Osteoarthritis (OA)-what’s new in diagnosis and management?

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1. Introduction
Osteoarthritis (OA) (osteoarthrosis or degenerative joint disease (DJD)) is a disease of synovial joints. Whilst the apophyseal joints of the spine can also be affected, the association between OA of these joints, disc disease and clinical signs is unclear. Consequently the following discussion is limited to the diagnosis and management of osteoarthritic joints of the appendicular skeleton.

2. Diagnosis
The diagnosis of joint disease/OA can involve many different steps from clinical examination to the utilisation of more advanced procedures such as magnetic resonance imaging. This lecture will review the most common tools used in the diagnosis of joint disease/osteoarthritis and highlight some of the newer techniques used in the diagnosis of joint disease and occult lameness in small animals.

The following diagnostic tools will be reviewed:

- Gait evaluation, clinical and orthopaedic examination
- Radiography including conventional and digital and arthrography
- Arthocentesis
- Ultrasonography
- Scintigraphy
- Computed tomography (CT)
- Magnetic resonance imaging (MRI)
- Arthroscopy

Gait evaluation, clinical and orthopaedic examinations
- Observation of dog/cats at stance, walk and at trot is an important and essential part in the diagnosis of osteoarthritis and joint disease. Kinetic and kinematic gait analysis can be used to objectively detect subtle lameness in dogs as well as monitor progression of lameness including clinical patients and clinical trials. These require specialised equipment and training.
- Pain on manipulation of the joint is at the centre of the clinical diagnosis. Flexion, extension, pronation and supination should be performed and compared to the contralateral side. One must appreciate the nature of the patient and some dogs will react to the slightest manipulation whereas others may be very stoic.
- The range of movement may be decreased in chronic joint disease or there may be abnormal movement in the case of injury to supporting structures such as ligaments and tendons.
- The joint may be palpably enlarged due to joint effusion or chronic extracapsular fibrosis. Obviously this will not be detectable in the hip and shoulder. The stifle joint should be palpated with the forefinger and thumb either side of the patellar ligament. This should enable the edges of the ligament to be defined - effusion or fibrosis will make this less easy to feel. In the same way, one can palpate and displace synovial swellings in the carpus and hock. There may be ‘heat’ detectable in some acute inflammatory conditions. Similarly effusions can be palpated on the caudolateral aspect of the elbow, between the lateral supracondylar crest and the triceps muscle, and on the dorsal aspect of the carpus. Palpation of hock effusions is difficult. Extension of the joint may allow a palpation dorsally.
Alternatively the dorsal aspect of the hock can be pressed to assess if the effusion can be felt bulging caudally.

- Metrology: client specific outcome measures such as questionnaires are now being used to help monitor the progression of clinical signs associated with joint disease and lameness [1].

### Radiography

**Conventional** radiography is an excellent imaging technique for imaging bony structures but is a poor method for visualising soft tissue structures. It also provides better spatial resolution than MRI or CT. As well as standard orthogonal views specialist views such as may be employed in certain situations. A top tip is to always radiograph the contralateral limb/bone/joint as this provides a comparator. Stressed views can be used to assess collateral stifle, tarsal or carpal ligament injury. Specialist views such as skyline, oblique, dorsal acetabular trim (DAR) and dorsolateral subluxations views (DLS) can be used in a variety of circumstances and conditions to aid in their diagnosis.

**Digital** radiography has become increasingly used in practice (for comprehensive review see [2]) with new high resolution monitors and advanced patient collection (picture archiving and communication systems (PACS)) systems, it is set to become the future of musculoskeletal imaging. It is important to choose your system correctly in terms or requirements and resolution. This system is useful for templating in elective (tibial tuberosity advancement) and joint replacement surgery (THR).

### Arthrography

- The use of positive contrast within joints may be employed when suspecting or investigating certain diseases. Arthrography can give information on the articular surface, integrity of the synovial capsule, position of cartilaginous joint mice, adhesions in bursae.
- This technique is most commonly used in the diagnosis of suspected shoulder and stifle joint injuries. It is infrequently used in the diagnosis of OA.

### Arthrocentesis

- The analysis of synovial fluid is under-used. It is, in most cases, a very straightforward procedure and may be carried out under heavy sedation for most joints although the shoulder and hip may require heavy sedation/general anaesthesia. It is useful for differentiating between osteoarthritic, infective and immune-mediated disease processes (see lecture for details on technique).

### Ultrasonography

Ultrasonography is useful for assessing joint disease. High frequency transducers (7.5 -15MHz) are recommended and considerable experience is needed to identify joint abnormalities. Sedation is sometimes required for joint examination because of the need to manipulate a painful area, hair must clipped around the area of interest and ultrasound gel applied to ensure good contact between the skin and the transducer [3]. The contralateral joint may need to be examined for comparison. Joint effusion, thickening of the joint capsule and cartilage defects can be identified sonographically [4]. Ultrasonography was not found to be an accurate test for cruciate rupture evaluation [5], identifying 20% of CCL ruptures when compared with cadaver findings [6]. Some experienced operators have a high success rate of identifying medial meniscal tears using a 15MHz linear transducer [7]. Ultrasonography examination has been used to identify Legg-Calve-Perthes disease, hip dysplasia and OA as well as soft tissues injuries around the shoulder joint [3]. We commonly use this for diagnosis of tendon injuries and associated OA around the shoulder joint.

### Scintigraphy

Scintigraphy has been used in assessing dogs with joint disease, namely stifle osteoarthritis [8], but its main application is in lameness investigation if pain is not easily localisable to any one joint [9].
Dogs are injected intravenously with $^{99m}$Tc Technetium methylene diphosphonate, which binds to the osteoblasts of active bone, and then scanned immediately to obtain soft tissue phase images. Bone phase images are obtained 2.5-3.5 hours later. Joints with erosive, osteophytic or sclerotic processes will be highlighted on the image obtained using a gamma camera. Technique is sensitive but non-specific.

**Computed Tomography**
CT is becoming more readily available and is a cross sectional imaging technique using X-rays and computers. CT is better for bone imaging than for soft tissues but better soft tissue differentiation and absence of superimposition are the major advantages of CT over conventional X-Ray techniques. CT greatly facilitates examining complex joint structures such as the elbow and tarsus and has been used in diagnosing talocrural OCD and elbow incongruity. CT arthrography may be useful for shoulder and stifle joint injuries.

**Magnetic Resonance Imaging**
MRI is becoming more available for imaging the joints of small animals. It is expensive but an excellent imaging tool. MRI has clear advantages over CT in delineating peri-articular and intra-articular soft tissue structures. It allows simultaneous visualisation of all of the joint components and can detect a wide range of abnormalities. With the current MRI technology it is often difficult to identify cartilage and its lesions in dogs, this may improve with higher frequency magnets and contrast imaging (dGEMRIC) [10]. The most common indications are for investigation of the internal structures of the stifle joint (menisci and cruciate ligaments) when the diagnosis is not clear, and for investigation of soft tissues in and around the shoulder and elbow joints [11]. On T1-weighted images synovial fluid has low signal intensity (dark) compared to the infrapatellar fat pad, which has a high signal intensity (bright). Articular cartilage has an intermediate bright signal and is separated from trabecular bone by a dark line representing subchondral bone.

**Arthroscopy**
Arthroscopy is an excellent technique to visualise articular structures not visible on radiographs. Arthroscopy allows biopsy and assessment of degenerative joint lesions and can replace the necessity of an exploratory arthrotomy. It has been used extensively in the diagnosis of meniscal lesions in the stifle, soft tissue injuries of the shoulder, ununited aconeal process and incomplete ossification of the humeral condyle of the elbow joint. It can also be used to assess articular cartilage damage prior to joint modification surgery such as triple pelvic osteotomy.

3. **Management/treatment**

**Goals for ideal management/treatment of the osteoarthritic patient:**
- Eliminate pain and inflammation
- Improve joint function
- Eliminate underlying causes of OA
- Halt progression of OA

Therefore management of the osteoarthritic patient is most commonly conservative and multimodal using a combination of NSAIDs, weight control, exercise modification, nutritional management and adjunct therapies. End stage treatment may require excision/arthrodesis/partial or total joint replacement.
1) **NSAIDS**

The mode of action of the modern NSAIDs (carprofen, meloxicam, deracoxib, firocoxib, mavacoxib, robenacoxib) involves reduction of pro-inflammatory prostaglandin (PGE₂) by inhibition of cyclooxygenase-2 (COX-2) and therefore avoids the side effect of COX-1 inhibition (important for normal functioning of urinary and GI tract). However the COX-1 “good” and COX-2 “bad” theory oversimplifies the mode of action of these enzymes as COX-2 is constitutively expressed in the kidney and GI tract. Specificity/selectively is based on a COX-1: COX-2 ratio. A drug which is COX-2 selective is likely to be safer at a lower concentration than that required to inhibit COX-1[12]. More recent COX-2 selective NSAIDs are mavacoxib (Trocoxil, Pfizer), robenacoxib (Onsior, Novartis) and firocoxib (Previcox, Merial). Recent reviews [13] suggest that there may be some benefit in the long term use of NSAIDs in the OA patient.

2) **Weight control**

Obesity has been identified as a contributing cause to certain orthopaedic diseases such as intervertebral disc and cruciate ligament disease [14]. Weight loss has been shown to reduce the clinical signs associated with OA and a lifetime study of dietary intake has shown a reduction in the clinical signs associated with hip dysplasia in high risk dogs with dietary restriction [15]. Canine obesity can also be associated with a subclinical pro-inflammatory state with increased TNF alpha and leptin [16].

3) **Exercise modification**

Exercise modification is very important in maintaining joint function and motion in the OA patient. We recommend frequent short on-lead exercise in the first instance. However its effects are generally undetermined. This is particularly useful in cats with OA. It may be useful to make ramps up to windowsills or other favourite places that cats like to jump. It may also be useful to modify the environment so that cats have to encounter gentle slopes or obstacles to acquiring food in order to encourage activity. Administration of analgesics to cats during this period of increased activity may be expected.

Physical therapy is a rapidly growing area and to date no specific evidence regarding long-term outcome with this treatment modality has been presented. Owners should only go to treatment centres with trained therapists. Physical modalities that can be used in rehabilitation of the OA patient include massage, cryotherapy, ultrasound, and acupuncture.

4) **Nutritional management**

Nutraceuticals are foods or any part of a food which provides medical or health benefits. They include glucosamine, and fatty acids (FA). There is little evidence to date in people or in small animals that glucosamine and related products have a valuable effect in the management of the OA patient.

Fatty acids can be classified as either omega 3 (N3) or 6 (N6). These compounds can help to reduce the production of inflammatory prostaglandins. The ratio of N3:N6 FA has been found to be important in its anti-inflammatory role in canine diets designed for the OA patient. A prescription diet is available with a ratio of omega 6:3 fatty acids (FA) less than 1:1 and contains the N3 FA eicosapentaenoic acid (EPA). Eicosanoids derived from EPA are less pro-inflammatory than those derived for arachidonic acid (AA). In vitro studies have shown EPA to be the only N3 FA to decrease the loss of aggrecan in a canine cartilage model. Clinical studies have reported an increase in the peak vertical force of 82% of dogs on the prescription diet compared to 38% of those on a control diet [17].
5) **Adjunct medications**

Glucocorticoids (corticosteroids) have been used in cases non-responsive to NSAID therapy but have major side effects and should be used sparingly in the management of OA. Have been used for intra-articular injection and in people it is thought that their beneficial effects can exceed their harmful effects [18].

**Tramadol**, an opioidergic/monoaminergic drug, is a synthetic derivative of codeine and has action at the mu opioid receptor. It has been used for oncologic and musculoskeletal pain in dogs at a dose of 2-5mg/kg tid-qid. It has been used in cats but may cause neurological signs [19]. It is also obtainable in combination with paracetamol. There are currently no studies in its efficacy or toxicity in small animals.

**Paracetamol/codeine** (Pardale V, Martindale) (10mg/kg tid) has been used in dogs that are refractory to NSAIDs, it is thought that paracetamol may have a mode of action against a central COX isoenzyme- COX-1 slice variant. It may also activate serotonin receptors.

**Gabapentin** – GABA analogue used in people for neuropathic pain. It should be started at a low dose and tapered to effect and withdrawn slowly. It is not licensed in dogs or cats be can be used in dogs every 8 hours at 5-10mg/kg and at 5mg/kg in cats.

Other drugs such as **amantadine and amitriptyline** may be useful in adjunct to NSAID therapy for chronic pain [19].

**Candidate structure modifying agents for OA** include drugs such as pentosan polysulphate, and polysulphated glycosaminoglycans. Recent systematic reviews suggest that these drugs may achieve a moderate level of comfort in the OA patient [20-21].

6) **Adjunct therapies**

Mesenchymal stem cell therapies for OA involves harvesting adipose tissue and extraction of stromal cells. Its benefits are yet unclear but have been used in one placebo controlled trial [22].

7) **Education**

Educating clients about this condition will ultimately help in their management of OA in their dogs. It is useful if clients know that their osteoarthritic animal can be managed with pharmacological, physical, dietary and surgical modalities to ensure a good quality of life. In humans NSAID therapy has been shown to have a modest effect on pain reduction (20-30%), therefore it is essential that other non-pharmacological modalities are used in the management of the OA patient.

4. **Surgical management**

This is reserved with severe functional effect associated with OA. It consists of joint lavage and debridement, partial and total joint replacement, arthrodesis and excision and euthanasia.
References