Small Animal Osteoarthritis

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The Normal Joint

A healthy synovial joint provides predictable, energy-efficient, controlled and pain-free movement with effective transfer of loading during weight-bearing (figure 1).

The joint is comprised of a thick, fibrous joint capsule, which is lined by the synovium responsible for the production of synovial fluid. This fluid is an ultrafiltrate of plasma and contains a high concentration of the polysaccharide hyaluronan, which is actively produced by the synoviocytes. In addition to lubrication and shock absorption, the synovial fluid also provides a medium through which nutritional components can diffuse from the blood vessels in the synovium to the chondrocytes in the avascular cartilage. The articular (hyaline) cartilage is an intricate collagen network (mostly type II collagen) with a high water content (up to 90% in neonates). In addition to collagen, it also contains proteoglycans and glycoproteins along with smaller volumes of
lipids and chondrocytes, although the microstructure can vary slightly between weightbearing and non-weightbearing areas of joints. Blood vessels, with accompanying lymphatics and nerves enter the joint capsule and extend to within 5µm of the surface of the synovium. Each joint is stabilised by ligaments (e.g. collateral, cruciate, teres) and additionally, the stifle contains fibrocartilagenous menisci which provide additional shock absorption.

The Osteoarthritic Joint

In a healthy dog, more than double the body weight is transmitted through each forelimb whilst galloping and this force can be increased by a factor of ten in a diseased joint. Osteoarthritis clinically affects 25-30% of dogs older than one year and radiographically affects around 22% of cats older than one year. In the dog, primary osteoarthritis is extremely rare: it is almost always secondary to an initiating abnormality (e.g. osteochondrosis or joint laxity).

Osteoarthritis is primarily a non-inflammatory, slowly progressive joint disease characterised by:

- **irregular loss of hyaline articular cartilage** (figure 2), particularly in areas of increased/abnormal load which causes alterations to the cartilage structure (reductions in the proteoglycan concentration, swelling and aggregation of proteoglycans, increased water content, collagen fibril disruption and an imbalance in the synthesis and degradation of matrix macromolecules).
These changes result in increased stiffness and susceptibility to damage when loaded compared with healthy cartilage. The capacity for cartilage repair decreases with age and this may partly explain the increased incidence of osteoarthritis in older animals.

- **sclerosis of subchondral bone** occurs secondary to subchondral microfracture which occurs following abnormal loading of the joint (e.g. in developmental orthopaedic disease such as elbow or hip dysplasia).

- **development of osteophytes and enthesiophytes**, the aetiology of which is unknown but has been attributed to synovial membrane stretching at its insertion, vascular mediated effects, synovial membrane inflammation or remodelling of the degenerative process associated with structural cartilage changes. It is also thought to be associated with the overexpression of transforming growth factor β.

- **variable synovial inflammation**, which may also alter quality and quantity of hyaluronan in the joint. Hyaluronan depolymerisation occurs and this is the reason for the reduction in synovial fluid viscosity and poor mucin clot test result, but it will also detrimentally affect the nutrition of the articular cartilage.

Patients suffering from osteoarthritis display a wide variety of clinical signs varying from mild discomfort to severely debilitating pain. The signs may vary from day to day, with the time of year, or following exercise/rest and will usually worsen gradually over time. It is sometimes difficult for owners to appreciate that the condition is painful because signs seen are often insidious in onset and are readily attributed to ageing. Vocalisation is rare, probably because osteoarthritic pain is described by human sufferers as chronic and dull in nature and it is important that clients are educated about recognising subtle signs of pain. Once they can appreciate this, owners will rarely refuse treatment and in addition they can seek veterinary attention when appropriate and can also help to assess the efficacy of treatment.
Dogs may present with variable degrees of lameness, an altered gait or stiffness, muscle wastage, altered behaviour (e.g. increased aggression or hiding), or an inability to perform certain physical activities (e.g. jumping into the car or climbing stairs). The affected joint(s) may be painful on palpation, with a reduced range of motion, effusion, crepitus, periarticular fibrosis, joint instability or self mutilation (e.g. lick granuloma).

Clinical diagnosis of osteoarthritis is much more challenging in cats (figure 4): lameness is only demonstrated in 43% of cats with OA; periarticular thickening is minimal; 96% of affected joints show a normal range of motion; synovial effusions are seldom obvious and no crepitus can be appreciated.

Lifestyle alterations are the most frequently identified signs of disease and include weight loss, anorexia, depression, abnormal elimination habits, poor grooming habits, aggressive behaviour or resentment of handling. However, signs can be even more subtle and may simply include a reduced height of jump (in 67% of cats with osteoarthritis), and unwillingness to jump (in 71% of affected cats). As such, osteoarthritis should be on every differential list for cats with non-specific complaints. The most reported joints to be clinically affected in cats are the elbow, hip and shoulder.
Diagnostic Tests

Radiography is the initial modality of choice because it is cheap, readily accessible and highly sensitive for the detection of osteoarthritic changes (figure 5), which are essentially characterised by bony proliferation (in contrast, bone erosion is suggestive of rheumatoid arthritis or infection). It is important that good quality orthogonal radiographs of the joint are taken (with stressed views if indicated) and images of the contralateral limb are often helpful to use as a comparison.

Typical radiographic findings might include:

- joint effusion
- bone remodelling
- periarticular osteophytes
- enthesiophytes
- subchondral bone sclerosis
- soft tissue swelling
- subchondral cysts
- NB Joint space narrowing cannot be assessed in the absence of weight bearing.

A 30-50% change in bone density is required before radiographic changes are observable and so clinical suspicions may not be supported if radiographs are taken early in the disease process. Conversely, osteophytes or enthesiophytes may be seen incidentally on radiographs, post mortem or...
histopathology, but are not sufficient for a diagnosis of clinical osteoarthritis because they can develop in the absence of generalised cartilage damage. It is imperative that treatment is tailored to the clinical presentation of the patient and not to the radiograph.

It is also important to consider whether additional joints could be affected, since many dogs with hip dysplasia and hip osteoarthritis often have concurrent degenerative changes in the shoulder, elbow or stifle.

If conventional radiography is unrewarding, additional imaging can be performed and may include:

- Arthrography (figure 6), which can be used to outline the articular cartilage, synovial membrane, various bursae or radiolucent joint mice. It is a technique mainly used in the shoulder, elbow and stifle. Positive, negative or double contrast arthrography can be performed, but the contrast medium (non-ionic, low osmolar) may require dilution before use otherwise it can be too opaque and can mask lesions.

- Arthroscopy, which may help to stage the osteoarthritis but will have little clinical relevance
- Computed tomography, which is particularly useful in the elbow to identify a fragmented coronoid process, incomplete ossification of the humeral condyle or osteochondritis desiccans lesion.
- nuclear scintigraphy, which is most useful when the cause of the lameness is unknown. Intravenously injected technetium 99m is taken up into areas where there is increased metabolic activity of the subchondral bone or periarticular soft tissue and this is shown as a bright region on the bone-phase of the scan.
- magnetic resonance imaging (MRI), which is currently the gold standard for assessing the loss of cartilage in human joints. It is useful in detecting early cartilaginous or soft tissue change which cannot yet be demonstrated by conventional radiography and is currently being explored in canine joints.
- ultrasonography may be used to visualise cartilage or surrounding soft tissue structures of the joint, particularly tendons and nerves.

Arthrocentesis, analysis and culture of synovial fluid is often useful and it should be assessed for colour, turbidity, cell count, cell type and presence of infectious organisms (table 1).
Viscosity can be determined by estimating the length of string that can be formed with the fluid between the thumb and forefinger (figure 8), although the mucin clot test will provide a more objective assessment.

Management

Following diagnosis, any inciting or ongoing disease should be addressed (e.g. stifle stabilisation following cranial cruciate ligament rupture, internal fixation of incomplete ossification of the humeral condyles) but the cause is usually unknown. Even where an insult is resolved, the cartilage will be compromised and the resultant osteoarthritis may necessitate management. Pain is the major concern in humans suffering from osteoarthritis and this is largely attributed to synovitis. Alleviation of pain is the primary goal in veterinary medicine. Other goals include controlling inflammation, maintaining joint function, preventing/slowing down further deterioration (cartilage destruction, osteophyte formation, periarticular fibrosis, subchondral bone loss) and maintaining a normal biochemical environment within the joint and synovial fluid.

The management of osteoarthritis has been discussed in previous articles and should include a dynamic and multimodal approach incorporating:

- Weight control
- Exercise control
- Analgesia
- Complementary therapies such as acupuncture
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Figure 1: The structure of a synovial joint. Image courtesy of Martin Owen
Figure 2: Osteoarthritis is characterised by the irregular loss of hyaline cartilage which occurs in the regions of abnormal weight bearing. Photo courtesy of Neil Burton
Figure 3 The development of osteophytes is evident along the lateral aspect of the medial condylar ridge intraoperatively. Photo courtesy of Neil Burton.
Figure 4: Osteoarthritis is challenging to diagnose in cats. Often clinical signs will be non-specific. Photo courtesy of Sam Taylor.
Figure 5a-d: Radiography is the initial modality of choice for the diagnosis of osteoarthritis and multiple high quality views should be taken. It is often useful to radiograph the contralateral limb for comparison. Radiographs reproduced with thanks from Bristol University Small Animal Radiology Department.
Figure 6a,b : Positive contrast shoulder arthrography. Radiograph reproduced with thanks from Bristol University Small Animal Radiology Department.
Figure 7: MRI is being increasingly used in small animals to investigate joint disease and is the gold standard in human medicine. Photo courtesy of Neil Burton
Figure 8a: Arthrocentesis can be extremely useful in determining the cause of joint Disease. Arthrocentesis of the stifle joint
  8b: Blood tinged and turbid synovial fluid
  8c: Normal synovial fluid (right) compared to water (left). Photo courtesy of Martin Owen.
  8d: The viscosity of the synovial fluid can be assessed simply using the ‘string test’. Photo courtesy of Martin Owen.
Further Reading


Budsberg, SC (2001) Long-term temporal evaluation of ground reaction forces during development of experimentally induced osteoarthritis in dogs, American Journal of Veterinary Research, 62, 8, 1207-1211


