are often caused by motor vehicle trauma and is often a poly-trauma and there may be other organ systems affected. It is important to address the soft tissue injuries while considering appropriate fracture repair.

Patient assessment

These patients often present in an acute state of shock. This should be managed aggressively with appropriate goal directed fluid resuscitation. A full description of this can be found in most of the recent veterinary texts.

Thoracic trauma is the most commonly associated concurrent damage in cats whereas urinary tract injury is the most common concurrent injury in dogs. Regardless of the species affected, thoracic radiographs and an AFAST abdominal scan are essential steps in the diagnostic work up of patients with pelvic trauma. These should be repeated once the patient is stable to reassess any progression. A rectal exam is very important to assess for rectal damage in these patients as well as the internal diameter of the pelvic canal. Assessment of nerve function to the hind limbs is essential especially in the case of sacro-iliac luxations, acetabular fractures and fractures of the ishium caudal to the acetabulum. Peripheral nerve injury is common in patients with pelvic fractures, although fortunately, frequently not permanent. Injury to the sacrococcygeal nerve roots can manifest in bladder paralysis and urinary incontinence. Bladder function will often return, but the owners need to be warned that this may take up to several months and cannot be guaranteed. Absent deep pain in the hindlimbs and an absent anal reflex are poor prognostic signs and must not be overlooked.

The pelvis

There needs to be an understanding of the functional anatomy of the pelvic structure to guide decision making in pelvic fractures.

The pelvis is essentially a box. This means that for a fragment to be displaced there essentially has to be at least two, more often three fractures / luxations present. The only exceptions to this rule are a pubic symphysis fracture, ilial wing fracture cranial to the sacroiliac joint or an avulsion fracture of the tuber ischiadicum or tuber ischi.

The weight bearing axis (Fig. 1) of the pelvis is a vital part of the functional anatomy of the pelvis. Our decision

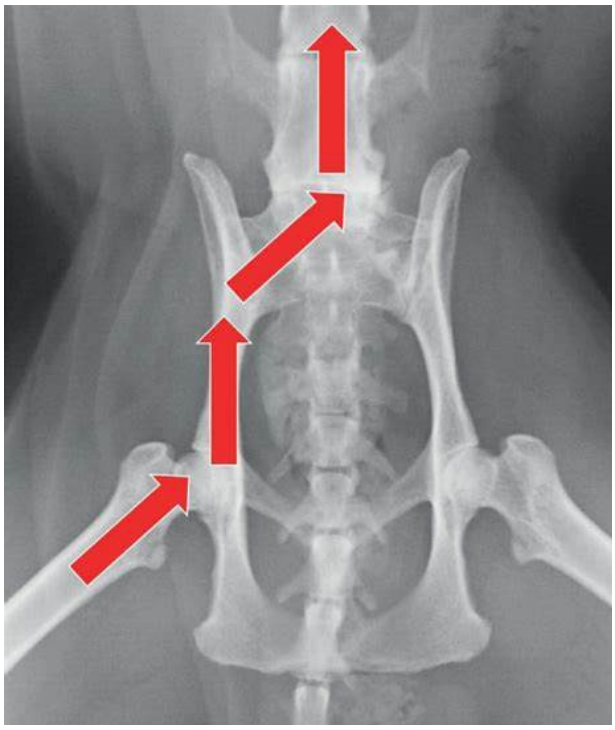


Fig. 1 - Weight bearing axis of the small animal pelvis

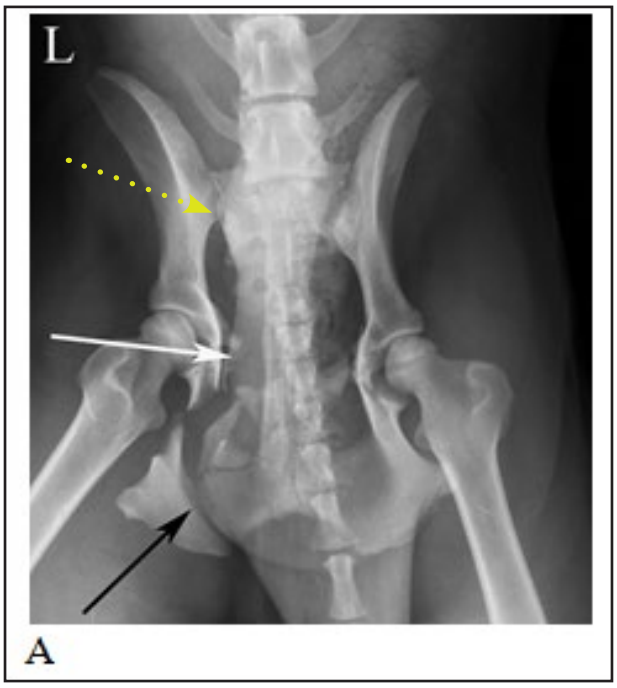


Figure 2. The white arrow shows a pubic floor fracture and the black arrow shows an ischial fracture. These need not be repaired. In this case only the sacro-iliac luxation (dotted arrow) would have been repaired.

making in the repair of pelvic fracture will mainly stem from this concept. As a general rule all fractures on the weight bearing axis need to be repaired surgically to give the best long-term outcomes and the lowest complication rates. The exception to this rule is avulsion fractures of the tuber ischiadicum with marked displacement and a function lameness. There are very rare. Intra-articular fractures need to be surgically repaired within 72 hours to salvage the articular cartilage. Pelvic canal diameter narrowing needs to be corrected, if the pelvic canal is narrowed more than 50% of normal this will result in severe long-term obstipation.

Pubic and ischial fractures

Fractures of the pubic floor and ischial table are extremely common (Fig. 2). These do not require surgical repair and can be treated with cage rest and analgesia. They should however be checked up on a weekly basis with repeat radiographs. This will detect any major displacement leading to narrowing of the pelvic canal which would require immediate attention
.

Acetabular fractures

Acetabular fractures are intra-articular fractures that all need accurate and rapid surgical reduction with rigid fixation. If these fractures are left they will result in a malunion which will lead to mal-articulation of the articular surface leading to degenerative joint disease. Fractures of the caudal third of the acetabulum in small breed dogs and cats, have historically, been left to heal without fixation. Although these fractures don't lie on the weight bearing axis of the pelvis, they are intra-articular and a recent study has shown marked degenerative joint disease in caudal third acetabular fractures in small breed dogs. The current recommendation is surgical repair, this is however

Fig. 3 - Shows a cranial acetabular fracture(A - lateral and B – ventro-dorsal) fixed with a String of Pearls plate™ and a pin (A – lateral and B ventro dorsal) This has been contoured over the acetabular rim. The screws will be aimed away for the articular surface. Clinical union can be seen in the radiographs taken 6 weeks later (A – lateral and B ventro-dorsal)

very challenging given the close proximity the sciatic nerve.

In general acetabular fractures are repaired with plates and screws. Locking polyaxial plates (Fig. 3) are ideal as they can be contoured in all 3 planes to angle the screws away from the acetabular joint surface. These plates don't rely on friction to maintain alignment so there will be no shifting of the fragments when tightening the screws. In smaller dogs 2 screws and a tension band can be used on the dorsal surface of the pelvis. These are challenging surgeries that often require an extensive approach to the pelvis.

If the medial wall of the acetabulum is destroyed surgical repair is often not possible, if attempted there will be a medial coxofemoral luxation (protrusio acetabuli) and an femur head ostectomy should be performed. A total hip replacement can be performed in some of these cases where there is enough dorsal rim using a cementless cup.

Ilial body/shaft fractures

These are often long oblique fractures of the ilium and can be missed on radiographs if one is not careful. If there is any asymmetry of the pelvis i.e. the left acetabulum is cranial positioned compared to the right a long oblique fracture of the ilium should be suspected. This can also occur with a sacroiliac luxation. Both of these situations will be associated with fractures of the pubis and ischium. The most common fixation method for an ilium fracture will be a plate and screws. In the majority of cases this will be applied as a lateral plate. Dorsal and ventral plating has been recommended by some authors to allow increase bone purchase and the use of a longer plate (dorsal). Ideally there should be at least 3 screws in the ilial wing and 2-3 screws in the ilial body on each side of the fracture (Figure 4.). The bone of the ilial wing is soft and thin especially cranial to the sacro-iliac joint. This predisposes to screw loosening. Ideally a longer plate with more screws or the use of locking plates can be used to combat this.

Some authors recommend having 1-2 screws penetrating the sacral wing to increase bone purchase. This should be done with caution to prevent penetration of the L7-S1 disc and the spinal canal. This method has been questioned by some as micro movement could increase screw loosening in these screws penetrating the sacrum.

Sacro-iliac luxations

The wing of the ilium will usually displace cranially and slightly dorsally to the sacrum. Sacro-iliac luxations are often associated with severe damage to the contra-lateral hemi-pelvis. In cases where there is mild displacement of the sacro-iliac luxation and a relatively stable contralateral hemi-pelvis surgical

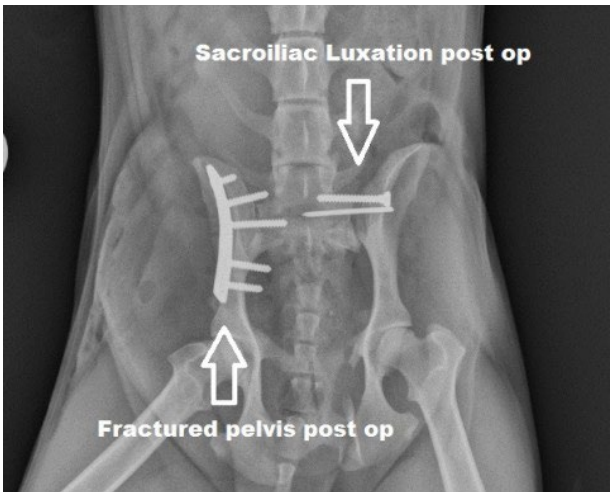


Fig. 4 - A post-operative radiograph showing a lateral plating of the ilial body and a sacro-iliac repair with a screw and an anti-rotational pin.

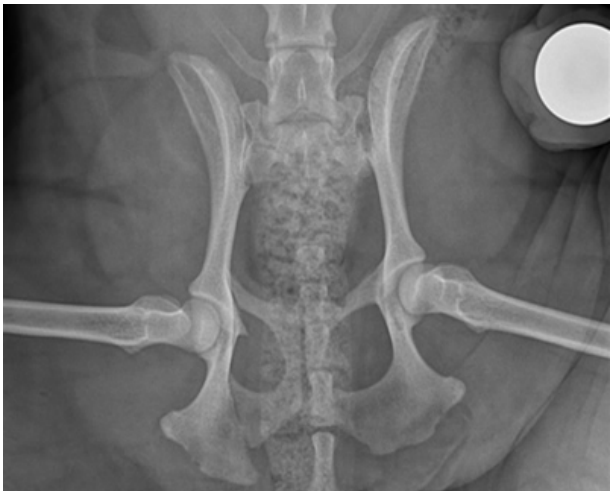


Fig.5 - A mild sacro-iliac luxation with minimal trauma to the contralateral hemi-pelvis.

stabilization is not necessary (Fig. 5). In cases with marked displacement, narrowing of the pelvic canal, compromise of the alignment of the coxo-femoral joint or in cases where extra support is needed, such as marked trauma to the contralateral hemi-pelvis sacro-iliac luxations should be repaired. Cage rest can often lead to increased pain and prolonged recovery thus we are currently repairing marked sacro-iliac luxations more often than in the past.

Surgical repair is performed using a lag screw and an anti-rotational pin (Fig. 4). The position of the screw is critical. It will need to engage at least 60% of the width of the sacrum and be centered over the largest area of bone stock. Any angulation of the screw can lead to perforation of the L7-S1 disc or ventrally out of the sacrum. This will predispose to screw loosening and implant failure.

In conclusion, the pelvis is a complex support structure but with correct decision-making, healing of horrendous pelvis fractures is possible.

Conservative Treatment of Pelvic Fractures

Because it is surrounded by a significant muscle mass, the pelvis is a good environment for fracture healing. Even displaced fractures that are managed medically rarely proceed to non-union. However, in many cases surgery is indicated to maximize functional outcome, relieve discomfort, and accelerate return to activity.

Indications for conservative treatment of pelvic fractures are:

- Minimally displaced ileal fractures (although these would do better with repair in most cases) repair more often than not
- Minimally displaced sacroiliac luxations
- Most pubic and ischial fractures
- Longstanding fractures (repair of the fractures becomes difficult after 7-10 days due to initial fibrosis at the fracture and muscle contraction)

Conservative management always entails strict cage rest for 4-8 weeks depending on the age of the animal and the severity of injuries. Movement should be restricted to short lead walks only, supported by an abdominal sling in early stages when still very lame. Soft padded bedding should be provided to avoid pressure sores. The patient's urination and defaecation need to be closely monitored and assisted as needed (lactulose and a low residue diet). Appropriate analgesia forms a central part of the treatment. Most often combinations of opioids and non-steroidal anti-inflammatory drugs will be helpful to provide an adequate level of pain relief, especially initially post trauma.

Indications for Surgical Repair of Pelvic Fractures are:

- Most ileal fractures with unstable acetabular fragment
- Bilateral fracture luxation
- Fractures resulting in significant narrowing of the pelvic canal of 50% or more
- Acetabular fractures
- Fractures in working dogs or breeding females
- Multiple limb fractures

Postoperative management includes strict cage rest for usually 4-6 weeks. The recommendations given for conservative management of pelvic fractures regarding pain relief, monitoring and assisting in urination and defecation, controlling exercise are also true for postoperative considerations.

Images used in this document courtesy of the Authors

Vitamin D Deficiency in Cats

Unistel Pets

Feline osteomalacia, more commonly known as rickets/vitamin D deficiency, is a nutrient deficiency affecting the bones of young and growing cats. Dietary phosphates, calcium, and magnesium are an essential component of a young cat's diet, and their incorporation into the collagen matrix of bones during growth is what lends them their strength and rigor. The integration of calcium, in particular, is vital to the formation of a healthy bone structure. This process, however, relies on the presence and activation of vitamin D3, another essential dietary component. Vitamin D3 is routinely consumed in its biologically inactive form, and requires a two-step metabolic process to be converted to its active form, beginning in the liver (conversion to calcidiol), and ending in the kidneys (conversion to biologically active calcitriol)

A diet lacking in any of these components, or an inability to properly absorb and incorporate them, would thus result in a significant reduction in bone rigidity, as well as an increase in the prevalence of deformities and folding fractures. Affected kittens most often present with uncontrolled muscle movements, bowing and lameness in the legs, swollen joints, and localized pain, all of which result in a reluctance to play or move and an inability to thrive. Left untreated, these symptoms become progressively more severe after 5 – 14 weeks of age.

Calcium/vitamin D deficiencies in cats can arise in a number of different ways, the most likely of which being a poor diet. If, however, the cat is consuming a balanced diet, and continues to develop a deficiency, the problem may lie more innately. Improper thyroid function, malabsorption in the gastrointestinal tract, or a failure to metabolise calcidiol to its active form, can all have a similar effect on the availability of calcium for bone structure and growth.

Fig. 1 - X-ray of skeletal demineralization and abnormal growth plates of a kitten suffering from vitamin D deficiency. Sourced from https://doi.org/10.1186/s12917-019-1784-1

In particular, an inability to convert calcidiol to calcitriol can be caused by an autosomal recessive mutation within the feline *CYP27B1* gene, which encodes the enzyme responsible for metabolising this process. Known as vitamin D-dependent rickets type 1 (VDDR1), the condition is caused by a single base pair deletion

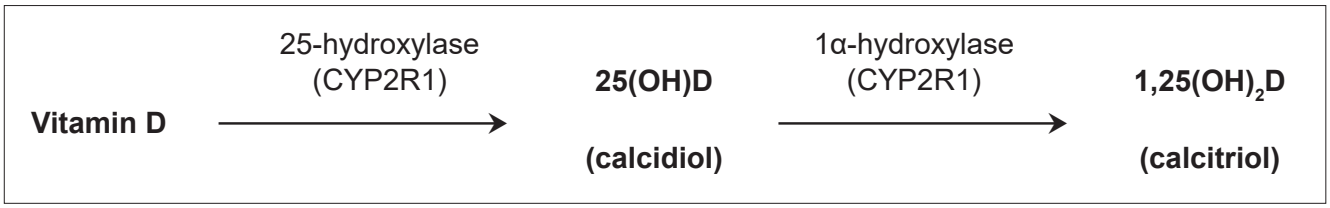


Fig. 2 - Metabolic conversion of vitamin D from its biologically inactive form to calcitriol. Sourced from https://doi.org/10.1186/s12917-019-1784-1

(731delG) within the *CYP27B1* gene, which results in a non-synonymous frameshift mutation, and the formation of a truncated, partially functional protein. Cats affected by this mutation therefore struggle to convert vitamin D to its active form, and thus also to benefit from the calcium present within their diet.

Fortunately, testing for the VDDR1 mutation is now available from several laboratories. Samples can be sent in the form of blood EDTA, buccal swabs, or sufficient hair (with roots), and the ensuing report will indicate whether the cat is clear of the mutation, a carrier, or affected. As with all recessive mutations, cats with a "Clear" or "Carrier" status will not show symptoms of vitamin D deficiency, although individuals carrying the mutation can still pass their affected copy of the gene on to their offspring. A cat with two copies of the mutated gene (homozygous) will be affected by the deficiency.

In such cases, oral calcitriol treatments can be effective in compensating for the deficiency and improving bone mineralization and calcium homeostasis. At the onset of treatment, affected kittens should be confined for the first few weeks. As the skeleton will still be susceptible to fractures, jumping and climbing

should be prevented as much as possible. X-rays can be used to monitor the response to treatment, with limited movement recommended until the skeleton returns to normal. It should be noted, however, that such treatments would most likely need to be lifelong, with frequent check-ups to re-assess dosage as the cat matures. Knowing the VDDR1 status of breeding animals, and being able to avoid breeding with carrier or affected individuals altogether, is therefore advised.

The ABCs of Veterinary Dentistry

X is for Intraoral X-rays

Most of the tooth is located below the gumline and out of view. Intraoral radiography can yield invaluable diagnostic information about your patients' oral health.

Jan Bellows, DVM, DAVDC, DABVP, FAVD

When a patient presents with chronic non-weight bearing lameness, you inform the owner that x-rays are needed to see what is going on. The same is true for patients that have been vomiting or coughing for a while, as well as a host of other reasons. It's a given that your full-body radiograph unit is an integral diagnostic tool. But how many of your patients present with halitosis? How important are intraoral x-rays to your practice? How can you incorporate them into your workflow in every case? How should you communicate the safety, importance, and expense of dental x-rays to your clients? Read on.

The importance of dental x-rays

Covered by gingiva encased in the alveolus and located subgingivally, about 60% of the oral anatomy in dogs and cats is not visible to the naked eye.1 Because skull radiographs result in superimposition of teeth, they are nondiagnostic in most cases (Figure 1). After the learning curve, it is easy to incorporate intraoral radiography in any dental workflow, and it's the key to unlocking a dental treatment plan.

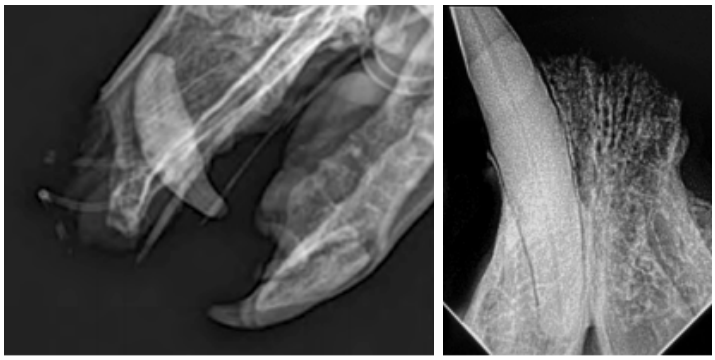
Incorporating intraoral radiography into your workflow

Incorporating intraoral radiography into your practice elevates dentistry from a one-size-fits-all quote over the phone and a drop-off for "a dental" to practicing diagnostic dentistry. Each dental appointment should include at least 3 client conversations: before they leave their dog or cat with you, during the procedure once pathology is found, and at patient discharge.

The initial phone call

During the initial client conversation, discuss what will happen when the pet comes to the clinic, when results of the exam under anaesthesia with intraoral films will be available, and what your client is able and willing to do at home with regard to daily plaque control. Here's how it should play out.

When a client calls to schedule a professional teeth cleaning appointment for a pet with halitosis, the receptionist advises the client that the pet must see the doctor for a general examination and preanaesthesia testing either days before or on the day of the visit. The receptionist also explains that the veterinarian will find the cause of the pet's halitosis via a tooth-by-tooth examination that includes full mouth dental x-rays and, while the pet is anaesthetised, contact them to share the findings and recommend treatment options. Treatment can be performed during that visit or at a later time, depending on the day's schedule and the client's preferences. Finally, the receptionist shares the initial examination fees, preoperative laboratory testing, dental scaling, tooth-by-tooth examination, polishing, and intraoral radiographs. (In some practices, the veterinarian discusses fees with the owner.)



FINDINGS:

The soft tissues in the submandibular region are thickened. A zone of lucency surrounds the right mandibular canine tooth (404). The maxillary and mandibular bones, where the teeth once resided, smoothly undulate. 204 and 404 the only remaining teeth.

CONCLUSIONS:

1. Probable tooth root abscess, 404.

Fig. 1 - (left) Referral skull image of the mandibular canines. (center) A radiologist's interpretation based on the skull image: probable tooth root abscess. (right) Intraoral radiograph shows no evidence of periapical disease, reinforcing the indication for intraoral radiographs.

The money conversation

It's a shame animals do not walk into our offices holding credit cards with unlimited maximums to pay for their care. Fortunately, many payment options are available to allay clients' money fears while allowing you to provide needed veterinary care.

If the client expresses cost concerns, discuss payment plan options and let the client know the entire team is dedicated to providing what their pet needs. A number of options are available today that enable clients to delay or divide payments over time, including CareCredit, Scratchpay, and Vetbilling, among others.

In addition, many wellness plans now include annual full mouth dental radiographs as well as anaesthetised dental scaling and polishing. These plans go a long way when you ask whether your client "wants" x-rays during an elective dental procedure.

The dental care visit

The following is a general timeline for an oral assessment, treatment, and prevention visit with a pet that has halitosis:

9:00 am: When the client brings their pet into the exam room, review the patient history and previous laboratory results, and examine the pet, focusing on the oral cavity. Discuss the client's willingness and ability to provide daily plaque control. If the client has not been given a fee schedule, the doctor or assistant shares the fees for the initial diagnostics and dental scaling before the client leaves the exam room. The client agrees in writing that they understand that you will place their pet under anaesthesia as well as the associated risks, and that there are likely to be additional fees for needed care. Discuss payment options openly. Inform the client what to expect over the course of the day and arrange a time to speak to the owner while the dog or cat is still anaesthetised after determining the cause of the pet's halitosis

9:30 am-11:00 am: The staff acquires preanaesthetic test results to share with you, and then prepares the patient for anaesthesia.

11:30 am-12:45 pm: Staff members anaesthetise the patient, scale and polish the pet's teeth, and obtain intraoral radiographs for the veterinarian to examine chairside. A team member then hands the veterinarian a dental probe to conduct the tooth-by-tooth examination and create a treatment plan, dictating the results to an assistant who creates the dental chart. The assistant tabulates additional fees, and creates and sends an email or text report to the client.

1:00 pm: Review with the client your findings and the optimal treatment plan, explaining all associated fees and discussing payment options if needed.

3:00 pm: Perform the necessary treatment.

5:30 pm: Meet with the client to review the diagnosis and therapy. Have the client set a follow-up appointment to evaluate healing and create a tailored daily plaque prevention program. To leave clients with a lasting positive impression, send them home with a simple digital report that includes clinical before and after images and radiographs of their pet.

Optimal vs functional care

Our patients do not need their teeth to live a full life, but they do need comfort. Root planing, local antimicrobial administration, and laser periodontal surgery are often recommended for optimal care but are not in the comfort range of some clients who cannot provide or afford needed follow-up care. In these cases, a treatment plan aimed at creating a pain-free functional mouth is the goal. You can make the pet comfortable by extracting teeth with complicated fractures and teeth affected by established periodontal disease.

One of the challenges in veterinary dentistry is getting the client to agree to your recommendations and having sufficient time to provide care during the same visit as the exam. When there is only one treatment table or extra time is not available, treatment staging becomes more imperative. In these cases, prepare your client that the diagnostics and teeth cleaning, polishing, and irrigation are performed during the initial visit, followed by a review of pathology with therapeutic recommendations, with the treatment itself performed 1 to 2 weeks later after the client agrees to the recommendation and has financial arrangements in place.

Interpreting oral x-rays and determining treatment

Periodontal disease Radiographs, which provide a 2-dimensional view of a 3-dimensional object, are used to determine indirectly the degree of bone (tooth support) loss. The bone level in periodontal disease often decreases as inflammation extends and bone is resorbed. In order to visualize bone loss radiographically, 40% of the bone has to be affected.

Distribution of bone loss is classified as either localized or generalized, depending on the number of areas affected. Localized bone loss occurs in isolated areas, whereas generalized bone loss involves the majority

of the marginal bone. You can classify specific areas of bone loss as horizontal (perpendicular to the tooth) or vertical (angular along the side of the root).

Periodontal disease is classified into four stages based on radiographic and clinical signs. In the normal cat or dog without periodontal disease, the alveolar margin resides within millimeters apical to the cementoenamel junction. **Stage 1, gingivitis,** occurs when the gingiva appears inflamed. There is no periodontal support loss or radiographic change.

Stage 2, early periodontitis, occurs when attachment loss is less than 25%, as measured from the cementoenamel junction to the apex. Clinically, early periodontitis is typified by pocket formation or gingival recession. Radiographically, stage 2 periodontitis appears as blunting (rounding) of the alveolar margin in addition to bone loss. There may also appear to be a loss of continuity of the lamina dura at the alveolar margin level.

Stage 3, moderate periodontitis, is diagnosed when 25% to 50% of attachment loss occurs (Fig. 2). The direction of bone loss is either horizontal or vertical (angular). Horizontal bone loss appears radiographically as decreased alveolar bone along adjacent teeth. Normally, the alveolar margin bone is located 1 mm apical to the cementoenamel junction. With horizontal bone loss, both the buccal and/or lingual bone plates, as well as interdental bone, are resorbed. Clinically, horizontal bone loss is typified by a suprabony pocket, which occurs when the epithelial attachment is above the bony defect.

Vertical bone loss, resulting from infrabony defects, occurs when the pocket walls are within a bony housing. Periodontal disease may cause a vertical defect to extend apically from the alveolar margin. Alveolar bone expansion appears clinically as bulging alveoli around 1 or both maxillary and/or mandibular canines. Radiographically, this lesion appears as bone loss around the root and expansile alveolar bone growth.

Stage 4, advanced periodontal disease, is typified by deep pockets and/ or marked gingival recession, tooth mobility, gingival bleeding, and purulent discharge. Attachment loss is greater than 50% of the root length.

Furcation exposure results from bone loss at the root junction of multirooted teeth due to advanced periodontal disease. Unless there is a radiolucent area in the region of the furcation, it is sometimes difficult to determine radiographically whether the interradicular space is involved. Lack of radiographically detectable furcation involvement is not confirmation of the absence of periodontal destruction. Advanced furcation exposures, where both cortical plates are resorbed, are easily recognized on radiographs.

Stage 1 furcation involvement exists when the tip of a probe can just enter the furcation area. Bone partially fills the area where the roots meet. Radiographically, there may be decreased opacity of the bone at the furcation.

Stage 2 furcation involvement exists when the probe tip extends horizontally into the area where the roots converge but does not exit on the other side. Radiographically, there will be bone loss at the furcation.

Stage 3 furcation exposure lesions exist secondary to advanced periodontal disease. Alveolar bone has resorbed to a point that an explorer probe passes through the defect unobstructed. Radiographically, there will be an area of complete bone loss.

Tooth resorption

Because tooth resorption is not observed clinically in most cases, intraoral x-rays are important in the diagnosis and treatment planning for canine and

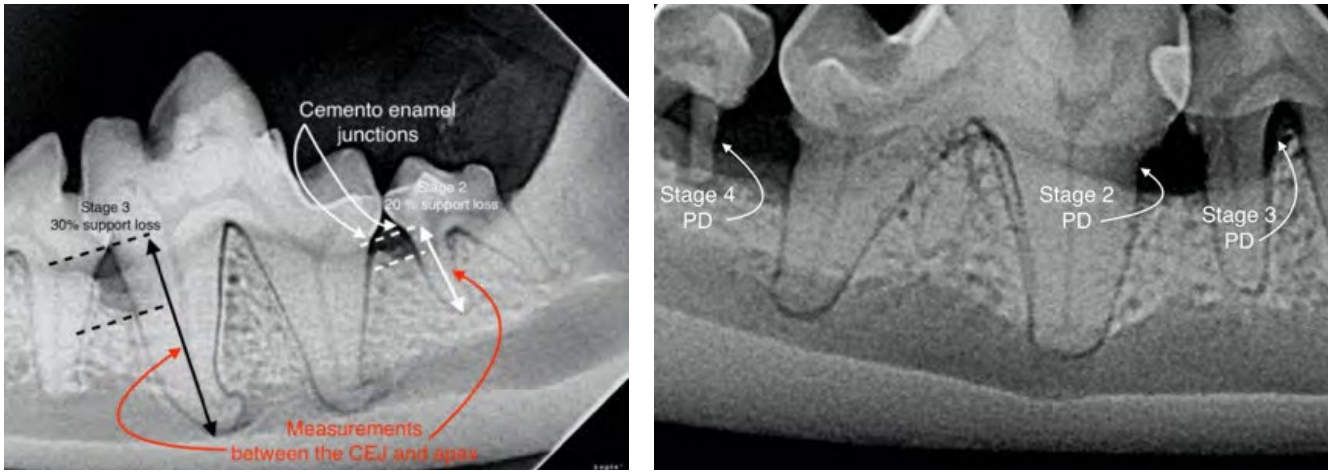


Figure 2. (left) Measurement of bone loss. (right) Stages 2, 3, and 4 periodontal disease.

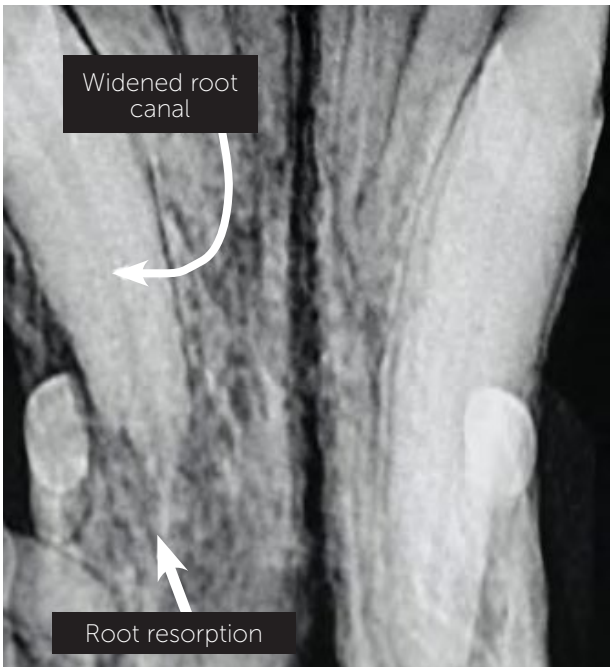


Fig. 3 - Type 1 tooth resorption of the right mandibular canine root.

Fig. 4 - Type 2 tooth resorption of both mandibular canines

feline tooth resorption. Radiographically, when the external resorption lesion is located apically, the apex will appear shortened, blunted, or square, and the lesion will be ragged or irregular. If the lesion is internal resorption, then the root canal system has an enlarged area and the margins of the lesion are sharp, smooth, and clearly defined. The canal is not present in the lesion, and the size is variable.

Classification of tooth resorption takes into account the extent of lesion progression, anatomic location, and etiology. The clinician should know whether the resorption is internal or external and, if external, whether it has extended to the oral cavity. Some investigators believe that 3 radiographic appearances of tooth resorption exist and have clinical significance related to therapy.

Type 1 usually involves loss of alveolar bone adjacent to an often well-defined area of tooth resorption; normal periodontal ligament space is maintained at other areas of the tooth. If the lesion extends to the oral cavity, the entire tooth should be extracted (Fig. 3).

Type 2 involves loss of the periodontal ligament space and lamina dura due to fusion of the tooth root and alveolar bone (dentoalveolar ankylosis); the resorbing tooth structure may appear less radiopaque than the unaffected tooth (replacement resorption) (Fig. 4). If the lesion extends to the oral cavity, the crown can be reduced in height below the gingiva followed by gingival closure.

Type 3 includes features present in types 1 and 2. If the lesion extends to the oral cavity, the tooth should be extracted.

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1. Karadzovska D, Chappell K, Coble S, *et al.* A randomized, controlled field study to assess the efficacy and safety of lotilaner flavored chewable tablets (Credelio™) in eliminating fleas in client-owned dogs in the USA. *Parasites & Vectors* 2017;10:528.

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