CHAPTER 7
ARTHROLOGY

Feline arthrology has been an overlooked subject in the past with most reviews of joint disease in small animals focusing on the dog. However, cats are now known to suffer from many different types of joint disease and, although there are many similarities with the dog, there are also many features that are unique to the feline patient.

CLASSIFICATION OF JOINT DISEASE

The terms arthritis and arthropathy literally mean joint inflammation and joint disease, respectively. These terms are used interchangeably in this chapter to describe a number of well defined joint diseases characterized by a combination of inflammatory and degenerative changes. The terms degenerative joint disease (DJD) and osteoarthritis are also often used synonymously. In this chapter, DJD is used as a general descriptive term to encompass degenerative changes in any joint in the axial or appendicular skeleton, including synovial, cartilaginous, and fibrous types. When DJD affects the fibrocartilaginous intervertebral joints of the spine, it is known as spondylosis deformans (see Chapter 11). The term osteoarthritis is reserved for the specific type of DJD that affects diarthrodial synovial articulations.

Diseases of synovial joints can conveniently be divided into degenerative arthritis and inflammatory arthritis on the basis of the predominant pathologic process (*Table 20*). Degenerative arthropathies are the most common types and include traumatic arthritis and osteoarthritis. Inflammatory arthropathies are less common than degenerative arthropathies and have either an infective or immune-mediated etiology. Infective arthritis caused by bacterial infection (septic arthritis) is the commonest type of inflammatory arthritis in the cat. Septic arthritis is classed as an erosive type of arthritis because there is destruction of articular cartilage in joints infected by bacteria. Immune-mediated arthropathies can be subdivided into both erosive and nonerosive forms. Differentiation between the infective and immune-mediated forms of inflammatory arthritis is essential since the therapeutic approaches to these conditions are diametrically opposed. Inappropriate treatment of an infective arthritis with immunosuppressive drugs will have disastrous results.

TABLE 20 CLASSIFICATION OF JOINT DISEASE.

Degenerative arthritides		**Inflammatory arthritides**		**Miscellaneous joint disorders**
	Osteoarthritis	*Infective arthritides*	*Immune-mediated arthritides*	Synovial sarcoma
Traumatic arthritis	Primary	Bacterial (septic)	Systemic lupus erythematosus	Secondary neoplasia
	Secondary	Bacterial L-form	Polyarthritis/meningitis	Hypervitmainosis A
		Mycoplasmal	Idiopathic	Osteochondroma
		Calicivirus	Periosteal proliferative	Synovial osteochondromatosis
		Lyme disease	Rheumatoid	Synovial cysts
		Tubercular		Patellar malformation
		Fungal		Meniscal calcification
				Osteochondritis dissecans
				Osteochondrodysplasia in the Scottish Fold cat

INVESTIGATION OF JOINT DISEASE

SYNOVIOCENTESIS

For details of synoviocentesis and analysis of synovial fluid see Chapter 2.

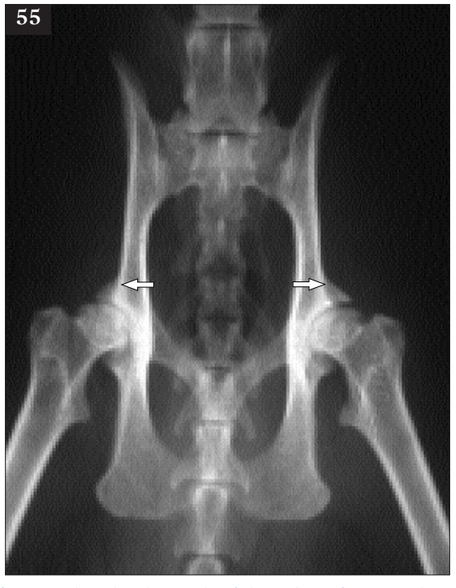
RADIOGRAPHY

Radiography is the most frequently used ancillary diagnostic aid in the investigation of joint disease. Radiographs should be interpreted in the light of the clinical findings and not used as a substitute for a correctly performed clinical examination. Radiography is usually used to confirm a suspected clinical diagnosis or to differentiate between two or more joint diseases that have similar clinical characteristics. However, radiographic surveys of multiple joints might be indicated to evaluate the overall status of the patient in conditions that are frequently polyarticular, such as osteoarthritis or immune-mediated arthritis. Radiographs of other body regions may be indicated; for example, in cats with joint trauma or neoplasia or some of the immune-mediated arthritides to check for evidence of lesions elsewhere.

Feline joints are small so it is essential to obtain high quality radiographs if they are to be of diagnostic value. Radiographs of joints should be correctly collimated to minimize scatter and obtained using fine detail screens in two orthogonal planes (i.e. at right angles to each other). Human mammography film/screen combinations are especially useful for radiographs of the distal extremities. Additional stress views may be performed in the evaluation of joint instability. Oblique projections and special views to outline certain structures are performed less frequently in the cat than in the dog. It is often useful to radiograph the contralateral joint to provide a normal radiograph for comparison or because some conditions occur bilaterally. General anesthesia or heavy sedation is usually required for optimal positioning.

Radiographic interpretation must be thorough and complete so that each structure is assessed according to its Roentgen signs. Radiographic lesions in feline joint disease are often subtle and the use of a magnifying glass and a bright light in addition to a normal viewer is recommended. The radiologist should be familiar with normal feline osteology and with the radiographic appearance of normal feline joints. Accessory centers of ossification and sesamoid bones may be present in or around joints and these ossicles should not be confused with chip fractures. For example, an accessory center of ossification may be present as a normal anatomic variant in the shoulder joint on the caudal or medial rim of the glenoid. Methodical examination is essential; the most common error is to find the expected abnormality and then to stop interpreting the radiograph before the whole film has been assessed. All three components of the joint should be evaluated radiographically: the bones, the soft tissues, and the joint space. The specific features that should be examined are the bony anatomic relationships, subchondral bone plates and subchondral bone of the epiphyses, the width and contents of the joint space, the articular margins and periarticular regions, and the periarticular soft tissues. The radiographic appearance of some disorders that are familiar to the canine clinician may differ in the cat. For example, the predominant radiographic signs of feline hip dysplasia are a shallow acetabulum with remodeling of the craniodorsal margin but with minimal remodeling of the femoral neck (**55**)[1].

- The anatomic relationships of the bones making up the joint may be altered with joint luxation, subluxation, and intraarticular fracture. Reference to a radiographic atlas, a file of normal cat radiographs, or a radiograph of the contralateral joint may be helpful, especially for the smaller more complex joints of the distal extremities.
- The subchondral bone plate should appear as a thin radiopaque line parallel to and adjacent to the joint space. Erosion of the subchondral plate occurs with erosive immune-mediated or infective arthritides, osteomyelitis, and joint neoplasia. Localized areas of sclerosis and remodeling of the subchondral plate may be seen at the margins of destructive lesions, such as osteomyelitis. However, sclerosis is more commonly seen as a generalized change in chronic osteoarthritic joints where there is loss of articular cartilage and eburnation of the opposing joint surfaces.
- The subchondral bone of the epiphysis subadjacent to the subchondral plate should have a homogenous appearance. In comparison with the dog, the cancellous bone of cats has a coarse trabecular pattern. Osteomyelitis, neoplasia, and articular fracture will cause an alteration in the internal architecture of the trabecular bone. Subchondral cysts are occasionally seen in osteoarthritic joints in cats as discrete radiolucent defects in the subchondral bone.
- Joint space width may be increased with joint subluxation or luxation. Narrowing of the joint space is indicative of loss of articular cartilage but cannot be appreciated on normal nonweight-bearing radiographs.
- Joint space structures are contained between the subchondral bone plates of the opposing bones that comprise the joint. This space, therefore, includes the articular cartilage, synovial fluid, and intracapsular fat (and intraarticular ligaments, menisci, and synovial effusion when present). Intraarticular structures are only visible when they become mineralized[2] or when increased joint mass results in distension of periarticular soft tissues or alteration of other intraarticular structures. An example of the latter would be a reduction in size of the infrapatellar fat pad in the stifle, associated with a synovial effusion. Differentiation between increased joint mass associated with the presence of soft tissue or fluid cannot be made radiographically and requires synoviocentesis.
- The articular margins and the periarticular areas where ligaments and tendons attach should have a regular, smooth cortical outline. Osteophytes generally develop at the articular margins where they appear as characteristic bony outgrowths. Osteophytes are most commonly associated with osteoarthritis. Osteophytes that develop at the site of bony attachment of the joint capsule or at ligament or tendon insertions are known as enthesiophytes.
- Periarticular soft tissues are assessed for swelling, thickening, and mineralization. Swelling most commonly occurs as a result of acute trauma, for example joint sprain, whereas thickening is a chronic change most often associated with joint instability, such as chronic cranial cruciate ligament (CrCL) rupture. It is not possible to differentiate between thickening and swelling radiographically. Mineralization of periarticular tissue is a rare occurrence. It is occasionally seen as a sequela to chronic inflammation, for example bacterial infective arthritis, and is also a feature of synovial osteochondromatosis.



55 Ventrodorsal radiograph of the pelvis of a cat with coxofemoral osteoarthritis secondary to hip dysplasia. Note the remodeling of the cranial margins of the acetabula.

Contrast arthrography

Contrast arthrography is rarely performed in the cat. Positive contrast arthrography involves the injection of a contrast agent into a joint space so that it mixes with the synovial fluid and delineates the internal margins of the joint. The contrast agent of choice is iohexol (Omnipaque 300; Nycomed), which is diluted 50:50 with sterile water to give a concentration of 150 mg of iodine per ml. The technique is most useful for investigation of shoulder joint pathology. The volume of contrast agent required for suspected articular cartilage lesions (0.5–1.0 ml) is less than that required to detect capsular defects or to outline the biceps tendon of origin (2.0–3.0 ml).

SONOGRAPHY

Ultrasonography has potential value for the investigation of joint disease but there are few reports of its use in cats[3–5]. The evaluation of bone is limited because of the inability of ultrasound to penetrate osseous tissues. However, sonography may be useful in the identification of joint effusion, joint thickening, articular or bone destruction, and joint instability using a dynamic examination. Periarticular soft tissue structures that may be examined with ultrasound include muscles, tendons, abscesses, cysts, foreign bodies, and tumors. Use of the technique is likely to remain restricted to specialized centers because of the small size of the structures under investigation and the difficulty in the interpretation of the images obtained.

ARTHROSCOPY

Arthroscopy is rarely used in the investigation and treatment of feline joint disease. Examination of the shoulder and stifle joints is possible[6,7] but so far there are mostly only anecdotal reports of its success. There is one report of the successful evaluation and debridement of the elbow joints of a cat with intraarticular osteochondral fragments[8]. Application of arthroscopy to other feline joints is likely to remain limited because of their small size.

Laboratory tests

A minimum database for investigation of a suspected inflammatory arthropathy would include a biochemistry and hematology panel and tests for feline leukaemia virus (FeLV) and feline immunodeficiency virus (FIV). This may help to identify cats that are immunosuppressed or those that have involvement of other body systems, such as may be seen with some immune-mediated arthritides, (systemic lupus erythematosus and idiopathic polyarthritis types II, III, and IV). Further investigation of joint disease requires synoviocentesis and synovial fluid analysis (see Chapter 2). Individual tests, such as measurement of titers for rheumatoid factor, antinuclear antibody, or antibodies to *Borrelia burgdorferi*, may be indicated in appropriate circumstances. These tests are discussed more fully with the relevant joint disorders.

Synovial membrane biopsy

Biopsy of the synovial membrane or synovium is rarely performed in the cat. The procedure can provide an invaluable insight into the pathology affecting a joint and is the only way of achieving a definitive diagnosis in some cases. Samples are usually collected by means of an arthrotomy and should be obtained from several different sites to ensure that the changes seen are representative of the pathologic process in the entire joint.

The histologic appearance of feline and canine synovial membrane is similar[9]. Histopathologic examination can provide precise information about the extent and type of cellular infiltrate, allowing differentiation between degenerative and inflammatory joint disease. Although there is considerable overlap between diseases, the nature of an inflammatory cell infiltrate may help in determining the type of inflammatory arthritis. Histopathology is the only way of achieving a definitive diagnosis of joint neoplasia. Samples of the synovium can also be submitted for bacterial culture and may be more likely to yield organisms than synovial fluid.

DEGENERATIVE ARTHRITIDES

Traumatic arthritis

Cause and pathogenesis

Traumatic arthritis follows a single acute joint injury caused, for example, by vehicular trauma, an awkward fall, gunshot wounds, or fights with other animals. The least severe form of injury is a joint sprain, in which there is variable stretching or tearing of ligaments and joint capsule. Joint luxation involves a more severe disruption of peri- and intraarticular structures, with tearing of ligaments and joint capsule and disruption of articular cartilage. Intraarticular osseous and/or cartilage fractures are associated with the more severe traumatic injuries and may occur in isolation or combined with joint luxation or subluxation. Following a traumatic incident there will be hemorrhage within the joint and synovitis, which may be localized to the site of injury.

Clinical signs

Clinical signs include lameness, joint swelling, joint deformity, and pain on manipulation. Crepitus will be present if there is fracture or luxation.

Diagnosis

If fracture or luxation is suspected, radiography should be performed. Joint instability and ligamentous disruption are evaluated by manipulation under general anesthesia and stress radiography. Injury to individual ligaments is most commonly encountered in the stifle and tarsocrural joints. Joint sprains are classified according to the severity of the ligamentous injury as first, second, and third degree.

Treatment and prognosis

A more detailed discussion of the treatment of traumatic disorders relating to specific joints can be found in Chapters 8 and 9. In general, treatment of joint trauma depends on the severity of the injury. First degree sprains are mild and only require rest and/or anti-inflammatory medication. Second and third degree sprains and more severe types of joint injury such as intraarticular fracture usually require external coaptation or surgical repair. Osteoarthritis will occur as a sequela to traumatic arthritis if there are repeated mild to moderate episodes or if a single episode is severe enough to cause significant damage to the joint.

Osteoarthritis

Osteoarthritis is a type of DJD that is defined as a disorder of diarthrodial synovial articulations characterized by degeneration of articular cartilage, bone remodeling, pathologic changes in periarticular tissues, low-grade nonpurulent inflammation, and the formation of new bone at the articular margins. Osteoarthritis may be classified into primary and secondary forms. Primary osteoarthritis is thought to occur as a consequence of an inherent defect in the articular cartilage so that it is unable to cope with normal joint forces, whereas secondary osteoarthritis is secondary to some other joint disorder. Most osteoarthritis is thought to be secondary in the cat. In a recent retrospective study of cats over 1 year of age

rediographed for any reason, 22% showed evidence of osteoarthritis of an appendicular synovial joint, although this was not clinically apparent in 67% of cases[10]. In another study of 100 cats over 12 years of age, radiographic evidence of DJD was found in 90% of cats and severe osteoarthritis was found in 17% of elbow joints[11]. The realization that osteoarthritis is a common clinical problem in the cat is a relatively recent phenomenon[12].

Cause and pathogenesis

Osteoarthritis as a cause of chronic pain is common in the geriatric cat, but it may be seen in any cat with joint abnormality or following injury. It is postulated that the inciting cause is repeated joint trauma associated with the cat's agile life style and ability to jump. In accordance with this theory, some studies have found that the shoulder and elbow joints of geriatric cats are preferentially affected. Osteoarthritis may also be secondary to gross trauma, such as joint fractures, luxations, and ligamentous disruption. Developmental diseases, such as hip dysplasia or patellar luxation, may lead to osteoarthritis. Osteoarthritis has been reported in multiple joints as part of feline mucopolysaccharidosis VI[13] and associated with acromegaly in middle-aged cats caused by a pituitary adenoma[14]. The pathogenesis of acromegalic arthropathy is not fully understood but it is thought that cartilage hypertrophy may interfere with cartilage metabolism, thereby causing cartilage degeneration.

Despite multiple etiologies, the pathologic changes of osteoarthritis share a final common pathway that serves to perpetuate the degenerative processes. Attention usually focuses on the articular cartilage but, typically, all of the joint structures are involved. Cartilage becomes fibrillated and ultimately may be completely lost, exposing the underlying subchondral bone, which responds by becoming thickened. The other main feature of osteoarthritis is the production of osteophytes, which initially develop outside the epiphysis of the joint, but eventually become incorporated into the joint, so that the joint assumes a different shape. This process is known as remodeling and is thought to be a mechanism that allows the joint to cope better with the altered stresses placed on it. Osteophytes are usually thought of as a chronic change in osteoarthritis, but they have been shown to start to develop within 1 week of experimental induction of joint instability[15]. Enthesiophytes are soft tissue mineralizations that develop when there is pathology of the entheses, which are osseous insertion sites of ligaments and tendons. Additional soft tissue mineralization may occur as a result of capsular dystrophic calcification or synovial metaplasia. Degenerative enthesiopathy and intraarticular or periarticular soft tissue mineralization often accompany osteoarthritis, but may also occur independently. Other pathologic changes include thickening of the joint capsule, an increase in vascularity with hypertrophy and hyperplasia of the lining layer of the synovial membrane, and degeneration of intraarticular menisci. The degeneration of articular cartilage that occurs in osteoarthritis may be associated with the formation of osteocartilaginous bodies that remain free in the joint, disappear, or become embedded in the synovium. Subchondral cysts are an occasional feature of osteoarthritic joints in cats. A cyst develops when there is replacement of subchondral bony trabeculae by mixed connective tissue.

Clinical signs

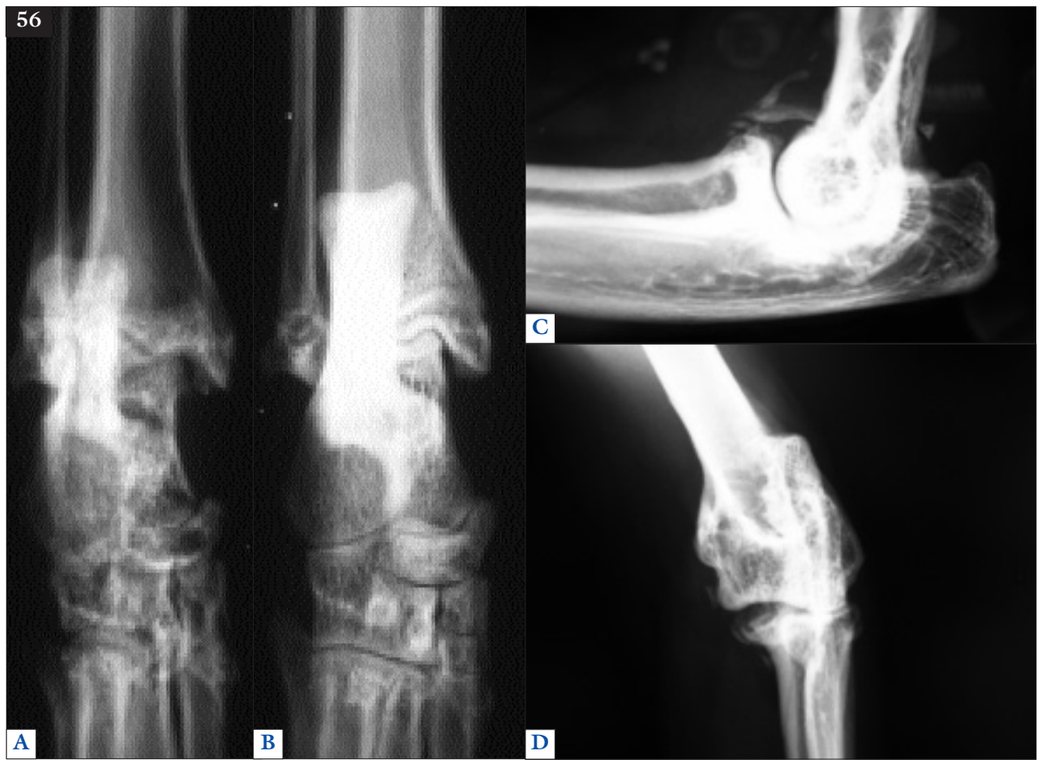
Osteoarthritis is an emerging disease of the older cat. Osteoarthritis has long been recognized radiographically in cats but, because the disease may be asymptomatic, the changes were often considered incidental. The lack of attention to feline osteoarthritis may be explained by a tendency to extrapolate information from the dog where the cardinal sign of osteoarthritis is lameness. It is now believed that behavioral changes reflecting chronic pain are more relevant to the diagnosis of osteoarthritis in the cat. Because cats are small, light, and agile they compensate well for musculoskeletal disease and are able to adapt by redistributing weight-bearing forces to other limbs. Additionally, because the cat's lifestyle prevents critical analysis of the gait by the owner, mild lameness or joint stiffness usually passes unnoticed. Behavioral changes reported by owners of cats with osteoarthritis are nonspecific and include those associated with attitude (hides away, resents handling, bad tempered, less playful) and those associated with disability (reduced grooming, cannot jump, inactive). Lameness and stiffness associated with osteoarthritis typically have an insidious onset and are chronic and progressive in nature. As in other species, signs are worse on rising after a period of rest following exercise and initially wear off after the animal warms up. The signs may tend to wax and wane and are usually exacerbated by cold and damp weather. Acute flare-ups of the signs of established osteoarthritis may occur as part of the natural history of the disease or be associated with joint sprain or sepsis. Osteoarthritic joints are susceptible to trauma and are also at increased risk of infection spread hematogenously from a septic focus elsewhere in the body.

Diagnosis

In advanced cases the diagnosis of osteoarthritis may be obvious, especially if there is overt lameness. Affected joints will be thickened on palpation owing to bony remodeling, joint capsule fibrosis, and synovial effusion. It is not usually possible to appreciate this in the shoulder and hip joints because of the surrounding soft tissues. Manipulation of a joint with osteoarthritis will usually be resented and there may be crepitus and a reduced range of joint motion. The subtler behavioral changes associated with osteoarthritis may be caused by many other diseases, and careful assessment of the geriatric cat is required to establish their significance. This may include radiographic and laboratory evaluation to confirm the presence of osteoarthritis and rule out intercurrent disease.

The radiographic changes of osteoarthritis are similar to those of the dog (**56**). The most striking feature is the presence of osteophytes. These are visualized as roughening of the joint margins, as obvious bony masses (spurs or exostoses) projecting beyond the normal bony outline, or as irregular bony densities when superimposed on the normal osseous architecture. There will be secondary soft tissue swelling with thickening of the joint capsule and there may be an increase in joint mass owing to synovial effusion. Although enthesiophytes and/or soft tissue mineralizations are commonly seen in osteoarthritic joints, these features alone are not indicative of osteoarthritis. With advanced osteoarthritis there will be changes in bone shape due to remodeling, accompanied by sclerosis of subchondral bone and, occasionally, subchondral bone cysts visualized as discrete radiolucent defects.

Analysis of the synovial fluid from affected joints can be performed to rule out inflammatory joint disease. The fluid from joints with osteoarthritis is normal or has only a slight reduction in viscosity and a minimal increase in cell numbers, with macrophages and lymphocytes predominating.



56 Osteoarthritis. **A** Plantarodorsal radiograph of a cat with osteoarthritis of the hock joint secondary to previous trauma. **B** Plantarodorsal view of the contralateral normal hock joint. **C** Mediolateral radiograph of a cat with osteoarthritis of the elbow. **D** Craniocaudal view of the joint in **C**.

Treatment and prognosis

The approach to the management of osteoarthritis in the cat is similar to that for dogs. Options include exercise modification, weight control, the use of drugs, and surgical intervention. Potential problems with the management of osteoarthritis include lack of familiarity with the disease in cats, difficulties with lifestyle modification, and the toxicity of available drug therapies. Despite this, the prognosis for osteoarthritis is generally better than that for the dog because cats are smaller and more athletic.

Modification of a cat's exercise regimen may be difficult but some control is possible; for example, by altering the environment or by only allowing the cat out at set times each day. Strategies used in the dog, such as restricted leash exercise and aquatic therapy, are sometimes appropriate for the cat. Lameness associated with flare-ups of osteoarthritis should be managed by enforcing strict confinement for a few days.

Weight loss is essential if the cat is obese and use of a commercial low-calorie diet is recommended. Conversely, geriatric cats that are underweight should be fed a calorie-dense diet, since osteoarthritis will worsen if they stop exercising as energy levels decline.

Pain control in cats with osteoarthritis has been a problem in the past because of a lack of drugs specifically licensed for long-term use in the cat (*Table 21*). Cats are more susceptible than other species to the adverse effects of nonsteroidal antiinflammatory drugs (NSAIDs) because of a deficiency of glucuronide conjugation. Slower drug metabolism and a longer half-life lead to accumulation of toxic amounts much faster in cats than other species[16,17]. Currently the only drugs for which safe chronic doses have been established by clinical usage are aspirin and meloxicam. Even with these drugs it is essential that dosing is performed accurately if toxic effects are to be avoided[18,19]. Aspirin is only available in human formulation and it is not commonly used in the cat for the treatment of osteoarthritis. Meloxicam is available in an injectable form and as a syrup, which is palatable to cats and

Table 21 Orally administered drugs and nutraceuticals used in the management of osteoarthritis.

Drug	Dose (mg/kg)	Dose (5 kg/cat)	Remarks
Meloxicam 1.5 mg/ml suspension	0.1 mg/kg once daily for 5 days then 0.02–0.04 mg/kg	5 drops once daily for 5 days then 1–2 drops once daily	Suspension is palatable
Tolfenamic acid 20 mg tablet	4 mg/kg	20 mg once daily	Do not exceed 3 days' use
Ketoprofen 5 mg tablet	1 mg/kg	5 mg once daily	Do not exceed 5 days' use
Flunixin meglumine 5 mg tablet	1 mg/kg	5 mg once daily	Do not exceed 3 days' use
Aspirin 75 mg & 300 mg tablets	15 mg/kg	75 mg every 48 hours	May cause gastrointestinal side-effects
Prednisolone 1 mg & 5 mg tablets	0.1–0.5 mg/kg	0.5–2.5 mg once or twice daily	Taper to every 48 hours
Butorphanol 5 mg tablets	0.5–1 mg/kg	2.5–5.0 mg two or three times daily	Sedative side-effects
Cosequin regular strength		1 capsule once daily for 6 weeks then once daily or 1 every 48 hours	Contains glucosamine, chondroitin sulphate, glycosaminoglycans, manganese ascorbate