CPD article

Rehabilitation of the canine stifle – a practical guide

This article is the last in a series of practical guides to rehabilitating the canine shoulder, elbow, hip, stifle and spine. This article looks at the stifle, including a brief description of the common conditions affecting this joint, followed by a practical guide on the various techniques used for rehabilitation following injury or surgery, or for management of long-term conditions affecting the stifle.

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This article is the last in a series exploring the rehabilitation of the individual joints of the canine. Suggested rehabilitation techniques used to improve stifle joint range of motion and build hind limb musculature are described, as well as how these can be applied to treat the common developmental conditions affecting the stifle, including osteochondrosis dissecans and patellar luxation. The treatment of degenerative conditions, such as cranial cruciate disease and osteoarthritis, is also discussed. It should be noted that continuous assessment and clinical reasoning will be required to determine what phase of recovery the animal is at, what exercises they are able to cope with, and what intensity and duration of therapeutic exercises are suitable. Communication between the referring veterinary surgeon and qualified rehabilitation therapist is essential to ensure recovery is progressing as expected.

Cranial cruciate ligament disease

Cruciate ligament disease is the most commonly diagnosed orthopaedic condition in dogs (Harasen, 2011). Rehabilitation techniques can be both surgical and non-surgical in cases of cranial crucial ligament disease. Non-surgical management may be selected for a variety of reasons, including dogs experiencing partial ligament tears, dogs under 15kg or cases where non-surgical management is the default option because of any contra-indications to surgery.

Partial tears can be defined as clinically stable with associated ligament fibre rupture. Many dogs with a partial cruciate tear will go on to develop a full rupture of the ligament, although the pathologic processes underlying this progression are not fully understood (Sample et al, 2018). Studies are warranted to determine what percentage of dogs with partial cruciate tears will progress to a full rupture, to enable both surgeons and owners to plan treatment for this condition.

From published studies, it is widely accepted that conservative management of cruciate disease is best suited to dogs weighing less than 15kg, that are without meniscal injury (Vasseur, 1984). However, a 2013 study demonstrated that over 60% of large-breed, overweight dogs had a successful outcome following non-surgical management of cruciate disease at 52 weeks post-rupture (Wucherer et al, 2013).

Non-surgical management may also be required if surgery or general anaesthesia is contraindicated, for example, as a result of comorbidities.

Conservative management

The goals of conservative management include pain relief, stabilisation of the stifle joint, maintaining and improving stifle range of motion, and maintaining and improving muscle mass of the hind quarters (Prydie and Hewitt, 2015). This can be achieved through use of a rehabilitation programme, which the author suggests should be broken down into three phases:

Phase 1

In the early phase of recovery, from approximately 0–2 weeks, the focus is placed upon reducing inflammation through use of non-steroidal anti-inflammatory drugs (NSAIDs), cryotherapy and photobiomodulation (Canapp, 2007). Photobiomodulation is also known as low-level level laser therapy, and can be defined as the clinical use of red and near-infrared light to promote tissue repair, provide analgesia and reduce inflammation (Freitas de Freitas and Hamblin, 2016). The mechanism of action is the activation of the enzyme cytochrome c oxidase in the mitochondrial electron transport chain, which increases cellular adenosine triphosphate production, reduces the levels of pro-inflammatory cytokines and stimulates the production of transcription factors (Freitas de Freitas and Hamblin, 2016).

Exercise at this stage should be restricted to 5 minutes of lead only exercise. The home environment should be adapted to ensure that high impact activities and the subsequent risk of trauma is avoided. Passive range of motion techniques to the digits, hock and hip (Prydie and Hewitt, 2015), and gentle limb loading techniques can be included at this stage *(Table 1)*. There has been some research to suggest that use of a stifle brace for support (*Figure 1*) may improve weight bearing through the affected limb in conservatively managed cruciate animals (Carr et al, 2016).

Phase 2

In the mid-phase of recovery, from approximately 2–4 weeks post-rupture, the goals of treatment include continued analgesia, the ongoing encouragement of limb loading, and the gradual progression of the early strengthening exercises (Prydie and Hewit, 2015). Examples of methods recommended by the author to achieve this would be increasing the length of sets on the underwater treadmill, and inclusion of the following exercises (alongside those already being carried out):

- Three-legged stand exercises. The dog stands squarely on a non-slip surface and the therapist lifts each limb a few centimetres from the ground in sequence, for a very short time initially, building gradually. Support from the therapist should be given if needed

Table 1. Examples of exercises used to facilitate early limb loading and strengthening

Early limb-loading exercise	Description
Parastanding (*Figure 2)*	A block or book is placed under the affected then the unaffected limb in turn, to enhance proprioception and encourage early limb loading.
Aquatic treadmill	The animal's loading is supported by the buoyant properties of water, the depth of which is adjusted to sit above the level of the stifle. This promotes early limb loading and strengthening.
Slow lead walking	The patient is walking slowly on a flat surface, for up to 5 minutes.
Rhythmical stabilisations:	With the dog standing squarely on a non-slip surface, the therapist manually and repeatedly shifts the patient's weight caudally using a point of control on the dog or through their harness.

Figure 1. Use of a stifle brace to enhance stifle stability may assist some patients with conservative management.

- Rhythmical stabilisations performed on a gentle uphill slope, in order to gently increase loading through the hind quarters
- Lead walks should be increased to 10 minutes, two to three times daily.

Phase 3

In the late phase of recovery, from approximately 4–16 weeks, the goals are continued strengthening until a return to function can be met, and improving stifle range of motion (Prydie and Hewit, 2015). Examples of exercises the author would add in with phase 2 exercises to achieve this are listed in *Table 2*. Lead exercise should be increased by 5 minutes per walk per week until 20–30 minutes is achieved. Gentle off-lead exercise can then be initiated, beginning with 5 minutes, avoiding high impact activities such as rough play with other dogs and ball play.

Surgical management

Three of the most commonly performed surgical techniques for cruciate management are the lateral suture technique, tibial plateau levelling osteotomy and tibial tuberosity transposition. During each of the three techniques, the meniscus can be visualised and resected if damaged. Despite the fact that a complication following on from cruciate surgery is a postoperative meniscal tear, due to the progression of degenerative joint disease if removed, the meniscus is not routinely resected if it is undamaged (Harasen, 2011).

- Tibial plateau levelling osteotomy is an osteotomy technique, performed with the aim of changing the biomechanics within the stifle joint to prevent cranial tibial thrust. This is achieved by incising the proximal tibia, rotating the tibia to produce a flattened tibial plateau which is less angled, and plating the site to secure it (Davidson et al, 2005)

Figure 2. Parastanding by placing a book or block under the affected, then unaffected limb encourages early limb loading.

- Tibial tuberosity transposition was introduced as a means of developing a surgical technique which also reduced the tibial plateau angle, but was less invasive than the tibial plateau levelling osteotomy (Tuan and Farrell, 2015). The technique involves creating an osteotomy in the proximal tibia and advancing the tibial tuberosity cranially. This is held in place by a titanium cage and bone plate, secured with a fork and bone screws to the tibial tuberosity and tibia respectively (Millis and Levine, 2014).
- For the lateral suture technique, a synthetic suture material is passed around the lateral fabella, then through a hole drilled in the proximal tibial crest. This mimics the function of the cruciate ligament by creating stability for the stifle joint (Harasen, 2011). The synthetic suture material will commonly rupture at some stage following the procedure, usually a few months later. By this point, the structures surrounding the stifle including the joint capsule have fibrosed, creating stability in this way (Millis and Levine, 2014).

Rehabilitation is indicated following surgical management of cranial crucial ligament disease, regardless of the surgical technique selected, and can be broken down into four phases.

Phase 1

Up to approximately 14 days postoperatively, goals for the patient include pain management, wound management, reduction of swelling and maintenance of joint range of motion. This is achieved through use of pharmaceuticals, electrotherapy, cryotherapy and passive range of motion techniques (avoiding the stifle for now) (Prydie and Hewitt, 2015).

Phase 2

From approximately day 14, up to week 6, the focus is on continued analgesia, early limb loading and early strengthening for the core and atrophied musculature of the affected hindlimb (*Table 1*).

Phase 3

Around week 6 is the stage at which postoperative radiographs are most often taken for dogs that have undergone tibial plateau levelling osteotomy or tibial tuberosity transposition procedures. After this stage, as long as the osteotomy site has healed well, continued strengthening with the inclusion of exercises which are higher in impact (*Table 2*) can be initiated, alongside continuing

Table 2. Advanced exercises for continued limb strengthening and improving range of motion

Exercise	Description
Sit-to-stand exercises *(Figure 3)*	The patient is asked to sit, with the therapist ensuring that the sit position is 'tidy', in that both stifles are flexed and the dog is straight and not rotated onto either hip. The dog is then asked to rise into a stand position. This exercise is then repeated, with the number of repetitions depending on capability. This strengthens the core and hindlimb extensor muscles, and opens up the range of motion in the stifle from 46° to 108°, (Marcellin-Little and Levine, 2015) so this also functions an active range of motion exercise. It should be noted that this exercise is best avoided until the stifle is stable, as well as in dogs with meniscal injuries, significant stifle osteoarthritis, or painful osteochondrosis dissecans lesions, because of the risk of aggravating pain
Cavaletti poles	The patient is walked slowly over cavaletti poles, the height and spacing of which is determined by the size and capability of the dog. This has been demonstrated to promote both stifle flexion and extension (Holler et al, 2010) and so can actively increase joint range of motion
Gentle incline walking	Walking the dog in a slow, controlled fashion uphill promotes strengthening of the hamstring muscle groups (Holler et al, 2010)
Use of wobble cushions	Wobble cushions are placed under the dog's hind limbs which makes the patient's centre of gravity unstable, so core and extensor muscle groups are stimulated to provide balance. This exercise should be closely supervised by a trained therapist as there is a risk of patient injury

Figure 3. The patient is asked to sit, with the position being checked by the therapist and aligned if necessary, to ensure it is 'tidy', before being asked to stand.

passive range of motion techniques, now including the stifle, until a normal range is achieved (Walker and Proot, 2009). This is also the case for animals that have undergone a lateral suture technique.

Phase 4

At around 12 weeks post-surgery and beyond, the inclusion of activities the animal participated in prior to rupture of the ligament may be reintroduced gradually (Prydie and Hewitt, 2015). This should only take place once the dog has been reassessed and found to have no evidence of lameness or stifle effusion.

Patellar luxation

Medial patellar luxation is a common orthopaedic condition among the canine population and varies hugely based on severity of the disease. Luxations are graded 1–4, with the form of management recommended being dependent upon the grade. Grade 1 luxations are a common incidental finding during examination, and typically do not cause the patient discomfort or lameness and do not warrant surgical intervention. Grade 3 and 4 luxations are painful and generally cause lameness as a result of cartilage erosion at the medial trochlear ridge and articular surface of the patella. Early surgical management is indicated in these animals to address bony deformities such as internal rotation and 'bowing' of the tibia which are likely to occur (Perez and Lafuente, 2014). Dogs suffering from grade 2 luxation should be selected for the form of management (surgical or conservative) on a case-by-case basis.

Conservative management of patellar luxation includes rehabilitation techniques, with the main goal of strengthening the following key muscle groups:

- The quadriceps femoris, which functions as a stifle extensor and hip flexor
- The biceps femoris which functions as a hip and hock extensor, stifle flexor and extensor
- The tensor fascia lata, which functions as a stifle extensor, hip flexor and hip abductor (Prydie and Hewitt, 2015).

Figure 4. Side stepping develops the muscles of the lateral thigh, including the biceps femoris and the tensor fascia lata.

Therapeutic exercises can be used to promote quadriceps strengthening, including those that promote stifle flexion and extension as a counteraction, such as hydrotherapy in the underwater treadmill with the water height above the stifle, walking over cavaletti poles and sit-to-stand exercises. These muscles can be further developed by introducing side stepping, where the dog is started in a standing position next to the therapist and encouraged to step sideways (*Figure 4*).

Surgical management involves some or all of the following procedures:

- Deepening of the trochlear groove
- Tibial tuberosity transposition
- Distal femoral or proximal tibial corrective osteotomy
- Soft tissue release and imbrication.

Post-operative rehabilitation techniques in combination with NSAIDs have been shown to improve muscle mass and weight bearing in animals, compared to those receiving NSAIDs alone (Wiputhanuphongs et al, 2015), and are indicated following surgery.

Post-surgical management initially focuses on analgesia with NSAIDs and cryotherapy to reduce inflammation. Gentle passive range of motion exercises can begin 72 hours after surgery (Perez and Lafuente, 2014). For the first 4–5 weeks post-operatively, gentle therapeutic exercises to encourage early limb loading and address atrophy can be initiated (*Table 1*), with further hind limb strengthening (*Table 2*) initiated after this time (Millis and Levine, 2014). The prognosis of animals who have undergone surgical management varies depending on the grade of luxation (Harasen, 2006). It is guarded in dogs with grade 4 luxations because of the level of deformity and cartilage loss present before surgery (Perez and Lafuente, 2014).

Osteochondrosis dissecans

The stifle is the fourth most common joint for the development of ostechondrosis, and lesions most often occur at the articular surface of the lateral femoral condyle (Cook et al, 2008). Surgical management, including debridement, curettage and, more recently, the use of synthetic osteochondral resurfacing is recommended for patients with joint 'mice' or sizeable osteochondral defects. Non-surgical management is only indicated for patients with mild lameness and small subchondral lesions, with the absence of joint fragments (Harari, 1998).

For approximately the first 14 days following surgical intervention, the focus should be pain and wound management through analgesics, electrotherapy, cryotherapy and the introduction of passive range of motion exercises once the patient is comfortable enough to tolerate them (Prydie and Hewitt, 2015). Early limb loading exercises can be introduced around day 14 (*Table 1*), with the progression to more advanced strengthening exercises (*Table 2*) being based on assessment of the animal to determine when they are comfortable and loading the limb well. This will allow for continued strengthening and a return to function. The outcome for surgical management of dogs is guarded to poor, as when pain, quality of life and limb function are assessed following surgery there is little improvement when compared with assessment findings prior to surgical intervention. (Cook et al, 2008).

KEY POINTS

- The stifle is a common area of pathology, that can result in lameness in dogs.
- The common conditions affecting the stifle can be described as developmental or degenerative in nature.
- Rehabilitation techniques can be used to assist the patient with recovery from specific conditions, managed surgically or non-surgically, or as part of a management strategy for degenerative joint disease.
- Techniques vary and include both passive and active range of motion techniques, strengthening exercises, balance exercises, electrotherapy and thermotherapy.

Osteoarthritis

Osteoarthritis affects up to 20% of dogs over one year of age (Barale et al, 2020) and commonly affects the stifle joint, often secondary to the various conditions described above.

Physical therapies are indicated in the management of osteoarthritis to reduce joint pain, improve range of motion, improve strength and balance, and restore a more normal joint function (Johnston et al, 2008). This can be achieved through a combination of passive range of motion exercises, stretching techniques, massage therapies to address secondary soft tissue

pain, and strengthening exercises (such as those described in *Tables 1* and *2*). Aquatic therapy is particularly useful for dogs with osteoarthritis as a result of the buoyancy properties of water reducing the load placed through arthritic joints (Millis and Ciuperca, 2015).

Dogs with osteoarthritis often suffer from a reduction in proprioception (Dycus et al, 2017), so balance exercises are a useful part of a physical therapy programme. Examples of exercises which enhance balance and co-ordination include:

- Controlled walking on an uneven surface
- Supervised use of wobble cushions with support if necessary
- Rhythmic stabilisations
- Three-legged stands with manual support if required.

There has been much interest in recent times about the use of photobiomodulation as a treatment technique to assist with the management of osteoarthritis. Results from studies are encouraging and often demonstrate reduced pain scores in arthritic patients receiving therapy (Barale et al, 2020).

Summary

Rehabilitation techniques can be used as part of a treatment programme for a variety of conditions affecting the stifle, for non-surgical or surgical management of specific conditions, and for management of long-term conditions. Continuous reassessment of the patient, clinical reasoning to select suitable treatment techniques and communication with the referring vet are three key elements that qualified rehabilitation therapists must adhere to, in order to maximise successful treatment outcomes.

Conflicts of interest

The author declares no conflicts of interest.

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