Canine stifle: diagnostic imaging

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Kate Bradley discusses the benefits of radiography, and looks at how alternative methods stack up against it.

Summary

The stifle is a common site of lameness in dogs. This article reviews diagnostic imaging in dogs with lameness localised to the stifle. The emphasis is on radiography and the radiological features that can be seen associated with stifle injury and disease, as this remains the most commonly used modality in veterinary practice. Imaging with other modalities, including ultrasonography, magnetic resonance imaging and computed tomography, is covered briefly, including their main indications and the advantages they can confer over radiographs.

Key words

dog, stifle, radiology, diagnostic imaging

HINDLIMB lameness in dogs is common, with the majority of cases resulting from either hip or stifle pain.

When pain can be clinically localised to the stifle, imaging of this area plays an important role in the diagnosis, assessment and monitoring of some subsequent surgical interventions.

Radiography of the stifle
Radiography remains the primary technique used in first opinion and referral practice. Animals should be heavily sedated or under general anaesthesia to facilitate accurate positioning. A standard examination of the stifle should include mediolateral and caudocranial views. An optimal mediolateral radiograph should have the femoral condyles superimposed, and should be exposed so that the soft tissues are clearly visible.

A caudocranial view may be taken with the animal in sternal recumbency, with the affected hindlimb drawn caudally and the body tilted slightly towards this side. Alternatively, using a horizontal beam makes it easier to obtain a straight caudocranial view (Figure 1), but due attention should be paid to radiation safety – particularly the wall or other barrier at which the beam is directed.

If there is any doubt as to the suitability of the room for horizontal beam work, advice should be sought from the practice’s radiation protection advisor.

Oblique views at 45° to the standard projections will add information in some cases, but are rarely taken. A craniodistalcranioproximal oblique view may also be useful – in some cases – for assessing the patella and depth of the trochlear groove, particularly in cases of patella luxation or trauma. This view can be obtained with a horizontal beam, placing the patient in dorsal recumbency, with the affected limb flexed and the cassette placed proximal to the stifle. In cases of suspected instability, particularly collateral ligament injury, stressed views (which can be safely obtained by means of tapes proximal and distal to the joint) will demonstrate increased joint movement on the affected side.

If certain surgical techniques are planned, such as a tibial plateau-levelling osteotomy (TPLO), it may be necessary to include the hock to facilitate certain measurements, such as the angle of the tibial plateau. In these cases, it is preferable to take two views on one film or digital imaging plate, with the first centred over the stifle and the second centred over the hock, making sure that the limb does not move between the two exposures (Figure 2). It is also necessary to standardise positioning for these by angling both the stifle and the hock at 90° of flexion.

Some means of measuring magnification may be needed to facilitate the accurate choice of implants – devices are commercially available to enable this (Figure 3).

**Radiology of the stifle**

The stifle should be assessed for both bone and soft tissue pathology. The infrapatellar fat pad and the fascial planes caudal to the stifle allow a radiographic assessment of the soft tissues in the joint space and whether the volume of the soft tissue within the joint is increased by effusion, haemorrhage and so on.

**Incidental findings**
Bipartite or multipartite fabellae are seen as a congenital condition in dogs, especially poodles and fox terriers. In some toy breed dogs (and cats), the medial fabella may be smaller than the lateral fabella, and can occasionally be completely non-ossified. Distal displacement of one fabella (usually medial) may occasionally be seen in terrier breeds.

**Cruciate disease**

Cruciate disease remains the most common cause of stifle pain in mature dogs. In some cases, it is possible to see cranial displacement of the tibia radiographically, analogous to the “cranial drawer” detected clinically (Figure 4).

However, in many cases, radiographic changes are not specific for cruciate rupture, but reflect degenerative changes that occur secondary to stifle instability. Effusion is a common finding that is seen radiographically as reduction or obliteration of the infrapatellar fat pad, and caudal displacement of the fascial planes.

Secondary osteoarthritis (OA) is usually present in more chronic cases, and osteophytes may be visible on the trochlear ridges of the femur, the tibial plateau, the patella and the fabellae.

**Trauma**

Trauma can manifest in the stifle in many ways. In younger dogs, avulsion fractures of the tibial tuberosity can occur (Figure 5a), often due to intrinsic forces, with the owner not reporting any incidents of external trauma.

The main radiographic feature with this injury is displacement of the tibial tuberosity cranially and/or proximally, with widening and irregularity of the physis. It is important not to confuse the appearance of the normal physis for a fracture – the tibial tuberosity joins the tibial plateau at six to eight months, and they subsequently fuse to the tibial shaft at eight to 12 months of age (Figure 5b). Physeal fractures of the distal femur may also occur, so particular attention should be paid to the width and alignment of the physes either side of the joint in young dogs.

Avulsion of the long digital extensor tendon is also an injury usually seen in younger dogs and has a characteristic appearance, with the avulsed bone fragment lying in the lateral aspect of the joint. A corresponding lucent defect is usually seen in the lateral femoral condyle on both projections.

Rupture of the straight patella ligament, with or without an associated patella fracture, leads to proximal displacement of the patella. Avulsion of gastrocnemius (one or both heads) can lead to distal displacement or fracture of the associated fabella, as well as soft tissue swelling locally that can disrupt the caudal fascial planes. Similarly, avulsion of popliteus can lead to distomedial displacement of the popliteal sesamoid.
Osteochondritis dissecans

Within the stifle, osteochondritis dissecans (OCD) usually occurs on the femoral condyle. Both the lateral and medial condyles may be affected, although the lateral condyle is most commonly involved.

Radiographically, flattening and irregularity of the affected condyle are seen, which is usually evident on both standard views. On the caudocranial view, a subchondral lucency is usually seen, often with a surrounding area of sclerosis.

Free mineralised fragments may be present within the joint. If no defect or irregularity is present on standard orthogonal views, oblique views may be useful to highlight any lesions on other aspects of the trochlear ridges. Joint effusion is commonly present and, depending on the chronicity, there may also be secondary osteoarthritic change.

Patella luxation

Congenital patella luxation is seen in small, toy-breed dogs, where it is usually a medial luxation. The condition can also occur in medium to large-breed dogs, where the patella can luxate medially or laterally. Traumatic luxation could occur in any breed. A straight caudocranial view is best for assessing the position of the patella, although a luxated patella is usually evident on a mediolateral projection, where it appears superimposed on the distal femur.

The craniodistal-cranioproximal oblique view may be helpful for assessing the depth of the trochlear groove. As with other causes of stifle instability, joint effusion and secondary OA may be present.

Neoplasia

Metaphyses of the distal femur and proximal tibia are both predilection sites for primary bone tumours, although these are not as common in the hindlimb as they are in the forelimb.

Radiographic changes would include those typical of aggressive bone lesions, such as poor marginated lesions with bone destruction, cortical thinning, irregular periosteal reaction and so on. The stifle is also a predilection site for synovial sarcoma – in these cases, lytic areas are usually seen in both the distal femur and proximal tibia, usually in conjunction with a soft tissue mass or marked swelling.

Calcification

Meniscal mineralisation can occur as a primary (idiopathic) condition or in association with
trauma/cruciate disease.

Most commonly, mineralisation is seen in the cranial horn of the medial meniscus. Synovial osteochondromatosis (synovial chondrometaplasia) is rare in dogs, although it can occasionally be seen in cats, and can be primary or secondary to joint disease. Focal areas of mineralisation form in the synovial connective tissue and may be seen as multiple smooth peri and intra-articular opacities. Differential diagnosis in the cat is hypervitaminosis A.

**Ultrasonography of the stifle**

Ultrasonography is not widely used to assess the stifle in small animals, but has the potential to evaluate soft tissue structures that are not evident radiographically. The straight patella ligament is readily accessible to ultrasonographic examination and appears similar to other tendons, such as biceps. The tendon of the long digital extensor is also well differentiated from the adjacent tibialis cranialis muscle.

Joint effusion, thickening of the joint capsule and cartilage defects can be identified. With full stifle flexion in larger dogs, it is possible to examine the menisci and cruciate ligaments. In smaller dogs (less than 20kg), artefacts may prevent examination of the menisci and the intercondylar region may be too narrow for the caudal cruciate ligament to be visible (Kramer et al, 1999).

In another study (Arnault et al, 2009) ultrasonography had a low sensitivity for detection of cranial cruciate rupture, but a relatively high (90 per cent) positive predictive value for meniscal lesions.

**Scintigraphy**

Bone scintigraphy is a useful modality for detecting changes in bone metabolism associated with injury or disease, and can be part of the work-up of lame dogs in which lameness cannot be localised by other means (Schwarz et al, 2004).

In the stifle, it has been used for the early detection of stifle OA (Innes et al, 1996). However, use of scintigraphy in small animals is not widely used in veterinary practice, due to limited availability of equipment and radiation protection issues.

**Magnetic resonance imaging**

Magnetic resonance imaging (MRI) is used widely in human medicine for detecting internal derangements of the knee.

It provides excellent soft tissue detail, allowing an accurate assessment of the cruciate ligaments (Figure 6) and menisci, and provides a non-invasive alternative to exploratory surgery. MRI of the
canine stifle has been described in both normal dogs and those with stifle disease. Use is limited by availability of equipment, cost and the need for general anaesthesia. However, MRI has been shown to have a high diagnostic accuracy in cases of meniscal injury and cruciate rupture (Barrett et al, 2009; Blond et al, 2008; D’Anjou et al, 2008). MRI has also been shown to be more sensitive than radiography in assessing the onset and progression of osteophytosis in an experimental model of canine stifle OA, and provided enhanced soft tissue detail, enabling discrimination between joint effusion and synovial thickening.

**Computed tomography**

Computed tomography (CT) of the stifle is a minimally invasive and repeatable technique that does not require general anaesthesia. However, unlike MRI, it does involve the use of ionising radiation.

With CT, images can be reconstructed in any plane or as three-dimensional projections. Soft tissue structures not seen on plain radiographs can be evaluated (Figures 7a and 7b) – for example, the cruciate and collateral ligaments and the menisci. With the addition of intra-articular contrast, which improves the definition of ligamentous margins, the inter-meniscal, meniscotibial and meniscofemoral ligaments may also be identified (Samii and Dyce, 2004).

CT has been used for assessing stifle morphology, such as the shape of the intercondylar notch in normal stifles versus those affected with cruciate disease (Lewis et al, 2008). Clinically, CT is of use for identifying tears of the cranial cruciate ligament, with sensitivity and specificity of up to 100 per cent reported (Samii et al, 2009).

Detection of a decrease in a cruciate area associated with a partial tear has also been reported in a cadaver study (Han et al, 2008). Accuracy of CT arthrography for diagnosing medial meniscal tears has been reported as good (Tivers et al, 2009), and, like MRI, this technique could remove the need for repeated surgery in cases where the cranial cruciate ligament has already undergone surgical repair.

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**References**


