

## Investigation and management of canine osteoarthritis

(change in title OK?)

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Osteoarthritis is the most common cause of arthritis in the dog and affects up to 20 per cent of the adult canine population. Other causes of arthritis include, for example, immune mediated and sepsis. In dogs both primary and secondary forms of osteoarthritis occur although the secondary form is far more common. This form occurs following injury or insult to the affected joint, for example, cranial cruciate ligament rupture, articular fracture or osteochondrosis, which initiates the biochemical cascade leading to a common pathway of arthritis.

The susceptibility of any individual to osteoarthritis is related to factors such as genetics, age and systemic factors such as obesity. Superimposed on this inherent susceptibility are local factors such as instability and injury to the joint itself. Models of osteoarthritis are well documented in the literature (Dieppe and Lohmander 2005) but are not within the scope of this article.

Clinically, the major presenting signs are lameness, stiffness, exercise intolerance or an unwillingness/inability to climb or jump. The signs can be attributed to the primary inciting cause, pain associated with arthritis or a combination of both.

### **History**

It is important to start with an accurate and complete history when assessing patients with osteoarthritis. In dogs, osteoarthritis has specific breed and age predilections so the signalment of an animal may help the clinician in reaching a diagnosis. For example, hip dysplasia is present in very young medium- to large-breed dogs and the secondary radiographic changes are evident from a very early age.

More specific questions that need to be asked when taking a history include:

- duration of lameness
- clinical progression
- response to any treatment
- any history of trauma or other inciting causes
- behavioural changes
- response to amount of exercise performed
- effects of weather.

The most common manifestation of osteoarthritis is so-called 'inactivity stiffness'. Owners report that their pet's lameness seems to resolve during exercise but then worsens after periods of rest following these bouts of activity. Other common presentations include a change in the animal's ability to climb, for example, the stairs, or jump, such as into the back of the car.

As part of the history-taking and ongoing management of osteoarthritis there have been recent efforts to design and validate client-based questionnaires that provide a summative score and can be used to assess the severity of the disease at the outset and the response to any treatment. Although these questionnaires have not been fully validated they provide a useful tool in the management of osteoarthritis and are available either as downloads or under licence (Brown and others 2008, Walton and others 2013).

### **Physical examination**

Osteoarthritis is usually secondary to a primary inciting cause so a diagnosis of osteoarthritis alone is usually insufficient and the clinician needs to identify the primary cause. A physical examination should be systematic and complete. It is useful to compare the contralateral limb when assessing the range of motion, and also when looking for soft tissue swelling and muscle atrophy. However, since the most common forms of orthopaedic disease (eg, cruciate disease, elbow dysplasia and hip dysplasia) can frequently present bilaterally this is not always useful.

A complete analysis of the gait should be performed. This is most commonly done in two ways:

- The patient can be examined while in the consultation room during the history taking. This can often reveal very subtle lameness and allows the clinician to monitor the animal lying down and standing up as well when walking around the consultation room.
- Further analysis of the gait should be made in an area that allows the animal to be walked and trotted in a straight line. The animal should be observed walking away from and back towards the clinician, as pelvic limb lameness is often more obvious when walking away and thoracic limb lameness when walking back towards the clinician.
- This is usually performed before the physical examination as the lameness may be worsened by the examination, although repeated single joint examination followed by immediate gait analysis may help to localise lesions, especially in the more subtle cases.

Osteoarthritis is associated with a variety of clinical and physical signs that are similar to many joint -related conditions, such as

- lameness
- reluctance to exercise
- inactivity stiffness
- pain
- Joint effusion
- muscle atrophy
- joint thickening
- altered range of motion
- altered gait
- altered behaviour.

Assessing thickening and effusions in the hip and shoulder are not possible due to the presence of the overlying muscle masses. Assessment of the range of motion should be both to assess any reduction in the normal planes of motion for a joint, for example, flexion and extension, but also to assess abnormal increases in range of motion such as the cranial draw test for cruciate ligament disease. It is often better to perform these latter tests under sedation as they can be painful for the patient and difficult to interpret in conscious animals

After finishing a complete history and physical examination the clinician will often have a good idea of potential differential diagnoses and a plan can be formulated based on this.

### **Further investigations**

**Haematology and biochemistry** are not routinely taken in cases of osteoarthritis unless the history and physical findings indicate a reason to do so. Blood tests may be useful in older animals or where long-term medical therapy is planned.

**Radiography** is the mainstay in clinical practice for diagnosis of osteoarthritis in dogs. However, its limitations must be appreciated as it mainly provides information on the osseous changes, such as sclerosis and osteophyte formation, providing a limited amount of information about the soft tissues. Radiographic signs of osteoarthritis are relatively non-specific and include:

- osteophytosis
- enthesiophytosis
- subchondral sclerosis
- effusion
- soft tissue swelling
- intra-articular mineralisation
- cysts.

Although the presence of osteophytes can be used to diagnose osteoarthritis, there is a tendency for clinicians is to focus on these osseous changes even if they do not necessarily

correlate well to severity of disease or the clinical situation seen. Elbow dysplasia, for example, produces osteophytes very slowly whereas within three or four weeks of a cranial cruciate ligament rupture there will be radiographic evidence of osteoarthritis. It has also been shown that some breeds produce more osteophytes than others despite having the same degree of hip laxity (Smith and others 1995). For this reason, it is important to always evaluate the radiographs in line with the clinical situation in order to appropriately manage the cases.

Subchondral sclerosis is commonly quoted as an indicator of osteoarthritis although its sensitivity on plain radiography is limited, due to the wide variation in exposure factors that can lead to apparent differences in density, and, in one study, detection of subchondral sclerosis was unacceptably low among board-certified radiologists (Innes and others 2004). Care should be taken to not overinterpret this radiographic finding because, taken in isolation, it is not a reliable indicator of osteoarthritis. However, if present in conjunction with other radiographic findings, it can be used to confirm the diagnosis.

**Synovial fluid analysis** is an underused diagnostic test in clinical practice. With osteoarthritis there are early changes that occur in the synovial fluid. In osteoarthritic joints the volume of fluid may be increased, cell counts (predominantly monocytes (>88%)) are usually low (less than  $5 \times 10^9$  WBC/l) and can often be within normal limits ( $<2 \times 10^9$  WBC/l), and the colour remains clear to pale yellow. In the early stages of the disease viscosity is not reduced although, as the hyaluronic acid concentration diminishes over time, the viscosity decreases. Hydroxyapatite crystals are common features in the synovial fluid of human patients with OA but laboratories do not routinely them and the significance with respect to clinical outcome and treatments in dogs is unknown. The authors do not request HA counts from their labs on submitted samples. Biomarkers have been investigated as a possible way of diagnosing osteoarthritis and although several potential markers have been identified, none are validated in the dog.

**Advanced imaging** modalities such as MRI and CT are becoming more routinely available to clinicians and, therefore, their use is increasing in the work-up of orthopaedic cases. For patients with osteoarthritis, CT can be useful in the early stages of disease, as it may help to

identify the primary lesion which may not be present or obvious on radiographs. This is particularly the case for elbow dysplasia, where the primary medial coronoid disease is often not visible on radiographs and progression of osteoarthritis may be so slow that radiographs appear normal when taken. CT is also much more useful than radiography when investigating complex joints such as the elbow, carpus and tarsus.

MRI can be useful as it gives better information about the articular soft tissue structures such as ligaments, menisci and the synovium. The main disadvantage of MRI, apart from its expense, is that canine cartilage is very thin and most of the magnets available to veterinary surgeons are not powerful enough to have a sufficient signal-to-noise ratio to allow accurate detection of cartilage lesions.

**Scintigraphy** is very limited in its availability due to the restrictions governing the use of radioactive material. Its relative lack of usefulness clinically also limits its use. As it can readily identify areas of increased bone turnover, it is most commonly used in cases of occult lameness where the source of the lameness is not obvious.

**Arthroscopy** Although mainly considered to be a surgical tool, arthroscopy also has a diagnostic application and, given its ever-increasing availability, now offers the best and most cost-effective method for staging osteoarthritis in dogs (see surgical management section below). Depending upon the joint involved arthroscopic surgery may involve:

- joint debridement and micropicking of the subchondral bone (to release mesenchymal stem cells)
- assessment of the cartilage surfaces through observation and palpation
- Removal of loose fragments/ lesions to facilitate fibrocartilage formation
- Surgical techniques to stabilise the joint.

## **Management of osteoarthritis**

The management of osteoarthritis may involve a combination of medical and surgical approaches. Owners need to be counselled from the outset that osteoarthritis is likely to be a lifelong process with flare-ups that may increase in severity and frequency as the dog ages. The approach to these cases often involves a balancing act between exercise, medical management, weight management (if the dog is overweight), and surgery.

### **Exercise**

Although one study demonstrated that a short period of exercise (1.2 km of trotting) increased the degree of lameness when measured on a force platform (Beraud and others 2010), very little is really known about the effects of exercise on osteoarthritis. In people it does seem that some exercise may be beneficial and certainly in canine patients exercise should be moderated but continued. Anecdotally, no exercise may be as detrimental as doing extremes of exercise. When advising owners on exercise levels for their dog it is important to advise them to try and avoid exuberant activities such as chasing balls, agility activities or other forms of high-energy exercise. When a flare-up of osteoarthritis has occurred for most patients the best course of action is to reduce the levels of exercise to short frequent lead walks which, if appropriate, are gradually increased over a period of weeks to previous levels of exercise.

### **Medical management**

Drugs that are used to manage osteoarthritis can be divided into two main categories:

- symptom-modifying
- structure-modifying.

**Symptom-modifying:** The main drugs that can modify clinical signs are aimed at relieving the pain associated with osteoarthritis, include:

- NSAIDs
- paracetamol/codeine (Pardale V; Dechra)
- oral opioids (eg buprenorphine, tramadol)
- gabapentin
- amantadine

- corticosteroids.

It is important for clinicians' to abide by the Cascade system when prescribing medication for the management of osteoarthritis and not just go for the more 'fashionable' options. Most cases of osteoarthritis, especially in the early stages, can more than adequately be managed with a balanced approach using licensed medication in combination with other treatment modalities, in particular, weight control.

#### *Non-steroidal anti-inflammatory drugs (NSAIDs)*

These form the backbone of the medical options for the management of osteoarthritis and an ever increasing range of licensed products is available for dogs (Fig 1). NSAIDs work by inhibiting the cyclooxygenase (COX) enzyme in order to reduce prostaglandin production. Two main forms of COX exist, namely COX 1 (constitutive) and COX 2 (inducible), although this classification is somewhat simplified and cross over between the functions of the classes exist. A third class, COX 3, has been identified and may be the target for paracetamol (acetaminophen). COX 3 is found in greatest abundance in the canine brain and paracetamol has a greater ability to cross the blood brain barrier better than other NSAIDs so offers an alternative pathway for pain management. Note, paracetamol is not considered to be a NSAID as it has only weak anti-inflammatory activity.

NSAIDs have been developed to be more selective for COX 2 in preference to COX 1 in order to allow analgesia to occur without creating the common side effects (in particular gastrointestinal irritation and ulceration, nausea, diarrhoea and renal papillary necrosis) associated with inhibiting COX 1. A drug that selectively induces COX 2 inhibition at a concentration lower than that needed to inhibit COX 1 is potentially safer although this is an oversimplification of the actual situation. There is not a clear distinction between the pathways of constitutive and inducible prostaglandins and, in some cases, Cox 2 provides a protective effect (e.g. in inflamed gastrointestinal mucosa). However drugs (e.g. meloxicam and carprofen) that provide analgesia without significant inhibition of Cox 1 pathways (so called Cox 2 selective) have been shown to have greater safety profiles.



Osteoarthritis is a long-term disease and management should be aimed at the chronic pain associated with it and not just the acute flare-up. Many (table 1) (can this data be put into a table??) of the drugs currently available are licensed for use for more than 28 days, which allows the clinician to prescribe long-term therapies although it is prudent to reduce the levels to the lowest effective dose (which may be below that stated in the data sheets), with a return to higher doses in cases of flare-ups. It should also be noted that the efficacy of NSAIDs in individual patients can be very variable and the lack of response to one particular NSAID should not be seen as a lack of response to NSAIDs *per se*. If a change in NSAID is to be trialled then a few days gap (washout) should be left to reduce the risks of side effects. It may be necessary during that period to use alternative analgesia protocols to manage the pain. The licensing laws require drugs in the same class to show efficacy equivalent to current licensed products as well as equal safety so the newer products are not necessarily more efficacious.

#### *Paracetamol/codeine*

*Paracetamol/codeine* (Pardale V; Dechra) is licensed in dogs for use in the management of pain but only for five days and not in conjunction with NSAIDs. Its use in the management of osteoarthritis, within the license, is therefore limited. However, in the human field paracetamol is now routinely used in conjunction with NSAIDs as an alternating protocol and we use similar protocols in our practice, albeit off license. The licensed dose for Pardale V is one tablet per 12.5kg/ twice daily which equates to 33.33 mg/kg of paracetamol. Paracetamol alone is not licensed but the recommended dose rate is 10 mg/kg twice daily. If Pardale V is used in conjunction with NSAID the authors use it at a dose rate of 10mg/kg which equates to one tablet per 40kg twice daily. Pardale V may be useful in cases where NSAID intolerance has been reported or in cases where patients are already on steroid therapy for another reason. The course can be extended for longer than five days but this is again an off license indication. Paracetamol should never be used in cats due to potentially fatal toxicity.

#### *Oral opiates/tramadol*

Tramadol is anecdotally reported to be a popular therapy given by veterinary surgeons although there is little evidence of its efficacy and the drug is not licensed for use in dogs or

cats in the UK. It has recently been reclassified as a Schedule 3 controlled drug. Tramadol is metabolised into eight substrates of which only one is active in the dog, and that is only for a short (one to two hours) period. If tramadol is used then careful monitoring of the patient is needed to ensure adequate levels of analgesia are provided (Benitez and others 2015, Delgado and others 2014).

#### *Gabapentin and amantadine*

Gabapentin and amantadine are drugs that are designed to manage chronic pain but are unlicensed. Amantadine works by acting on the N-methyl-D-aspartate (NMDA) receptor and reduces the prolonged inflammatory pain associated with chronic disease. One study of dogs showed an improvement in terms of both veterinary- and owner-assessed lameness when used with meloxicam compared to those case on meloxicam only; by day 42, the amantadine and meloxicam group had improved scores (Lascelles and others 2008) .

Gabapentin works on the g-aminobutyric acid (GABA) receptor and is thought to reduce neuropathic pain, although its exact mechanism is not known. The use of these drugs should not be routine and each case where this is being considered needs to be carefully judged. In the authors clinic they are generally used in those cases that are refractory to a multimodal management of pain in chronic cases of OA.

#### Corticosteroids

The use of these drugs in the management of osteoarthritis is generally restricted to isolated joints where a long acting intraarticular injection (of methylprednisolone acetate) may provide rapid alleviation of clinical signs without inducing systemic signs. The response, although rapid and significant , is often only relatively short lived and often needs repeating once or twice. Multiple repeats in excess of this are not recommended due to the detrimental effects of the steroid on the articular cartilage. Systemic steroid therapy should be avoided due to the potential side effects of the medication.

#### **Structure modifying drugs**

**Structure-modifying drugs** are less available for dogs due to the strict criteria needed to validate such drugs. The main example includes pentosan polysulphate (Cartrophen; Biopharm Australia), which is a licensed product made from beech and similar in structure to heparin. Clinical trials of this drug have shown mixed results and two systemic reviews have concluded that only a moderate level of comfort is achieved when using this product for canine osteoarthritis (Aragon and others 2007, Sanderson and others 2009)

### **Nutritional management of osteoarthritis**

A lot of effort has gone into the development of nutritional means of managing osteoarthritis recently and an ever-increasing number of nutraceutical products are available to the clinician. However, the majority of these show only anecdotal evidence of efficacy with little evidence to support their claims. As opposed to pharmaceutical products, which are under the direct regulation of the Veterinary Medicines Directorate (VMD) through the Veterinary Medicines Regulations 2006, nutraceuticals are not subjected to the same restrictions unless they make specific health claims. The definition of what constitutes a health claim is quite vague but essentially any claim relating to a specific disease, as opposed to maintaining a healthy body system would require the relevant marketing authority. If no such claims are made then regulation lies with the Food Standards Agency. The regulations are mainly limited to the composition and labelling of the product but also cover food hygiene controls during the manufacturing process.

*In vitro* work into glucosamine has shown that it can alter chondrocyte metabolism and this is the rationale for its use in osteoarthritis. However, the efficacy of glucosamine *in vivo* remains unproven and evidence is lacking as to whether oral glucosamine reaches the chondrocytes in any useful form. Similar findings have been seen with chondroitin sulphate where there has been much debate over whether the molecule reaches articular cartilage intact or as a depolymerised version. The benefits of nutraceuticals in the management of osteoarthritis are debatable and two large double-blinded negative-controlled studies reported no significant efficacy (Clegg and others 2006, Moreau and others 2003) and current evidence remains insufficient to endorse their efficacy in the management of canine osteoarthritis.

Essential fatty acids, in particular omega 3, have been shown to affect synovial fluid metalloproteinase and tissue inhibitors of metalloproteinase concentrations following surgery for rupture of the cranial cruciate ligament (Hansen and others 2008) . Further studies using objective outcome measures showed significantly increased levels of peak vertical force in dogs with osteoarthritis fed the test food diet compared to the control group (Fritsch and others 2010, Roush and others 2010). This improvement was seen in 82 per cent of the test food group compared to 38 per cent of the controls.

### **Weight management**

Obesity is one of the most important medical diseases in dogs, with recent studies suggesting that approximately half of all pet dogs are either overweight ( $\geq 10\%$  above ideal weight) or obese ( $\geq 20\%$  above ideal weight) (German 2006). Overweight dogs often have a number of health concerns and an increased risk of developing other diseases, most notably orthopaedic disease. In addition, a recent study (German et al 2012) has also demonstrated that various aspects of quality of life are worse in obese dogs, as they tend to be less mobile and more likely to show signs of chronic pain than dogs with an ideal weight. Therefore, weight control can be a useful adjunct therapy for overweight dogs with concurrent osteoarthritis. Indeed, recent studies (Mlacknik et al 2006; Marshall et al 2010) have demonstrated that weight loss can significantly improve the gait of obese osteoarthritic dogs, as judged by force-plate analysis. There is also evidence of improved quality of life when obese dogs lose weight, and this includes significant improvements in activity and evidence of a decrease in chronic pain. So, while the evidence for many therapeutic measures (including nutritional modification) have not been well established, the benefits of weight loss are clear. It is worth emphasising that the benefits of increased mobility can be demonstrated with only a modest amount of weight loss; improvements in gait can be observed on force-plate analysis once body weight loss exceeds 6 per cent (Marshall et al 2010). Such a degree of weight loss can be achieved within two to three months, and at least 80 per cent of dogs will be successful with such a programme (Deagle et al 2014).

#### *Weight management strategies*

In the last 10 years, two microsomal membrane transfer protein inhibitor drugs (dirlotapide and mitratapide) have been available, which were licensed (as Slentrol; Pfizer and Yarvitan;

Janssen) for controlled weight loss in overweight dogs. While the reported efficacy in published studies was good (Gossellin et al 2007; Pena et al 2014), performance in clinical practice was more disappointing, and they failed to gain widespread acceptance. In light of this, both drugs have been withdrawn from the market. Therefore, the most widely accepted strategy for weight management continues to be dietary energy restriction in conjunction with increasing physical activity.

Use of weight management should always be considered in conjunction with other forms of medical management and surgery. The sooner a weight management protocol is started, the sooner the benefits will be observed. That said, because the process can take time, it should not be used as the sole strategy, as other medical therapies can alleviate clinical signs sooner. Indeed, combining weight management with other strategies might improve outcomes; for example, if analgesia alleviates chronic pain, mobility can be improved and this might help to promote weight loss. The timing of weight management in relation to surgery should also be considered. Successful surgery can improve mobility and again may improve the outcomes of weight loss; however, delaying surgery until after a period of weight loss may reduce the risks of complications of the procedure. It might also be that, as mobility improves, the need for surgery decreases. As a general guide for an overweight dog with concurrent osteoarthritis, we would suggest a short period of weight management (two to three months) before any surgical procedure, provided that this delay is appropriate. Such a period is a reasonable compromise since, as mentioned above, the vast majority of dogs will successfully lose weight and measurable improvements in mobility will be expected.

### *Dietary management*

Purpose-formulated weight loss diets (do you want to give any eggs here?) should always be used because they tend to be supplemented in essential nutrients relative to energy content, which reduces the chance of malnutrition arising. These diets are often supplemented with protein and fibre, which is known to minimise signs of hunger in the pet thereby improving owner compliance. Food intake during weight loss should be accurately measured, with the exact amount fed depending upon the food used, the dog's sex and whether it is neutered. A recent study has also demonstrated that obese dogs with

orthopaedic disease need a greater level of energy restriction to achieve successful weight loss than dogs that are not lame (German et al 2014). It is critical for the owner to measure food portions precisely (eg, using electronic scales), because other methods (including the use of measuring cups) are unreliable and usually lead to overfeeding. Table scraps and treats should be avoided, although some treats (especially those with a purported health benefit such as a dental chew) can be allowed, provided that the energy content is taken into account within the feeding strategy. A final consideration is how the food should be fed. Rather than using feeding bowls, puzzle feeders are a good idea, and these can either be hollow toys or modified feed bowls. The devices have been shown to slow feed intake dramatically, which can help to reduce hunger and improve enjoyment of the feeding process.

#### *Lifestyle management*

In addition to dietary management, increasing physical activity can help with the weight loss programme. Owners often struggle with weight management programme for their pet because of the strength of the owner-pet bond, and the fact that they are deprived of the main method they use to demonstrate love to their pet. Strategies that increase physical activity can provide an alternative means for an owner to interact with their pet. There is also emerging evidence that including such strategies into weight management programmes might improve the outcomes (Chauvet et al 2011). Suitable strategies include regular lead walking, hydrotherapy (such as the use of underwater treadmills and swimming), and various methods of increasing play activity, including the use of puzzle feeders. Not only do the latter slow food intake, but they can also increase play activity and mental stimulation.

#### *Monitoring the weight management regime*

To maximise the chance of success, the weight management regime needs to be monitored closely, usually by performing regular weight checks. At the start, most clinicians choose to undertake such checks every two weeks, but the interval can be altered if consistent progress is made, and it better suits the owner. The same set of electronic scales should be used to ensure consistency. Body weight checks should be continued periodically after the target weight has been reached (e.g. at 2 weeks, 4 weeks, and 3 months, and then at least twice a year thereafter), in order to reduce the likelihood of rebound weight gain occurring.

Continuing to feed the weight management diet, during the maintenance period, makes the likelihood of rebound less likely (German et al 2012b).

### **Surgical management of osteoarthritis**

Most patients with osteoarthritis can be managed with a combination of medical measures and other conservative measures. However, for some patients and some joints, the response is poor and surgical management should be considered. Although arthroscopic management is relatively routine for people with osteoarthritis, there is little evidence to support it in the management of canine osteoarthritis and so is not recommended.

The mainstay of the canine surgical management of osteoarthritis is total joint arthroplasty. Joint replacements are readily available for the hip, stifle and elbow although bespoke replacements have been performed in other joints. Of these, the total hip replacement is currently the most commonly performed and most reliable arthroplasty, with good to excellent function being achieved in more than 90 per cent of cases (Allen 2012) . Such is the success of this procedure that intervention is now performed at a much earlier stage than previously recommended. Dogs in their early adult years with pain associated with osteoarthritis that is affecting quality of life may well undergo a total hip replacement as this may allow these animals to lead normal, and in some cases full working, lives. Stifle and elbow replacements are technically more challenging and remain salvage procedures where all else has failed.

In some cases, total joint replacement is not possible and arthrodesis may be a suitable alternative. This has the effect of removing the intractable pain although it produces a rigid joint and so is better suited to the low motion joints such as the carpus and tarsus. Elbow, stifle and shoulder arthrodesis is possible and tolerated reasonably well but is technically challenging. Arthrodesis of the coxofemoral joint is not possible, and so a femoral head and neck excision should be performed if replacement is not possible.

In extreme cases amputation is a possibility, although in most cases patients have multi-limb osteoarthritis so careful preoperative assessment is essential to ensure the patient will still be able to ambulate following surgery. Euthanasia is an option in some extreme cases where

the welfare of the animal is a concern and treatment options have failed or are not affordable.

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Table 1 –list of the licensed NSAID products currently available.

<b>Drug generic name</b>	<b>Trade name</b>	<b>Licensed formulation</b>	<b>Species</b>
Meloxicam	Meloxidyl	5mg/ml injection	Dogs/cats
	Meloxidyl	1.5mg/ml suspension	Dogs
	Meloxidyl	0.5mg/ml	Cats
	Metacam	Chewable tablets 1 or 2.5mg	Dogs
	Metacam	5mg/ml solution	Dogs/cats
	Metacam	1.5mg/ml suspension	Dogs
	Metacam	0.5mg/ml suspension	Cats
	RevitaCAM	5mg/ml oromucosal spray	Dogs
	Inflacam	1.5mg/ml oral suspension	Dogs
	Inflacam	1 and 2.5mg chewable tablets	Dogs
	Meloxivet	0.5 and 1.5mg/ml oral suspension	Dogs
Carprofen	Carprodyl	10, 20 or 100mg tablets	Dogs
	Rimadyl	50mg/ml solution	Dog/cat
	Dolagid	50mg tablet and 120mg chewable tablet	Dogs
Phenylbutazone	Phenylbutazone	200mg tablets	Dogs
Mavacoxib	Trocoxil	6, 20, 30, 75 or 95mg chewable tablets	Dogs
Cimicoxib	Cimalgex	8, 30, 80mg chewable tablets	Dogs
	Tolfedine	6, 20 and 60mg tablets	Dogs/cats
Chinchophen	PLT	200mg (plus 1mg prednisolone)	Dogs
Robenacoxib	Onsior	6mg flavoured tablets	Cats
	Onsior	5, 10, 20 and 40mg flavoured tablets	Dogs
	Onsior	20mg/ml solution	Dogs/cats
Firocoxib	Previcox	57 and 227mg chewable tablets	Dogs
Ketoprofen	Ketofen	5, 20mg tablets	Dogs
	Ketofen	1% solution	Dogs
Tolfenamic acid	Tolfedine	4% injection	Dogs/cats
	Tolfedine	6, 20, 60 mg tablets	Dogs/cats

<b>Drug generic name</b>	<b>Trade name</b>	<b>Licensed formulation</b>	<b>Species</b>
Meloxicam	Meloxidyl	5mg/ml injection	Dogs/cats
	Meloxidyl	1.5mg/ml suspension	Dogs
	Meloxidyl	0.5mg/ml	Cats
	Metacam	Chewable tablets 1 or 2.5mg	Dogs
	Metacam	5mg/ml solution	Dogs/cats
	Metacam	1.5mg/ml suspension	Dogs
	Metacam	0.5mg/ml suspension	Cats
	RevitaCAM	5mg/ml oromucosal spray	Dogs
	Inflacam	1.5mg/ml oral suspension	Dogs
	Inflacam	1 and 2.5mg chewable tablets	Dogs
	Meloxivet	0.5 and 1.5mg/ml oral suspension	Dogs
Carprofen	Carprodyl	10, 20 or 100mg tablets	Dogs
	Rimadyl	50mg/ml solution	Dog/cat
	Dolagid	50mg tablet and 120mg chewable tablet	Dogs
Phenylbutazone	Phenylbutazone	200mg tablets	Dogs
Mavacoxib	Trocoxil	6, 20, 30, 75 or 95mg chewable tablets	Dogs
Cimicoxib	Cimalgex	8, 30, 80mg chewable tablets	Dogs
	Tolfedine	6, 20 and 60mg tablets	Dogs/cats
Chinchophen	PLT	200mg (plus 1mg prednisolone)	Dogs
Robenacoxib	Onsior	6mg flavoured tablets	Cats
	Onsior	5, 10, 20 and 40mg flavoured tablets	Dogs
	Onsior	20mg/ml solution	Dogs/cats
Firocoxib	Previcox	57 and 227mg chewable tablets	Dogs
Ketoprofen	Ketofen	5, 20mg tablets	Dogs
	Ketofen	1% solution	Dogs
Tolfenamic acid	Tolfedine	4% injection	Dogs/cats
	Tolfedine	6, 20, 60 mg tablets	Dogs/cats