Conservative Management of Cruciate Ligament deficiency with Physical Therapy

Laurie Edge-Hughes, BScPT, MAnimSt (Animal Physiotherapy), CAFCI, CCRT

The Canine Fitness Centre Ltd, Calgary, Alberta, Canada

Small animal health care practitioners know that some patients are not surgical candidates because of age, poor health, inadequate state of fitness, and/or because of owner's financial status. Still, this subset of patients deserves a chance at optimal function.

The Cruciate Deficient Human Knee

A scant amount of literature has been published on the conservative rehabilitation of canine cruciate deficiency. While some studies have used cruciate-deficient dogs as control animals, evidence-based rehabilitation programs are not generally part of standard management protocols for a comparable evaluation of this option.

Human literature has attempted to make comparisons between surgical and conservative management of the cruciate-deficient knee, and to study specific treatments and outcomes pertaining to the rehabilitation of the non-operative knee joint.

Electromyography (EMG) activity of anterior cruciate ligament-deficient (ACL-D) knees compared to normal and reconstructed knees at a walk has been studied. There is an increase in vastus lateralis activity at loading (vastus lateralis resists internal rotation of the tibia). There is an increase in rectus femoris activity at pre-swing (this may indicate a decrease in knee flexion). There is an increase in biceps femoris activity at terminal swing (this may prevent anterior tibial translation with quads contraction at loading). Lastly, there is an increase in tibial anterior activity at terminal stance (tibialis anterior creates dorsiflexion and inversion, which also externally rotates the tibia and resists internal rotation forces).

The conclusion was made that rehabilitation did not restore normal EMG patterns, as compared with surgery, and further postulated that there was a reduction in performance in ACL-D knees in more strenuous sports. These results also suggest that neuropathways other than those mediated by ACL mechanoreceptors exist to coordinate muscle activity.

Other studies have shown a greater flexion angle in ACL-D knees during certain stance periods. Quadriceps weakness has been identified as a common problem after ACL injury, and this weakness was persistent in patients with poor functioning knees. Prior to rehabilitation strengthening, these patients did not extend the injured knee to the same extent as the uninjured knee. A certain amount of tibial translation is important to good functioning after ACL injury; however symptomatic ACL-D patients exhibited more anterior displacement than those who were asymptomatic during weight bearing. Static tibial translation has not been found to correlate with functional outcome. Significant kinaesthetic proprioceptive deficits affect both the cruciate-deficient and surgically-reconstructed knee as well as the contralateral normal knee. There is a correlation between proprioceptive deficits and subjective knee function in patients with symptomatic ACL deficiency. There is also a relationship between the patient's ability to detect passive motion and morphological lesions (chondral or meniscal lesions).

Rehabilitation of the Cruciate Deficient Human Knee

Some papers report conservative treatment of human anterior cruciate ligament deficiency to be unsuccessful or only successful in older or inactive patients. However, successful treatment of the non-surgical ACL-D knee has been possible with specifically targeted rehabilitation programs.

A rule of thirds has been proposed for chronic ACL injuries treated with rehabilitation: 1/3 of patients resume previous recreational activities without reconstruction (copers); 1/3 manage without reconstruction by modifying or lowering their activity level (compensators); and 1/3 require reconstruction because of recurring giving-way episodes (non-copers).

Comparisons of rehabilitated ACL-D and normal knees for function (using the single leg hop test) was found to result in 77% of the subjects having normal function at one year post-injury, 89% normal at 3-years post, and 85% normal at 15 years of follow-up. Strength (isometric and concentric) as measured by dynamometer was shown to be normal in 42 – 56% of the subjects at 1 year, 54 – 68% at 3 years, and 69 – 82% at 15 years follow-up. Activity levels change with rehabilitation management and surgical management of the ACL-injured knee. Both groups showed an overall decline in activity levels, with the rehab-only group doing slightly better than the reconstruction and rehab group at the 1-year follow-up mark, equal in activity level at the 3-year mark, but then slightly lower in activity level at the 15-year mark.

The same study also collected data on subjective knee function / quality of life (QOL) scoring. Patients scored the highest 1 and 3 years following injury in the rehab-only group, with patients injured in contact sports scoring the lowest. Interestingly, at the 15-year follow-up, those patients with reconstruction surgery scored lower in the QOL scores than the non-reconstructed patients. This same cohort of patients was also evaluated for evidence of radiographic osteoarthritis (OA) at the 15-year mark following injury. Sixteen percent of the rehabilitated patients developed radiographic OA. All of the patients with OA had undergone a meniscectomy. None of the non-meniscetomized patients developed OA. Sixty-eight percent of the patients reported having an asymptomatic knee, while 23 % reported having reconstructive surgery at an average of 4-years after injury.

A separate study found that 91% of competitive handball players treated without reconstruction returned to pre-injury activity level, whereas only 58% in the reconstructed group were able to do the same. A literature review concluded that, while ACL reconstruction yielded the least amount of secondary meniscal surgery, OA morbidity was higher compared with the conservatively managed group. Sports participation tended to be higher in the reconstructed group as well.

Successful management of the ACL-D knee in humans centers on common goals: Early activity modification, neuromuscular knee rehabilitation, and strength training. It is appropriate to stage the rehabilitation goals and activities through rehabilitation. Time alone is not the signal for advancement from one program to another, and attention should be paid to range of motion (ROM), strength, fluidity of performance of functional activities, as well as functional testing.

Rehabilitation of the Cruciate Deficient Canine Stifle

Using the goals for each phase of rehabilitation of an ACL-D human knee, treatment regimes can be proposed for the canine with an ACL-D stifle. The following tables 1 – 4 illustrate the goals and this author's (LEH) suggestions for reha-

bilitation of the canine patient.

While natural healing of a meniscal tear has been reportedly possible, a meniscal injury may inhibit success of this regimen. Preventing OA should be an important goal for all animals that suffer joint trauma. Human studies have found a correlation with glucosamine use and a reduction in joint space narrowing and erosive effects of OA. Canine studies have found that the use of a glucosamine / chondroitin sulfate mixture enhances synthesis and turn-over of the matrix of proteoglycans and collagen, and hence can have a protective effect against synovitis and associated bone remodelling. Cetylated fatty acids have also been shown in both human and animal studies to modulate the immune response and inflammatory process of OA and, in turn, improve ROM and overall function. Advisement on nutritional supplementation should be considered just as important as physical management of the condition. Additionally, excessive weight can impact the stresses on articular cartilage. A human study found that each pound of weight loss resulted in a 4-fold reduction in the load exerted on the knee per step. A canine study found that dogs with hip OA that were fed 60% of their current calorie intake lost 11 – 18% of their body weight, and experienced a significant decrease in hind limb lameness. Weight management should be deemed an integral part of rehabilitation of the ACL-D dog.

TABLE 1, *Phase 1* (weeks 1-4) – Goals and Treatment Suggestions for Protection of the Canine ACL-D Stifle

Goal	Suggestion
Increase ROM	PROM flexion and extension; tummy rubs into extension; 'square' sitting practise.
Increase muscle function using movement synergies and utilizing motor learning transfer	Active sitting down to a stool (guiding rear legs for symmetry of movement); Toe pinches (alternating and simultaneous) in side lying; Leash walk to toilet, progressing to 5 minutes and increasing time by 3 – 5 minutes per week (if no increase in joint inflammation); Weight shifting exercises; Balance board exercises (front legs on board); Standing on soft surfaces and balance; 3-leg standing; Step ups; Walking in circles or figure-of-8 patterns.
Increase proprioception	Joint compressions; Grades 1 – 2 joint mobilizations.
Decrease pain and effusion	Icing; PROM & AROM within pain tolerance; Joint compressions. Grades 1 -2 joint mobilizations; NMES. Modalities.

TABLE 2. *Phase 2* (weeks 5-8) – Goals and Treatment Suggestions for Early Strength Training of the Canine ACL-D Stifle

Full ROM	As above; May add toe-touch hanging, or extension on the stairs; May add sitting practise on a stool or platform.
Normal gait	Walking with a 'disturbance' on the unaffected foot; Obstacle walking or trotting; Step up- hill walking or trotting.
Increase motor control (neuromuscular training) and strength	Underwater treadmill or swimming exercise; NMES or manual tapping on quadriceps or gluteals with 3-leg standing; NMES or manual facilitation on of hamstrings with sitting practice; Side stepping or back stepping over a pole; Stepping up backwards; Walking backwards; Any of the above land exercises on a soft surface; Hill walking; Stair walking.
Load: 50 – 60% of uninjured limb	Increase time and duration of exercises above.

TABLE 3. *Phase 3* (weeks 9-12) - Goals and Treatment Suggestions for Intense Strength Training of the Canine ACL-D Stifle

Increased strength, and motor control (neuromuscular training)	Continue most challenging exercises from above; Walking with a weight on the affected leg (open kinetic chain training); Trotting up–down-hills; Walking on uneven surfaces; Recall running between two people.
Increase Load: 70 – 80% of uninjured limb (increasing by 10% nearer end of stage)	Increase time and duration of exercises above; Perform exercises above with a weight pack.

TABLE 4. *Phase 4* (weeks 13-16) – Goals and Treatment Suggestions for Intensive Strength Training and Return to Sports of the Canine ACL-D Stifle

Increased strength	Continue most challenging exercises from above; Destination jumping exercises from a stand (plyometrics).
Increased coordination	Agility-type training.
Increased ability in sport-specific activities	Short distance ball retrieves; 1 or 2 agility-type pieces of equipment. Avoid play with other dogs until closer to 6 months or longer and start with only short intervals.
Load 80% of uninjured leg (increasing by 10% nearer end of stage)	Increase time and duration of exercises above; Perform exercises above with a weight pack.

Conclusion

Good functional recovery following a cruciate ligament injury is possible with conservative management. Older animals and those not engaged in high energy sporting activities might have an acceptable outcome with conservative care. Additionally, animals who are not surgical candidates may benefit from this evidence-based proposal for the conservative management of ACL-D in dogs.

References:

Full Article and references available upon request; physio@fourleg.com