Lameness in the Small Animal Patient: Orthopaedic Examination

Ronan Doyle  MVB CertSAS MRCVS DipECVS
European and RCVS Specialist in Small Animal Surgery
Davies Veterinary Specialists, Hertfordshire, UK
rsd@vetspecialists.co.uk

Introduction

Orthopaedic examination in the small animal patient involves a systematic and logical approach that follows from an adequate history and forms part of the general physical examination. Using a systemic approach to the general physical examination (cardiovascular, respiratory, GIT etc.) ensures that multiple or concurrent problems are discovered and also places the orthopaedic problems within their proper context for the animal. Obviously the approach for a patient with major traumatic injuries such as an open fracture will differ from the chronically lame dog with concurrent PU/PD.

The quantity and, more importantly, the quality of the information obtained will vary with the skill and experience of the examiner, as well as with the cooperation of the animal. To achieve the maximum information a methodical and logical approach based on a thorough understanding of normal anatomy and locomotion is required.

Lameness is defined as a deviation from the normal gait or locomotion of an animal and is most commonly due to an abnormality of the musculoskeletal system. The most common cause of lameness is a problem of the skeletal system – this can be obvious with non-weightbearing lameness due to a fracture or luxation, or more subtle as with many joint problems such as elbow dysplasia or cruciate disease. Lameness or apparent lameness can also be caused by abnormalities of the muscular or neurological systems or due to systemic disease (for example weakness due to a systemic disease is often misinterpreted by an owner as lameness).

Animals that present with an orthopaedic problem should always have a thorough and complete physical examination to place the problem in context to the whole animal.
General Approach to Lameness

The goal is to answer the following questions:

- Which is the lame limb?
- Where is the problem?
- What is the cause?
- What is the treatment/prognosis

The tools to achieve this are:

- History
- Gait examination
- General physical examination
- Orthopaedic examination
- Further diagnostics

History

The orthopaedic examination begins by observing the animal for lameness while obtaining the history. Although it is useful to be aware of the owner’s identification of lame limb, it is important that this is not allowed to prejudice your approach as it is very common for them to identify the wrong leg as lame. This is particularly common with subtle forelimb lameness. Allow the animal to wander around the consultation room. This lets it settle to its surroundings and may allow identification of an obvious lameness or more subtle signs such as weightbearing on the limbs while standing or sitting.

Never allow the owner’s opinion prejudice your own – it is very common to miss the lame limb with this approach

The signalment of the animal is important as many orthopaedic diseases are predictable within certain breeds and ages (Table 1). This is useful information but should not be relied upon to make a diagnosis. Questions regarding the general health of the animal are important as a history of anorexia, lethargy, vomiting, weight loss etc. could indicate systemic abnormalities
The key questions to ask relate to:

- Duration – was there a specific initiating event?
- Severity
- Progression
- Effect of exercise/rest
- Response to treatment
- Feeding/exercise regime
- General environment
- Prior history
- Intended function of dog

**Gait examination**

Observe the gait to determine the lame limb. The stride = the contact phase (when the foot is in contact with the ground) + the swing phase (when the foot is in the air). To protect a sore limb an animal will tend to shorten the stride and may also land more heavily on the contralateral limb. In the forelimb this is characterised by the headbob – the head is raised when the painful limb contacts the ground and lowered when the contralateral limb strikes the ground. External swinging or circumduction is seen when the animal advances the limb that has a joint that is painful or has a reduced range of motion (especially seen with the forelimb in elbow disease). Animals may also shift weight to the sound limb – particularly observe this when the animal is standing. Bilateral or subtle lameness may only exhibit a shifting stance or a bilaterally shortened stride. Looking out for these signs, the animal’s gait is:

- Assessed at walk
- Assessed at trot
- Assessed after rest/examination
- Assessed over steps/hard ground/tight circling
- Classify severity of lameness – mild-moderate-severe-nonweightbearing or grade 1 to 5 or 1 to 10
- Video lameness?
But

- Beware very mild/subtle lameness – often need to assess gait along with palpation
- Beware the nervous dog
- Beware bilateral lameness

**General physical examination**

As mentioned earlier it is essential to perform a general physical examination as part of the routine assessment of lameness. This allows not only determination of potential systemic causes of lameness or apparent lameness but also assessment of the animal for potential concurrent illnesses that may be important if sedation/anaesthesia/surgery is required (in particular following major trauma or is the older patient).

**Orthopaedic examination**

The specific orthopaedic examination involves two stages

1. Standing and initial neurological examination
   - Stand the animal as squarely as possible and using both hands lightly palpate both sides simultaneously. The objective is to detect asymmetry between muscle groups (muscle atrophy around prominences) or bony landmarks or due to joint swelling (joint effusion or periarticular fibrosis). Knowledge of normal anatomy is essential as with bilateral problems these changes may be symmetrical and subtle.
   - Joint effusion is best assessed in the standing than the recumbent dog
   - Initial neurological assessment is easily performed by assessing conscious proprioception. With the animal standing squarely, the chest is supported (to relieve weightbearing) and the paw is knuckled over onto its dorsal aspect. A rapid return to standing position is normal. This is assessed multiple times on each paw. A delay or failure to right the paw is suggestive of a neurologic abnormality and a more complete neurological examination is required. Assessment of the neck range of motion as well as palpation along the dorsal spinous processes is also performed to check for discomfort.
2. Examination in lateral recumbency

- Systematic and thorough examination of each limb while the dog is in lateral recumbency should allow identification of the affected area of the affected limb. As the muscles should be in a more relaxed state and the animal is more easily restrained, more accurate assessment of the limb should be possible. Animals are usually least stressed when on the floor than on the tabletop.

- Usually start from the pads and digits and work proximally on the non-affected limb. This should allow some initial assessment of normal for this animal (as long as there is not bilateral disease).

- Palpate each joint for pain, instability, crepitus, swelling or altered ranges of motion. Careful gentle manipulation is essential to prevent overt discomfort. This should also allow careful repetition of these manoeuvres to help confirm the localisation of the problem. Beware the stoic animal that does not demonstrate pain on manipulation of the affected area.

Perform these tests initially in the conscious animal and then if necessary under sedation or general anaesthesia for increased accuracy, although the pain response will obviously be decreased or absent

- Paw
  - Assess for nails, pads and interdigital skin for swelling, abrasions, masses, corns
  - Manipulate each joint of each digit through a range of motion. Palpate each joint, phalanx, sesamoid and metacarpal/tarsal. Assess the flexor and extensor tendons of each digit as well as the lateral and medial stability of each joint.

It is important to interpret the range of motion of the joints based on experience and comparison with the contralateral joint
• **Carpus**
  o Palpate the dorsal surface of the carpus gently for joint effusion (fluctuant swelling). Assess for periarticular fibrosis (perform both of these standing as well). Palpate each row of carpal bones for discomfort.
  o Normal range of motion for flexion/extension of the carpus is 45 - 180°. This will often decrease in the older dog without causing obvious lameness. Extension past 180° is minimal in normal animals. Place varus and valgus stresses on carpus in extension and flexion.

• **Elbow**
  o Palpate the elbow for joint effusion especially in the region between the lateral or medial condyle and olecranon. This is often easier to palpate standing. Assess the elbow for firm generalised periarticular swelling.
  o Assess the range of motion – normal is from 40/50 – 165°. In the normal dog the carpus should almost touch the elbow when the elbow is flexed. Check for discomfort on maximal extension/flexion. In very thin dogs a click is often palpated on flexion and extension as the ulnar nerve slides back and forth.
  o Check for discomfort with external or internal rotation with digital pressure on the medial joint. This is very useful for assessing for elbow pain in the immature animal.

• **Shoulder**
  o Due to the deep position of the shoulder under its surrounding muscles, joint effusion is not palpable. Care is needed when assessing for shoulder pain on maximal flexion and extension as manipulation of the elbow also occurs and this can cloud assessment. It is best to stabilise the scapula with one hand and manipulate the shoulder by grasping the foreleg at the elbow.
  o Assess for instability by stressing the humerus laterally and medially while holding the shoulder stable.
  o A test for shoulder pain is to extend the elbow and bring the limb parallel to the thorax while applying digital pressure to the biceps tendon (medial
aspect of proximal humerus). This test is not specific for biceps tendon pain as was previously thought but does indicate shoulder pain.

It can be very difficult to assess the shoulder accurately when there is concurrent elbow discomfort

- **Long bone palpation**
  - Perform long bone palpation in areas where the bone can be gently squeezed in between muscles (distal radius, proximal ulna, distal and proximal humerus). Deep palpation into the axillary region is also performed (brachial plexus tumours in older dogs can be very painful).

- **Hock**
  - Assess for joint effusion (often a general fluctuant feeling). Manipulate and stress the joint in extension and flexion (range of motion 45 – 170˚) and in varus and valgus (in both flexion, normal and extended positions to assess the collateral ligaments). Palpate each layer of tarsal bones.
  - Flex and extend the intertarsal joints – place one thumb along the planter aspect of the calcaneus and the other along the planter aspect of the metatarsals. There should be minimal movement but if flexion is present it is indicative of rupture of the planter ligament (especially in rough collies).
  - Palpate the Achilles tendon along its length and into the bellies of its constituent muscles. In particular palpate it at its insertion onto the calcaneus. The tendon should be palpated under tension (stifle extended and hock stressed into flexion) and relaxed. If the whole tendon complex is ruptured then the hock can be flexed while the stifle is extended. If the superficial digital flexor tendon is still intact the hock will only partially flex and the digits will simultaneously flex.

Assess the Achilles tendons and associated muscles simultaneously in the standing dog.

The standing angle of the hock will differ in different breeds of dog
• **Stifle**
  - It is very useful to palpate the stifles simultaneously when the animal is standing. In particular assessing for medial joint periarticular fibrosis (‘medial buttress’) and for joint effusion (palpable as a fluctuant swelling on either side of the straight patellar ligament which becomes less distinct) is performed. These are strongly indicative of degenerative joint disease, which is most commonly due to cranial cruciate ligament rupture.
  - Assess the range of motion of the stifle (normal is 45 – 170°) and simultaneously palpate for any crepitus within the joint or around the patella during flexion/extension.
  - Assess the stability of the patella by from a caudal position extend the stifle, internally rotate the lower limb and apply digital pressure to the patella medially. Assess lateral stability by slightly flexing the stifle, externally rotate the foot and apply digital pressure laterally. It is also important to assess the position of the tibial tuberosity in relation to the patella tendon and trochlea/patella. The patella normally will slightly move medially and laterally within the trochlea. Luxation from the trochlea is abnormal and may cause lameness. It is ESSENTIAL to also assess the cranial cruciate ligament.
  - Cranial cruciate ligament
    - Cranial drawer: standing caudal to the limb, place the index finger of one hand on the cranial aspect of the patella and the thumb of the same hand on the lateral fabella. Place the index finger of other hand on the tibial tuberosity and the thumb of the same hand on the head of the fibula. Slightly flex the stifle, keep your wrists held straight and while holding the femur stable, push the tibia forward gently and quickly several times. Repeat this with the stifle in extension and in flexion. There is minimal drawer motion in normal cats and dogs.
    - Tibial compression test: this is used to detect indirect drawer motion. Stand caudal to stifle, place the hand on the cranial aspect of the distal femur with the index finger along the cranial aspect of the patella, straight patellar ligament with the fingertip on the tibial tuberosity. With the stifle in a fixed slightly flexed position, simulate
weightbearing by stressing the hock in flexion. With rupture of the cranial cruciate ligament the tibia will slide cranially.

- Mensical injuries are often suspected with clicks or clunks on flexion and extension of the stifle. Clicks and crepitus can also be present however with marked degenerative joint disease. Mensical injuries are often suspected with the history – a gradually improving hindlimb lameness that acutely deteriorates.

- Assess the collateral ligaments with medial and lateral stress of the stifle.

- **Hip**

  - Assess range of motion of the hip while one hand is placed over the greater trochanter to feel crepitus. Normal range of motion is 10/20° to 170/180°. In normal dogs there should be no pain on maximal extension to 180°. It is important to have assessed for lower back pain prior to hip palpation. This achieved by, with the animal standing, direct palpation over the lumbosacral region to elicit pain or an immediate sit response. Also perform the pelvic tilt test – with the animal standing place direct pressure over the lumbar region with the heel of one hand while pushing up under the caudal pelvis with the other. Dorsal flexion of the tail may also elicit pain in these animals.

  **Be careful to differentiate hip pain from lumbosacral pain particularly in the larger dog**

  - Objectively assess the stability of the hip joint with the Ortolani test – place one hand over the greater trochanter while pushing the femur proximally and abducting. If there is joint laxity present then this movement with subluxate the femoral head up onto the dorsal acetabular rim and when abducting it will clunk back into the acetabulum. If there is marked remodelling of the acetabulum due to degenerative joint disease, this may not be evident but crepitus will be palpated. This test generally needs to be performed under sedation of general anaesthesia as muscle tension may camouflage it.

  - Check the local landmarks around the hip. The greater trochanter should from an obvious ventrally pointing triangle in relation to a line between the
tuber coxae and tuber ischii. With craniodorsal luxation these three landmarks will make a more obvious line.

- **Cats**

These can present a challenge as they can be difficult to examine and may mask any lameness during consultation. Examination of gait can be difficult as they will often hide instead of walking around the consultation room. It is best to minimise stress and distraction. Place the cat on the floor farthest away from the hiding place (such as the carry box) and watch it as it passes to this area. Conscious examination is often limited and will generally need to be carried out speedily. Therefore examination under sedation or general anaesthesia is very useful. Common things are especially common in cats – a cat bite is always the first thing to rule out on examination.

**Animals with a subtle or intermittent lameness can be frustrating – repeated examination in particular after exercise or rest is often necessary**

**A common pitfall is to fail to rule out common conditions when diagnosing uncommon conditions. On the other hand make sure to avoid tunnel vision based on signalment and history when making the orthopaedic assessment**

**Recommened reading:**

Fossum, T.: Small Animal Surgery, Mosby, St. Louis, 1997


Lameness in the Small Animal Patient: 
Further Diagnostic Investigation

Ronan Doyle MVB CertSAS MRCVS DipECVS
European and RCVS Specialist in Small Animal Surgery
Davies Veterinary Specialists, Hertfordshire, UK
rsd@vetspecialists.co.uk

Introduction

Further diagnostic imaging is indicated to confirm or refute clinical suspicions; therefore the importance of a thorough history and clinical examination cannot be overstressed. It is the information that is gained from this that will guide the selection and extent of further tests that are then performed. Again it is important during the initial examination to rule out neurological causes of lameness as this will take the thrust of the following investigation in a different direction (for example serology, electomyographic testing, advanced imaging, nerve and muscle biopsy etc).

Extensive testing is often unnecessary if a thorough orthopaedic examination has been performed and often it is better in the chronically or subtly lame animal to repeat the orthopaedic examination following exercise, rest or under sedation than performing multiple and potentially expensive further tests. On the other hand carefully selected and performed tests can give very valuable and objective information that aids the rapid diagnosis and treatment of the animal.

Further Diagnostics

- Radiography
- Joint fluid analysis
- Laboratory evaluation
- Scintigraphy
- Arthroscopy
- Ultrasound/CT/MRI

Radiography
Radiography is an accurate, readily available, straightforward and cost-effective tool in the evaluation of the clinically lame animal. Following localisation the area is radiographed with orthogonal views. Proper radiographic technique is obviously important to allow adequate assessment of radiographs for soft tissue or osseous changes to make a presumptive or definitive diagnosis and to allow development of a treatment plan. A thorough knowledge of normal radiographic findings is essential however radiographs can be easily referred for specialist opinion. Serial radiographic examination may be useful in assessing the region of interest (in particular with fracture healing). Contrast studies are rarely performed apart from within the shoulder and have now been largely superceded by additional techniques such as arthroscopy.

**Joint Fluid Analysis**

Arthrocentesis and analysis of synovial fluid is a simple and useful tool for the assessment of joint disorders. It allows the differentiation of inflammatory and non-inflammatory arthropathy; infectious and immune-mediated arthropathy; and acute from chronic inflammation. Instrumentation required is minimal – 22 - 25G needles (length dependent on position of joint), 2ml syringes, microscope slides (always make direct smears), EDTA tubes (if enough fluid present +/- Heparin tube for mucin clot test) and sterile gloves. The technique requires a good knowledge of surrounding anatomy and is usually performed under general anaesthesia (to avoid movement and iatrogenic cartilage damage) following an adequate clip of surrounding hair and a proper surgical preparation technique. Insert the needle and syringe into the joint and gently aspirate. If there is no fluid, carefully reposition the needle and change the needle if there is initial aspiration of blood. Try to avoid aspiration of blood with the joint fluid sample but note this if this occurs for subsequent clinical pathological interpretation.

*Carpus:* Approach from dorsally into the antebrachial-carpal joint space with the carpus flexed. The joint capsule is superficial and easily entered, but avoid the accessory cephalic vein just under the skin.

*Elbow:* Approach caudolaterally. The joint is flexed 45° and the needle is directed just medial to the lateral epicondylar ridge and directed cranially, medially and slightly distally into the supratrochlea foramen.

*Shoulder:* Approach from lateral just distal to the acromium and caudal to the greater tubercle. This can be difficult in the obese or heavily muscled dog. Direct the needle medially and slightly caudally into the joint space.
Hock: This joint can be more difficult and the yield of synovial fluid is generally small. Approach from a platarolateral direction just medial and plantar to the lateral malleolus with the hock flexed.

Stifle: Instead on directing the needle into the centre of the femorotibial joint (where it will either cause iatrogenic damage or get embedded in the fat pad, cruciates or meniscus), the joint is best approached via the aspiration from the femoropatella joint pouches on either the medial or lateral sides (this is only effective when there is a joint effusion). The needle is inserted lateral to the patella and trochlear ridge and directed dorsally.

Hip: This is rarely aspirated (it can be difficult to enter due to surrounding muscle) but can be approached via a lateral or ventral approach.

The easiest joints to aspirate are the carpus, elbow and stifle joints

Assess the physical qualities of the joint fluid first – colour, turbidity and viscosity. Normal joint fluid is clear, colourless to slightly yellow and is highly viscous - it should form a string of 2.5cm easily between fingers. Make thin ‘squash’ preparations on microscope slides initially. Then if there is a sufficient volume collect in EDTA for cell counts. Then collect in plain tubes for culture and finally in heparin for total protein and mucin clot estimation (objective assessment of viscosity). Total protein is more easily assessed by refractometer. Cytology is very useful to assess total cell count (usually < 3x 10⁹/L in normal, < 5x 10⁹/L for degenerative joint disease and >10x 10⁹/L for inflammatory arthropathy). Morphology is also very useful as normally >90% of cells are mononuclear. Elevation of neutrophils >10% is significant and due to either an inflammatory arthropathy (septic or immune-mediated) or blood contamination (iatrogenic or with trauma). With septic arthritis cells appear to remain non-degenerate and bacteria are rarely encountered – it is important therefore to submit fluid for culture – preferably inoculated directly into blood culture medium or culture of synovial fluid biopsies. Immune mediated polyarthritis are generally present in multiple joints and dogs often have a history of a shifting lameness. Cell counts are >10x 10⁹ /L with neutrophils predominating. These arthropathies can be further divided into non-erosive and erosive (as seen on radiographs or on biopsy).
Laboratory evaluation
As discussed before routine haematology, serum biochemistry and serology can be useful for the general assessment of the animal’s clinical condition. Elevations in alkaline phosphatase or creatine kinase may be noted especially after trauma but are non-specific findings. Additional serology for rheumatoid factor and anti-nuclear antibody can be performed to further differentiate suspected immune-mediated arthropathy. Serology for Toxoplasma or Neospora antibodies can be performed if there is a high index of suspicion from the clinical signs. Coagulation testing is indicated with generalised haemarthrosis and assessment of a bleeding time and von Willebrands factor is indicated in all dobermanns (or dogs suspected of von Willebrands disease) prior to undergoing surgery.

Scintigraphy
Skeletal scintigraphy involves the injection of radioactively-labelled phosphonate compound which is subsequently imaged for the distribution of radioactivity. Initially a soft-tissue phase will indicate areas of increased blood supply (inflammation). Two to three hours after this, areas with increased bone turnover will usually take up higher levels of the compound that are then visible. It is therefore especially useful with subtle lameness due to stress fractures or non-radiographically evident fractures or early neoplastic lesions. This offers a high sensitivity for detecting early skeletal disease but the changes are not specific for assessing the type of bone lesion. Also strict restrictions apply due to the radioactive nature of the compounds.

Arthroscopy
This is an extremely valuable tool and is now the gold standard for intra-articular assessment of joint structures. This allows accurate diagnosis as well as effective intra-articular treatment with specialised instruments. This technique has revolutionised the management of many conditions such as elbow dysplasia, shoulder conditions and the assessment of the cruciate ligaments and menisci. The equipment required however is expensive and there is a relatively steep learning curve to the development of the skills involved.

Ultrasound/CT/MRI
More advanced imaging can have very useful roles in the diagnosis of many causes of lameness. Ultrasound is used primarily for the assessment of tendons but has also been used experimentally for assessing intrarticular structures and the progression of fracture healing. CT and MRI are especially useful when assessing neurological causes of lameness such as intervertebral disc disease and vertebral lesions. They are also being increasingly used for assessment of both extra and intra-articular structures. The key limiting issues for these modalities are access and cost.
Cranial Cruciate Ligament Rupture

Introduction
Cruciate disease is the partial or complete rupture of the cranial cruciate ligament and associated degenerative joint disease of the stifle. There are two cruciate ligaments the cranial and caudal, although injuries to the caudal cruciate are rare.

Rupture of the CCL is the one of the most common causes of hindlimb lameness but often goes undiagnosed

The cranial cruciate ligament (CCL) is composed of two bands that function independently throughout the range of motion of the stifle:
- Craniomedial band
  - Taut in FLEXION AND EXTENSION
- Caudolateral band
  - Taut in EXTENSION ONLY

The cranial cruciate originates from the medial aspect of the lateral femoral condyle and courses cranially, distally and medially to insert on the cranial inter condylar area of the tibial plateau.

The functions of the CCL are:
- Limit cranial displacement of the tibia in relation to the femur (cranial drawer)
- Limit internal tibial rotation
- Prevent hyperextension of the stifle

Rupture of the CCL occurs due to either:
- Excessive stress on a normal ligament as with TRAUMA
  - Generally due to a hyperextension injury or in conjunction with extensive collateral ligament damage.
  - This is an uncommon cause of rupture in dogs
• Normal stress on a degenerated ligament
  o This is MOST COMMON in dogs
  o The specific cause of the degeneration is unknown but it is complex and probably multifactorial in origin
  o This can occur in any age or breed of dog however some broad categories have been identified
    ▪ Middle aged to old, medium to large breed dogs that have a history of chronic hindlimb lameness that acutely worsens. Possibly an age related change.
    ▪ Young, large breed dogs (such as rottweilers, Bernese mountain dogs, Labradors, mastiffs) – early degeneration possibly occurs due to conformational problems but this is still unclear
    ▪ Small breed, middle aged dogs that rupture the CCL secondary to medial patellar luxation. Increased internal rotation of the tibia when the patella is medially luxated increases the strain on the CCL. These dogs often have conformational changes to the hindlimb that increase the forces on the CCL.
    ▪ Secondary to an immune mediated arthropathy - very uncommon

**Diagnosis**

• History
• Gait examination
• General physical examination
• Orthopaedic examination
• Further diagnostics

o History
  o Depends on type of rupture – if traumatic acute, but more commonly an acute deterioration of a chronic lameness (due to complete rupture or meniscal injury)

o Gait examination
  o Lameness on the affected hindlimb.
  o Dog will tend to rest limb when standing
  o **When sitting the dog will tend to keep the stifle extended** rather than tucking it under the body – this is a very good non-specific sign for stifle disease
Orthopaedic examination

Acute rupture
- moderate weight bearing lameness
- joint effusion
- surprisingly not very painful to examine
- cranial drawer sign
- +/- tibial compression test

Chronic rupture
- muscle atrophy
- periarticular fibrosis (medial buttress)
- joint effusion
- +/- crepitus
- decreased range of motion
- +/- cranial drawer sign
- +/- tibial compression test

Cranial drawer sign is the gold standard diagnostic test but interpretation can be difficult

**Cranial drawer sign**

- Technique: standing caudal to the limb, place the index finger of one hand on the cranial aspect of the patella and the thumb of the same hand on the lateral fabella. Place the index finger of other hand on the tibial tuberosity and the thumb of the same hand on the head of the fibula. Slightly flex the stifle, keep your wrists held straight and while holding the femur stable, push the tibia forward gently and quickly several times. Repeat this with the stifle in extension and in flexion. There is minimal drawer motion in normal cats and dogs.

- Interpretation
  - Movement over 2-3mm with NO FIXED endpoint – **POSITIVE**
  - Movement over 2mm but with a SHARP endpoint in IMMATURE dog – **NORMAL**
  - The ABSENCE of cranial drawer – **DOES NOT RULE OUT CRUCIATE DISEASE**
- **Why?**

  1. **Partial Rupture of CCL**

     Craniomedial band
     - is taut during *flexion* and *extension*
     - if ruptured - drawer ONLY in flexion

     Caudolateral band
     - is *only* taut during *extension*
     - But the craniomedial band is taut during *flexion* and *extension*
     - Therefore if the caudolateral band is ruptured = NO cranial drawer sign

  2. **High muscle tone** – can be difficult to detect in conscious animals so anaesthetise to assess.

  3. **Presence of extensive periarticular fibrosis that is limiting cranial drawer**

  4. **Poor technique** – Must know normal to assess abnormal

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**Remember there is no such thing as “only a little bit of cranial drawer”**

- **Further diagnostics**
  - **Radiography**
    - Not always essential but important as an aid to diagnosis and to document the degree of DJD
    - Chronic disease - degenerative joint disease (osteoophytosis on distal pole of patella, tibial plateau, fabellae, fibular head and trochlea ridge; subchondral bone sclerosis) and joint effusion (compression of fat pad on lateral radiograph)
    - Acute – joint effusion only (rare)
    - Important in the diagnosis of partial rupture particularly when cranial drawer is not apparent as degenerative joint disease and joint effusion strongly suggests partial rupture
    - Helps rule out other conditions such as traumatic injuries, erosive disease or neoplasia
    - Always radiograph the contralateral stifle as >50% of dogs with signs of DJD in this stifle go on to rupture the CCL in the next 12 months. This is useful information to advise an owner.
Joint fluid analysis
- Can help confirm presence of degenerative joint disease by an increased cell count (>3 but <5 x10^9) but is often normal.

Arthroscopy
- Useful to assess the cruciates and menisci in suspicious cases, followed by surgical treatment

Exploratory arthrotomy
- In cases with a very high index of suspicion, i.e. medial buttress and signs of degenerative joint disease then this is indicated followed by surgical management.

Tips for diagnosis of CCL rupture
- Acute onset hindlimb lameness in a large breed adult dog is most likely caused by cruciate disease. This must be ruled out first.
- Medial buttress and signs of degenerative joint disease on radiography is a partial or complete CCL rupture until proven otherwise.
- Positive cranial drawer is the gold standard for diagnosis but requires some experience and knowledge of anatomy to interpret.
- In the large breed dog with hip dysplasia, cruciate disease and an acute onset of a hindlimb lameness – the lameness is primarily due to the cruciate disease and not the hip dysplasia.

Differential diagnosis
- Medial patella luxation
- Primary or secondary arthritis
- Traumatic wound to the stifle
- Avulsion of the long digital extensor
- Caudal cruciate rupture
- Neoplasia
- Other cause of hindlimb lameness
Treatment

Conservative treatment

- is not recommended
- remember that conservatively treated animals improve initially but the continued instability leads to subsequent worsening either due to degenerative joint disease or a meniscal injury
- This approach requires weight loss, strict rest for at least 4 weeks and a gradual increase in lead exercise over 3 months and NSAIDs +/- chondroprotective agents.
- Less than 20% of dogs over 15kg improve with this approach.

Surgical treatment

Aims of cruciate surgery:

- stabilise the stifle joint
- diagnose and treat any meniscal injury present

3 basic groups of techniques

- **Intracapsular techniques**
  - These replace the ligament with some type of graft, which then stabilises the joint.

- **Extracapsular techniques** (Lateral fabello-tibial suture)
  - Stability of the joint is achieved by the use of a suture (usually of nylon) crossing the outside of the joint in the same line as the CCL. This stabilises the joint allowing periarticular fibrosis to occur.

- **Altering the biomechanics of stifle joint**
  - **TIBIAL PLATEAU LEVELLING OSTEOTOMY (TPLO)**
    
    This technique alters the biomechanics of the stifle joint by changing the slope of the tibial plateau. This reduces the cranial tibial thrust within the joint giving a dynamically more stable joint (during weightbearing). This relatively new technique has shown encouraging results in large breed dogs in particular in the early stages of recovery. It is currently one of the most commonly used technique for CCL rupture in large breed dogs amongst specialists, although no objective data exists to prove a longterm advantage over the lateral fabello-tibial suture.

  - **A newer technique that also alters the biomechanics of the stifle joint is called the Tibial Tuberosity Advancement (TTA) technique.**
My technique of choice depends on the individual case:

- Degree of clinical lameness
- Size of patient
- Presence of DJD
- Presence of contralateral cruciate disease
- Other factors – temperament of animal, size of animal etc

Generally I will perform a

- Lateral fabello-tibial suture stabilisation <25kg
- TPLO (ideally) >25kg
TIPS TO IMPROVE EXTRACAPSULAR REPAIR

• Good confident knowledge of the local anatomy is essential – if unsure thoroughly familiarise with anatomy textbooks (dissection pictures are most accurate) or better still on a cadaver.

• Thorough surgical preparation using a wide clip and good skin disinfection is ESSENTIAL. Strict asepsis must be maintained throughout surgery as the development of a septic arthritis is a very serious longterm complication.

• Prior to opening the joint make the careful dissection to expose the lateral fabella. This aids placement of the suture after the arthrotomy.

• **Always** perform an exploratory arthrotomy to remove the remnants of the cruciate and to adequately examine the cranial cruciate ligament. Using stifle distractors is ESSENTIAL if operating without an assistant to aid good visualisation. A good surgical light is also critical.

• Take special care to avoid iatrogenic injury to the intraarticular structures. Thoroughly lavage the joint with sterile saline prior to closure. Always close the joint prior to placement of the fabello-tibial suture

• Use prepackaged sterile monofilament nylon with a swaged needle for maximal strength and ease of placement.

• Ensure correct placement of the suture behind the lateral fabella in the femorofabella ligament. Too superficial means an ineffective suture, too deep risks incorporation of the peroneal nerve

• Check placement by elevating the suture and palpating the movement of the fabella.

• The tibial attachment is through a bone tunnel in the proximal cranial tibial crest usually just cranial to the long digital extensor. Placing the tunnel too distal is a common error that renders the suture inefficient.

• Using a crimp to secure the suture instead of a knot has more security especially with larger suture material. Tighten with the leg slightly flexed (a weightbearing position).

• Put the joint through a good range of motion and assess cranial drawer and a tibial compression test before proceeding to fascial lata imbrication (overlap)

• Careful postoperative care is ESSENTIAL and complete client compliance is necessary
Postoperative care

- This is as important as the surgical technique itself and poor postop management is a common cause of failure. Research has shown that significant benefits in limb function occur when formalised postoperative physiotherapy is performed following extracapsular stabilisation.
- Early physical therapy limits the untoward effects of immobilisation such as muscle atrophy, joint stiffness and cartilage degeneration.
- Adequate analgesia is essential and is provided with opioids (over the first 24-48 hours) and NSAIDs (usually a 30 day course as long as no contraindications).
- Postoperative physiotherapy can begin on the first postoperative day with cold therapy (ice-packs for the first 48 hours), gentle passive range of motion exercises and muscle massage.
- Leash walking is required over the following 3-6 months
  - All running must be strictly avoided as should be excessive playing, stairs and jumping.
  - Very strict rest for 2 weeks with short walks for toilet purposes. Over this time the dog should be encouraged to touch the floor to the ground and gradually build up its weightbearing.
  - By the time of suture removal at 10-12 days the dog should be consistently placing the foot to the ground although will only be slightly weightbearing.
  - Over the next 4-6 weeks lead walking is increased to 10-15 minutes 3-4 times daily with a consistent improvement over this time.
  - By 8-12 weeks after surgery the amount of lead walking is gradually increased.
  - Over this period of time hydrotherapy has been found to be very effective at improving limb function.
  - From 3mths to 6mths after surgery the dog should gradually return to normal activity.
  - If there is no improvement or if there is a deterioration, reassessment and potential investigation for infection or failure of the suture should be performed. Acute recurrence of lameness is most commonly due to a late meniscal injury (reported risk of 13.8% in one study when intact at surgery) or infection and radiographs, joint fluid analysis and possibly repeat exploratory arthrotomy may be indicated.
  - It is common for there still to be cranial drawer by 3-6 months after surgery although 90% of dogs get back to nearly normal function.
Ongoing management of DJD is essential – weight control, carefully monitored exercise and NSAIDS as appropriate.

Remember that bilateral disease is common and a report suggested that 37% of cases develop rupture of the contralateral cruciate within a year.

**Meniscal injuries**

- The meniscal cartilages are two C shaped cartilages within the stifle joint which help to stabilise the joint and distribute weightbearing forces within the joint.
- Meniscal injuries rarely occur alone but are seen in association with CCL disease. The medial meniscus is predominantly injured. An incidence of 40 – 80% has been reported with CCL rupture. This is because as the tibia translates cranially with a CCL rupture, the caudal pole of the medial meniscus (which is firmly attached to the tibial plateau by its caudal ligament and to the medial collateral ligament) is entrapped by the femoral condyle.
- Healing is unlikely to occur as the injury generally occurs in the avascular portion of the meniscus and the untreated tear or flap causes significant pain and lameness postoperatively.
- Thorough inspection of the joint is essential at the time of CCL repair regardless of the technique used to stabilise the joint. This is performed using a Hohmann retractor (generally with an assistant) or a stifle distractor. Careful probing of the meniscus with fine right angle probes aids visualisation.
- Partial meniscectomy by removal of the torn pieces of the meniscus only is performed and preferable to total meniscectomy, as it maintains some of the support of the articular cartilage and results in less inflammation and degeneration within the joint.
- Perform a total meniscectomy if completely damaged as this will otherwise be a cause of persistent lameness.

Assume a meniscal injury in all CCL ruptures until proved otherwise on exploratory arthrotomy.

Accurate assessment of the meniscus requires good light, correct instrumentation and **PATIENCE**
**Patellar Luxation**

**Introduction**

- Patella luxation is the displacement of the patella (which sits within the tendon of insertion of quadriceps muscle) from the trochlea groove.
- This is a common cause of lameness in dogs and varies from complete irreducible lameness causing severe lameness to mild to moderate instability without clinical signs.
- Luxation is most commonly medially regardless of body size and is a common developmental problem in small breed dogs. A grading system exists for medial patellar luxation (see table below).
- It is caused by musculoskeletal abnormalities of the quadriceps, tibial tuberosity, distal femur and trochlea groove. In larger breed dogs there is often significant change to the distal femur that can complicate successful treatment.
- Lateral patellar luxation is rare in small dogs and usually congenital. In large breed dogs it is usually due to a distinct syndrome of major limb deformities and carries a guarded prognosis.

**Assessing patella luxation**

- Assess the gait at a walk and a trot.
- Assess the normal track of the patella by placing one hand over it while placing the stifle through a full range of motion. Assess for crepitation or pain and spontaneous luxation (a popping sensation).
- Assess the stability of the patella by, from a caudal position, extend the stifle, internally rotate the lower limb and apply digital pressure to the patella medially.
- Assess lateral stability by slightly flexing the stifle, externally rotate the foot and apply digital pressure laterally.
- It is important to assess the position of the tibial tuberosity/proximal tibia in relation to the straight patella tendon and trochlea/patella/distal femur. This is best done by causal palpation of the standing animal.
- The patella normally will slightly move medially and laterally within the trochlea. Luxation from the trochlea is abnormal and may cause lameness (see grading system below).
- It is ESSENTIAL to also assess the cranial cruciate ligament.
- Radiographs of the stifle are required to assess the bony abnormalities present and for secondary DJD.
Table 1: Singleton’s grading system for medial patella luxation

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>Patella can be luxated medially when the stifle is fully extended without crepitation or bony deformity. Clinical signs are not present or very infrequent (limb may be carried very occasionally). This is usually an incidental finding.</td>
</tr>
<tr>
<td>Grade 2</td>
<td>Spontaneous luxation with clinical signs of non-painful skipping type lameness. The patella luxates easily especially when the foot is internally rotated. Reduction easily occurs. There may be mild bony deformities such as internal rotation of the proximal tibia tuberosity with slight abduction of the hock when the patella is luxated. With time erosion of the medial trochlear ridge leads to crepitation and increased pain. This will often tend to worsen to grade 3.</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Patella is permanently luxated but can be reduced manually. More severe bony deformities are present such as an S-shaped curve of the distal femur and proximal tibia and more severe torsion of the tibia. There is usually a shallow trochlea groove. The dog often exhibits a crouched gait as the stifle is kept in a semi-flexed internally rotated position with more pronounced abduction of the hocks.</td>
</tr>
<tr>
<td>Grade 4</td>
<td>There is severe bony deformity with a permanent non-reducible patellar luxation. The tibia is medially twisted with the tibial tuberosity at a 60-90° angle to the cranial-caudal plane. The trochlea groove is very shallow, absent or convex. Correction of this in the growing dog is essential as worsening bony deformities will otherwise ensue.</td>
</tr>
</tbody>
</table>

**Medial patellar luxation – Clinical Presentations**

1) Neonates or older puppies with abnormal hindlimb gait from the time of walking – unilateral or bilateral and generally grade 3 – 4. Even if asymptomatic, repair by 3 to 4 months is necessary to prevent irreparable contracture and bony deformity.

2) Young to mature dogs with grade 2 to 3 luxations that have had gait abnormalities all their life but only present when the lameness worsens – these are usually surgically managed.
3) Mature animals with grade 1 to 2 luxations that present when there is a sudden deterioration due to CCL rupture or worsening DJD – these are surgical candidates.

4) **Asymptomatic** or mildly affected dogs
   - These are generally **not operated on** and are monitored for worsening signs except in:
     a. Immature dogs with grade 3-4 luxations (see 1) above)
     b. Large breed dogs with grade 2-3 luxations, where early surgery is performed before further erosion or deformity of the trochlea ridge occurs.

**Surgical management**

- Surgery is aimed at realigning the extensor mechanism (quadriceps muscle/patellar tendon/tibial tuberosity) and deepening the trochlear groove to stabilise the patella.
- Soft tissue procedures alone that only release the patella or tighten the lateral patellar structures will definitely fail if there are concurrent uncorrected bony abnormalities (as is seen in all symptomatic cases).
- At surgery an exploratory arthrotomy is always performed to assess for CCL rupture +/- meniscal injury.

**Deepening the femoral trochlea**

- Techniques that preserve the articular cartilage such as a wedge resection trochleoplasty or block resection trochleoplasty are indicated, although experience is needed to accurately perform these procedures.
- In animals less than 6 months the cartilage can be carefully elevated and the subchondral bone removed and shaped as necessary.
- Older techniques that remove the articular cartilage (sulcoplasty) are best avoided due to the degree of damage and inflammation caused.
- Release of the medial supporting structures of the patella in the nonreducible patella luxation and imbrication of the lateral structures is usually performed.
Realigning the extensor mechanism

- The bony abnormalities that develop in many dogs shift the alignment of the extensor mechanism so that the tibial tuberosity is not in line with the length of the femoral trochlea.
- **Correction of this has been found to be a keystone in management and failure to do this is the most common cause of recurrent luxation.**
- To correct this in most dogs, the tibial tuberosity is transposed laterally. This is achieved by securing the transposed tuberosity with pins and tension band wire after checking alignment with the trochlea and the hock.
- In dogs with excessive internal tibial rotation following this procedure or with a ruptured CCL, a lateral fabellotibial suture may also be placed.
- With more extensive tibial and femoral deformities, corrective osteotomies may be required.
- More recently release of the rectus femoris muscle has been described to aid realignment of the quadriceps muscle and decrease medial force on the patella (this head arises from the ilium whereas the rest of the heads of the quadriceps arises from the femur).

Postoperative care

- A padded bandage is often placed for the first 24-48 hours to reduce swelling.
- Early active use of the limb is important although exercise is limited for 4-6 weeks and running and jumping is avoided. Passive range of motion exercise by the owner is encouraged.
- Follow up radiographs after tibial tuberosity transposition to ensure adequate healing
- The prognosis for grade 2 to 3 luxation in small breed dogs is good. This is the same in larger breed dogs, although can decrease when there is severe degenerative joint disease and cartilage erosion.
- Grade 4 disease needs early intervention (before 3-4 months) for a successful outcome.
Recommended reading:

Fossum, T.: Small Animal Surgery, Mosby, St. Louis, 1997