# ABC Awards Level 3 Introduction to Aquatic Treadmill Practice

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## Clinical Report

Aquatic therapies and the role of proprioception as part of a conservative management strategy for a 6 year old large cross breed companion dog with Cranial Cruciate Ligament disease in the out patient setting.

**Summary**

An energetic 6 year old Rottweiler/Labrador crossbreed was seen in the outpatient clinic for physiotherapy, hydrotherapy and land based therapies including electrotherapies. She had a 3 year history of intermittent lameness of the left hind and was diagnosed with Cranial Cruciate Ligament (CCL) disease in May 2019. Her owners did not want to put her through any surgical procedure at that time and requested to be referred to their local outpatient clinic for veterinary physiotherapy to improve movement and function.

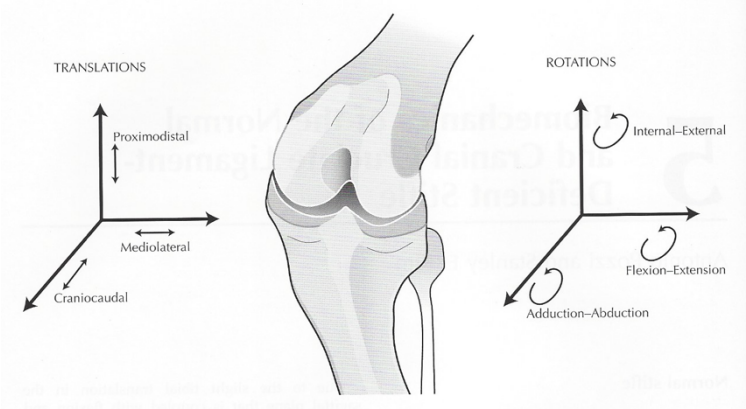
**Keywords**

Rottweiler/Labrador
Stifle
Cranial Cruciate Ligament (CCL)
Physiotherapy
Hydrotherapy
Underwater Treadmill (UWTM)
Behavioural modification
Therapeutic handling
Proprioception

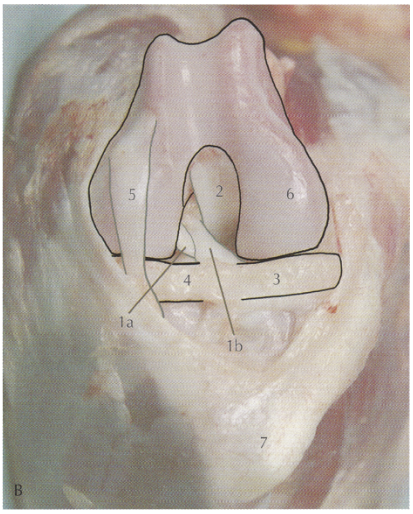
**Introduction**:

Cranial Cruciate Ligament disease in the dog is a multifactorial complex problem that requires a thorough understanding of the biomechanics of the stifle to be inderstood[1].

The stifle itself is a complex, diarthrodial, synovial joint that is highly unstable[2]. The menisci, ligaments, joint capsule, and pelvic limb muscles are all involved in complex movements occurring in three planes[2]. The stifle primarily functions as a hinge joint producing flexion and extension[3], however, approximately 20$^{o}$ of varus-valgus and internal-external rotation occurs during the gait cycle[4].



The six degrees of freedom of the femerotibial
(Picture reproduced from Muir, Peter, ed. *Advances in the canine cranial cruciate ligament*. Vol. 1. John Wiley & Sons, 2011)
Clinicians need to understand all three motions at the stifle joint as disruption to any of the components will alter the biomechanics of the whole structure leading to dysfunction[5].




Flexed right stifle joint of a dog
Picture reproduced from Muir, Peter, ed. *Advances in the canine cranial cruciate ligament*. Vol. 1. John Wiley & Sons, 2011)

1a: Caudolateral bundle of CrCL
1b: Craniomedial bundle of Caudal Cruciate Ligament

Of the 15 ligaments that support the stifle, the collateral and cruciate ligaments are of primary importance[2]. The stifle is dependent on the CrCL during the stance phase of gait[4] to prevent excessive internal rotation and hyperextension, and resist forces that cause the tibia to translate cranially relative to the femur[6].

Rupture or disease of the CrCL is a common cause of lameness in the dog[7], but is rarely traumatic[8]. It results in rotational instability and secondary osteoarthritis[9]. External limb loading is reduced, and limb flexion is increased through the gait cycle[4] clinically resulting in compensatory weight shift onto the contralateral or diagonally paired limb. Reported incidence of contralateral CrCL disease is as high as 60%[10] and Buote et al[8] found that within 5.5 months 50% of Labradors studied had contralateral CrCL rupture.

The decision as to whether to undergo surgical procedure or conservative management is a complex one and often debated in the veterinary world[11].The pro's and cons of this topic are not dealt with in this case study as the owner chose conservative management strategies.

As a crossbreed, the behaviours and physical characteristics of each individual breed should also be taken into consideration when planning and carrying out a treatment programme. Both breeds are energetic, medium to large sized dogs that are intelligent and good natured[12]. The Rottweiler however, is bred for great strength[13] and can be difficult to control if not properly trained from an early age[14].

Both breeds are prone to hip and elbow dysplasia[12,13,14], and also a variety of eye conditions. The Rottweiler also has a high incidence of Aortic stenosis, Osteochondritis Dessicans (OCD) and CCL rupture[13,14].

**Case History:**

**HPC:**
Isis, a 5 year 46.6kg intact female large crossbreed was referred for hydrotherapy after a 3-year history of intermittent left pelvic limb lameness. On X-ray in March 2019 she was noted to have significant arthritic changes and a mild cranial drawer on the left limb consistent with cranial cruciate ligament disease. The owners requested initial conservative management with a view to surgical intervention if needed.

Isis was first assessed on the 20th May and has been seen three times since the initial appointment. Treatment has focused on increasing strength and proprioceptive awareness in the left pelvic limb, caudal core engagement and soft tissue work to reduce compensatory overuse and fascial tension in the thoracic sling and lumbar epaxial musculature.

Isis has been treated with a combination of hydrotherapy, electrotherapies and land-based therapies. Her owners have also been given a bespoke home exercise programme to follow.

A veterinary referral form was received for this episode of treatment in accordance with the Veterinary Act 1966[15]

**PMH:**
Prone to ear infections
Grade II heart murmur: no clinical signs

**DH**
Serraquin
Salmon oil
Green lipped mussel

**SH and husbandry issues**:

Isis is a companion animal only who spends most of her day in the company of her owners
House with stairs and small enclosed garden
She walks 2 x 30 mins on lead
She sleeps in own bed, and does not need to do stairs
Jumps in/out of car
Altered gait pattern but no other specific functional issue

**Home Exercise Programme (HEP)**

- Balanced lead and harness work with sensory integration techniques to stimulate core stability and pelvic limb extensor muscle engagement
- Proprioceptive track and groundwork
- Avoidance of high force activities/rough play
- Management of exuberant behaviours such as squirrel chasing

**Risk Assessment**

Static and dynamic risk assessments were carried out prior to, and during Isis' treatment session. Isis's size, power, pathologies and intermittent energetic behaviours makes her a high risk to the therapist (as a sole practitioner), her owners and herself.

The therapist also needs to be aware that there is an increased demand on the cardiovascular system with higher VO2 output and oxygen consumption from the effects of exercise in water verses on land. This effect is greater with increases in water depth, than it is through increasing the speed of the UWTM[16].

Clinically Isis displays no signs of an underlying heart murmur, however this, combined with her mildly brachycephalic conformation makes it particularly important to increase the amount of health checks carried out throughout the session, specifically monitoring heart rate, pulse rate, respiratory rate and perfusion rate through mucus membrane colouration[17]. The owner also offers invaluable feedback when assessing behavioural responses of their dog to exercise.

Keeping this in mind her appointments were booked to be early in the day when the ambient temperature was cooler and with the treatment room appropriately ventilated. The dehumidifier was switched on, doors and windows were secured and all routine water management procedures had been carried out.

The environment was organised to be proprioceptively enriched through the creation of corridors to stimulate visual receptors[18] and guide direction of movement into the clinic. Positioning of stools, chairs and mats were all done in advance to enable movement shaping over different surfaces to increase efficient movement patterns.

Kneeling mats were placed in an arc to provide visual cues to then direct Isis towards the treatment area. On entering the therapist uses her own body posturing and verbal feedback to signal to the dog and owner to enter and where to settle for the session to commence.

An appropriate harness, collar and lead were chosen to be able to facilitate therapeutic handling and improve body balance and control. Strategies and treatment techniques were planned to ensure safe practice throughout and keep Isis focused for an effective treatment session.

Figure 1: Checking pulse rate in the treatment room in a balanced stand with harness and collar fitted.

Figure 1a: Proprioceptive track in corner of room

**Assessment at the session**;

Isis entered the clinic pulling on her lead displaying exuberant behaviours due to her excitement at attending the session and although wearing a Y shaped harness she was still out of balance. She was overusing her thoracic limbs with reduced caudal core activation and disengagement of the pelvic limbs. Lameness was graded as 3/10[19].

Ttouches were used by way of communication and as an introduction to therapeutic handling[20]. It also helped to positively modify her behaviours and calm her through the effect tactile information has in mediating conscious proprioception and activating the parasympathetic system[21].

The assessment process was ongoing from the moment Isis entered the treatment room.

**Key Findings:**

- Offloading the left pelvic limb with reduced metatarsal pad contact indicative of discomfort and reduced stability
- Mild swelling at the medial aspect of the left stifle joint
- Reduced muscle mass and tone in the quadriceps femoris and the extensor musculature of the left pelvic limb, specifically the biceps femoris, hamstring group and gluteals
- Over engagement and increased tone in the left gastrocnemius
- Fasiculation in the left cranial head of sartorius
- Spasm in the epaxials at the lumbosacral junction
- Spasm in the left lateral head of triceps
- Reduced proprioception in the left pelvic limb
- Buttressing around the medial aspect of the left stifle
- Compensatory over engagement of the thoracic sling musculature, specifically the superficial pectorals on the right, and the rhomboids
- Compensatory over engagement of the cervical epaxials, especially the left side
- Reduced protraction in the Thoracic Limbs (TL)

Functional implications:

- All transitions are dominated by overuse of the thoracic limbs
- Craniolateral placement of the left Pelvic Limb (PL) in stance
- Abducts and externally rotates the left pelvic limb in sitting
- Lameness and shortened stride length during the gait cycle

**Goals for the session**:

Prioritised veterinary therapy goals were set that were Specific, Measurable, Achievable, Relevant and Timed (SMART)[22]. This was done to focus the treatment session and enable effective reflective practice afterwards.

- Management of discomfort: aim to reduce underlying inflammation and effusion and enhance the healing process through movement[23], aquatic therapies[24] and PEME[25]
- Use of proprioceptive enrichment techniques to positively affect the sensorimotor system and improve left pelvic limb paw placement on land and in the water
- Use of soft tissue techniques and movement therapies to reduce areas of tension in the myofascial planes of the thoracic sling, cervical epaxials, lumbosacral junction and left lateral head of triceps
- Strengthen caudal core and extensor musculature of the left pelvic limb
- Improve stability at the stifle through strengthening of key antigravity muscle the quadriceps femoris[26]
- Use of behavioural modification techniques and therapeutic handling to improve focus, active participation and facilitate a more appropriate body balance and TL: PL loading ratio of 60:40[26,27]
- Improve function through re-education of movement patterns, increased proprioceptive awareness, muscle activation and groundwork[20]
- Review home exercise programme with owner

Functional Goals:

Short term goals: to improve paw placement during stance phase on the left pelvic limb to enable more effective recruitment of musculature leading to an improved gait pattern

Long term goals: Isis to be sound in walk and slow trot and owners to have ongoing strategies to be able to optimise Isis' movement patterns and manage any acute episodes

**Treatment strategies:**

Isis responded well to the therapeutic handling and touch work and became more settled and focused on the treatment session. Feedback signals[20] were constantly monitored throughout the entire session and verbal feedback sought from the owner as to how they perceived Isis to be. Baseline health checks were carried out at this point in the treatment room and then monitored during the session in the UWTM.

Isis was familiar with the harness from previous sessions and so therapeutic handling was used to put the harness on to be proprioceptively enriching and to engage the caudal core.

Sensory and touch work on the left pelvic limb extensor musculature stimulated the mechanoreceptors and increased activation[28] before Isis was then movement shaped into the wet room. Corridor alignment, body posturing and a slower than normal pace was used to increase proprioceptive input and improve body balance and loading of the left pelvic limb.

The initial focus of the session was to reduce discomfort, not only because of ethical considerations, but also because of the inhibitory effect pain has on muscle activation[29], which affects optimum functioning.

Therapeutic handling and treatment techniques such as Proprioceptive Paw Placement (PPP) were used to facilitate alignment at the shower whilst aquatic stimulation, sensory integration and touch work was carried out to increase the afferent information to the exteroceptors of the core and pelvic limbs. Fascial release work at the lumbosacral junction combined with rhythmical stabilisations had an immediate effect on improving the limb loading ratio. Functional carryover was then achieved by movement shaping Isis up the incline ramp to concentrically strengthen the pelvic limb extensors and drive her forwards.

Figure 2: Isis' initial positioning at the shower, with her left pelvic limb abducted

Figure 3 and 4: Proprioceptive paw placement techniques with sensory reinforcement using gentle circular compressions on the dorsum of the left paw to maintain an aligned position and improve body balance.

Once in the UWTM, the doors were secured and the water level increased to approximately elbow level. The depth of the water was chosen to utilise the effects of buoyancy providing weight relief and assisting passive range of movement techniques[24], without submerging too much of her thorax which would have increased CV demands as previously outlined. It also enabled the therapist to facilitate increased stride length[30] to improve extensor muscle engagement. The resistance provided by the water at this height enhanced strengthening which will increase stifle stability without stressing the joint or increasing flexion.

Figure 5: Myofascial release technique on the epaxial musculature of the lumbosacral junction.

Hydrostatic pressure helps in the management of oedema[31] whilst the heat of the water improves vascular flow[25], soft tissue extensibility and relaxation[32]. Pressure is therefore reduced at the joint as is loading, decreasing the nociceptive transmission[33]. This enabled better alignment and more appropriate weight bearing through the metatarsal pad and consequently improved the engagement of the surrounding musculature.

Isis had already had a few sessions of hydrotherapy which indicated that habituation to the UWTM had already been achieved[34]. The belt speed was therefore set initially to achieve her natural balanced movement pattern enabling her gait pattern to be assessed. She had a tendency to slightly circumduct the left pelvic limb through the water resulting in reduced stride length, however her stance phase improved in line with the reduced loading on the joint.

Belt speed was then reduced to be more proprioceptively enriching and corridor alignment techniques used to improve sagittal plane movement and facilitate extensor activity in the pelvic limb. Treatment durations were short to ensure quality movement patterns were achieved and rest sessions given as were deemed appropriate to avoid fatigue.

Soft tissue work included Myofascial Release (MFR) techniques targeted to reduce areas of tension within the linear region of the stress-strain curve[35], reducing the self perpetuating muscle spasm cycle[36] and improving range of movement specifically in the thoracic limbs and at the lumbosacral junction. Functionally this was seen through improved protraction and stride length.

Figure 6: Myofascial release technique on the left lateral head of triceps, whilst stabilising and maintaining body balance and alignment.

The function of the stifle is significantly dependent on the supportive musculature of the pelvic limb[1]. Pain and dysfunction caused by cranial cruciate ligament disease predominately affects the quadriceps femoris muscle[37] however, general thigh muscle atrophy is also associated with osteoarthritic joint changes which impacts on the ability to return to normal balanced motion and functioning[38]. It is of clinical important therefore to strengthen these areas, specifically the quadriceps as it is the key stifle extensor[39].

Treatment techniques were therefore used to facilitate bilateral quadriceps femoris activation using closed chain exercises. Sensory stimulation to the length of the epaxials, the gluteals and the hamstring group increased proprioceptive awareness and rhymical stabilisations activated co-contractions between agonist and antagonist muscle groups to aid proximal stability before then switching the belt on to carryover muscle engagement into gait.

Figure 7: Rhymical stimulation of the hamstrings to tap into central pattern generated movement and facilitate extensor activity in the pelvic limbs.

Figure 8: Asymmetrical alignment technique to engage the core and maintain sagittal plane movement at the left hip

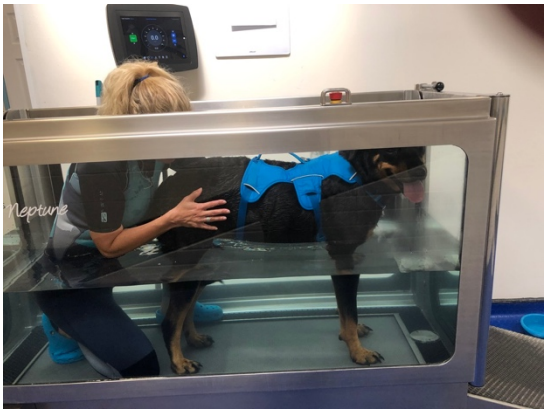




Figure 9: Proprioceptive paw placement followed by Figure 10: facilitation of an aligned balanced stand, reinforced with closed chain activity and leading into rhymical stabilisations to engage the quadriceps (not shown)

The owner fed back that she noticed Isis seem to “grow longer in her back” and seemed “more stable on her feet”. This feedback provided a good opportunity to reinforce the value of the HEP as she could see the immediate impact the sensory work had on improving the loading ratio.

Facilitated aligned transitions from perch sit to stand to perch sit (on therapist knee) were also used to strengthen concentric and eccentric muscle activity and re-educate functional movement patterns. These transitions were completed generally in lower water to enable

Isis to overcome the effects of buoyancy of the deeper water which was behaviourally and physically too challenging for Isis to complete the task. This was then carried over from the sit into Isis's natural balanced gait pattern with the treadmill belt on.

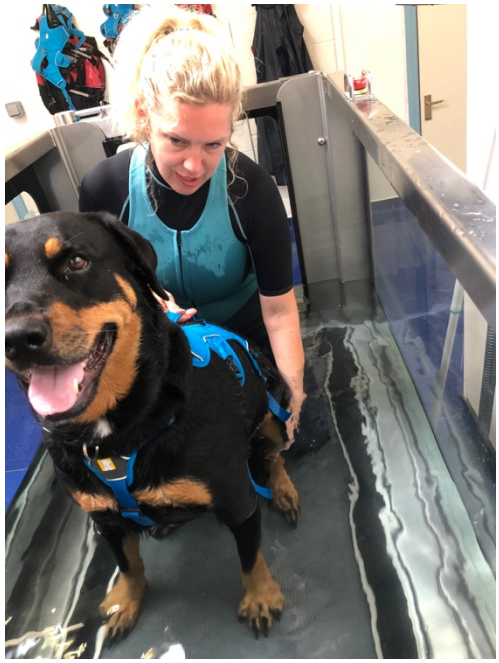



Figure 11a and b: Aligning pelvic limbs in supported sit using PPP to facilitate appropriate engagement of core and pelvic limb extensor muscles. Regular monitoring of feedback


Figure 12: using the harness to offer manual transmission in a caudal direction to provide light resistance to transition into stand.

Figure 13: Transition to balanced stand maintaining alignment at the left pelvic limb.

Figure 14: Balanced stand ready for safe decline out of UWTM.

The combination of MFR work, sensory integration techniques, PPP and corridor alignment techniques when layered with the changes of belt speed and water depths created a high level of proprioceptive integrity during the session enabling Isis to improve loading on the left pelvic limb, core engagement, body balance and stride length in both the thoracic and pelvic limbs. This combined with the increase in strength and stability at the stifle had a direct impact on improving her movement pattern during a controlled decline out of the UWTM. The increased engagement of the pelvic limb extensor musculature in a functional activity increases the relevance to the central nervous system and enhanced carryover into land based activities.

**Land based**:

After being showered off and therapeutically dried using gentle compression techniques, Isis was directed to the treatment room using movement shaping onto her own towel on the mat. This had been set up on arrival to encourage Isis to settle as the smell was familiar to her and therefore calming.

PEME was clinically reasoned to be done after the water based treatment as behaviourally Isis would have found it difficult to settle beforehand. Parameters were manipulated[40] to reduce the chronic pain and inflammation[41,42] associated with OA and to promote healing and synaptic messaging to the pelvic limb musculature[43].

Touch work and soft tissue techniques were also carried out to aid relaxation and to work on the cervical epaxial muscles to reduce tension and restore length to the tissues. This also promotes the release of serotonin[44] which as a chemical reward and positive reinforcement to the treatment experience.

Figure 15: PEME and soft tissue work on

**Outcome measures:**

- Improved alignment and loading of the left pelvic limb in stance
- Reduced tension in the rhomboids, right superficial pectoral and left lateral; head of triceps
- Improved stride length in both thoracic and pelvic limbs
- Improved body balance
- Improved proprioception demonstrated through improved sequencing in the water and on land during slow to fast walk
- More aligned sitting posture

Outcome not achieved: Assessment of specific proprioceptive groundwork due to time constraints.

**Next session**

Discuss outcome of this session and the carryover into function with her owner. If Isis maintained improved movement I would want to work on increasing strength in the left pelvic limb, proprioception and building endurance. I would modify the parameters in the UWTM to incorporate more graded transitions of pace to increase coordination, balance control and proprioception.

**Conclusions**

This was a complex case in terms of handling a large breed dog with intermittent exuberant behaviours in a confined space. The use of therapeutic handling had a huge impact on the outcome of the treatment session. Left to her own devices Isis is an exuberant, strong dog whose movement patterns are unbalanced. This incorporated with her marked offloading of the left pelvic limb would lead to a high probability of overloading and damaging the right CCL.

The use of touch work, therapeutic handling and movement shaping had a huge impact on calming her and improving her focus which resulted in active participation in the tasks. This voluntary control is essential for efficient movement patterns and to gain carryover into meaningful functional activities.

The session itself was very successful with Isis's owner noticing an immediate improvement in her gait and movement patterns. I do not think this would have been achieved as effectively or as quickly on land. Being able to manipulate the parameters of the UWTM and utilise the properties of the water was crucial in enabling alignment and activation of the targeted musculature.

**Reflections:**

Completing this case study has reinforced the fact that as therapists we should be constantly reflecting on what we do and how that effects the dog at each and every session. This includes not only our own body posturing, movement shaping, effectiveness of treatment strategies and the outcome from our intervention, but also our underlying understanding of the individual's biomechanics.

As therapists we are trying to improve normal balanced motion of the dog and a huge part of this involves understanding the specific biomechanics of each individual joint. The stifle for example, is a particularly complex joint with multiple ligaments which all play a role in supporting the joint through its movements. However, it is important to remember the specific role that the CCL plays and how a deficiency in this ligament affects movement. On reflection therefore, I feel I could have spent longer doing static closed chain work utilising the deweighting effects of the water with Isis to activate the Quadriceps Femoris muscle and work on stability and proprioception in stance as this is a key role for the CCL [6,7,9].

Overall this case has highlighted how essential it is to understand how proprioceptively enriching this environment can be, and the amazing results that can be achieved when the therapist manipulates the parameters in the UWTM to maximise use of the physical properties of water.

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