CONSERVATIVE MANAGEMENT OF CRUCIATE LIGAMENT DEFICIENCY WITH PHYSICAL THERAPY

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All practitioners involved in small animal health care are well aware of the fact that some animals are not surgical candidates, either due to age, poor health, an inadequate state of fitness, and/or because of financial constraints, or owners' beliefs. This subset of patients deserves a chance at optimal function as much as those that are prime surgical candidates with owners willing and able to bear the financial burden of surgery.

The Cruciate-Deficient Canine Stifle

The cranial cruciate ligament functions to prevent excessive forward movement and internal rotation of the tibia bone. In dogs, a ruptured cranial cruciate ligament (RCCL) can be caused by either a single large force incident or by repetitive mild trauma. Ruptures caused by mild trauma are due to daily mechanical wear and degenerative changes in the RCCL fibres. Studies have also established a genetic basis for RCCL in Newfoundland dogs. Breeds with a high prevalence of RCCL also include Rottweilers, Staffordshire Terriers, Neapolitan Mastiff, Akita, Saint Bernard, Mastiff, Chesapeake Bay Retriever, and Labrador Retriever. Studies also show that neutered dogs, whether male or female, had a higher prevalence of RCCL than did sexually intact dogs. Dogs weighing > 22kg had a higher prevalence of RCCL at a younger age compared with dogs weighing < 22 kg. Obesity has also been reported as a contributing factor.

In the case of non-surgically repaired RCCL's, dogs suffer from osteoarthritis. The sequence of events following rupture include: fraying of cartilage, swelling of surrounding tissues, bone spurs, medial joint swelling, thickening of the joint capsule (in an attempt to stabilize the joint), meniscal injury, growing of bone spurs with inflammation in the joint, wearing down of the joint cartilage, and finally cessation of bone spur growth. Studies have also shown that there is a gait modification in RCCL dogs in which the relationship between the movement of the knee relative to the hip joint is altered. Following a cruciate rupture, studies have also noted that there is an increase in the likelihood of meniscal injury by 3 months. Furthermore, at six months of age there was an insufficient amount of fibrous tissue formation needed to stabilize the joint and improve gait.

However, following an RCCL surgical repair, there is atrophy of the quadriceps muscle and the beginning of joint arthritis. Studies have also shown that following cruciate repair the unaffected knee is also susceptible to arthritis.

The Cruciate Deficient Human Knee

A minimal amount of literature has been published specifically dedicated to conservative rehabilitation of canine cruciate-deficiency. While some studies have used cruciate-deficient dogs as control animals, evidence-base 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

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surgical and conservative management of the anterior cruciate-deficient (ACL-D) knee and to study specific treatments and outcomes pertaining to the rehabilitation of the non-operative knee joint.

Following an anterior cruciate ligament (ACL) injury, alterations in muscle activation and balance have been observed in the knee. Studies found new muscles activation in ACL-D knees which leads to the alteration of joint mechanics. The authors concluded that rehabilitation does not restore normal muscle activation patterns yet reconstruction does. They further postulated that there is a likely reduction in the performance in ACL-D knees in more strenuous sports. Quadriceps muscle weakness has been found to be a factor in poor functioning knees. Several studies have shown significant balance deficits after an ACL injury. These deficits are apparent in both the cruciate deficient knee and the intact knee and ultimately affect the function of both knees.

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 deficient knee has been shown to be possible with specifically targeted rehabilitation programs. Noyes et al (1983) proposed the rule of thirds for chronic ACL injuries treated with rehabilitation: 1/3 of patients can resume previous recreational activities without reconstruction; 1/3 manage without reconstruction by modifying or lowering their activity level; and 1/3 require reconstruction because of recurring episodes of instability even in activities of daily living. Thus creating 3 groups of patients: copers, compensators, and non-copers. Comparisons of rehabilitated ACL-D and normal knees using functional testing (i.e. 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, and 85% normal at 15 years of follow up. Strength (isometric and concentric) 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. Table 2 reflects the decline in activity levels regardless of the intervention using the Tegner activity level scoring system.

Table 2. Tegner activity level scoring following unilateral ACL injury (median)

Treatment	**Pre-injury**	**1-Year Follow-up**	**3-Years Follow-up**	**15-Years Follow-up**
Rehabilitation only	7	6	6	4
Reconstruction & Rehab	7	5	6	5

The same study also collected data on subjective knee function scoring / quality of life (QOL) scoring. Patients scored the highest 1 and 3 years following injury in the rehab-only group, with patient injured in contact sports scoring the lowest as compared to those injured in non-contact sports. Interestingly at the15-year follow-up, those patients with reconstruction surgery scored lower in the QOL scores than the non-reconstructed patients. This same group of patients was also evaluated for evidence of radiographic osteoarthritis at the 15-year mark following injury. Sixteen percent of the rehabilitated patients developed radiographic osteoarthritis (OA). All of the patients with OA had undergone a meniscectomy (removal of the meniscus). None of the non-meniscetomized patients developed OA. Sixty-eight percent of the patients reported to have an asymptomatic knee, while 23 % reported having

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reconstructive surgery at an average of 4-years after injury. Myklebust et al (2003) found the 91% of competitive handball players treated without reconstruction could return to pre-injury activity level, whereas only 58% in the reconstructed group were able to do the same. A review of literature by Casteleyn (1999) concluded that while ACL reconstruction yielded the least amount of secondary meniscal surgery, osteoarthritic morbity was higher compared with a conservatively managed group. Sports participation tended to be higher in the reconstructed group as well.

Conservative Rehabilitation of Cruciate-Deficiency

Successful management of the ACL-D knee in humans centres on some 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 programme to another, and attention should be paid to range of motion(ROM), strength, fluidity of performance of functional activities as well as functional testing. Using the goals for each phase of rehabilitation of an ACL-D human knee, treatment regimes can be proposed. Tables 3 – 6 illustrate the goals and this author's (LEH) suggestions for rehab of the canine patient in each phase.

Table 3. Goals and Treatment Suggestions for Phase 1 (Protection) of the Canine ACL-D Stifle

Phase 1: Protection (Weeks 1 – 4)	
Goal	**Suggestion**
Increase ROM	Passive range of motion (PROM) flexion and extension; tummy rubs into extension; 'square' sitting practice.
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 walking 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 the board); Standing on soft surfaces and balance; 3-leg standing; step ups; Walking in circles or figure-of-8 patterns.
Increase proprioception/balance	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 4. Goals and Treatment Suggestions for Phase 2 (Early Strengthening) of the Canine ACL-D Stifle

Phase 2: Early Strength Training (Weeks 5 – 8)	
Full ROM	As above; may add toe-touch hanging, or extension on the stairs; may add sitting practice on a stool or platform.
Normal gait	Walking with a 'disturbance' on the unaffected foot; Obstacle walking or trotting; Steep 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.

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Table 5. Goals and Treatment Suggestions for Phase 3 (Intense Strengthening) of the Canine ACL-D Stifle	
Phase 3: Intense Strength Training (Weeks 9 – 12)	
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 6. Goals and Treatment Suggestions for Phase 4 (Intensive strength training and return to sports) of the Canine ACL-D Stifle	
Phase 4: Intensive Strength Training and Return to Sports (13 – 16 weeks)	
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.

While natural healing of a meniscal tear has been reportedly possible, a meniscal injury may inhibit success of this regimen. Preventing osteoarthritis should be an important goal for all animals that have suffered a joint trauma. Human studies have found a correlation with glucosamine use and a reduction in joint space narrowing and erosive effects of OA over a period of three years. Canine studies have found that the use of a glucosamine / chondroitin sulfate mixture 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 osteoarthritis 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 lost will result in a 4-fold reduction in the load exerted on the knee per step during daily activities. 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 cruciate-deficient dog.

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

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outcome with conservative care. Additionally, animals who are not surgical candidates for whatever reason may benefit from this evidence-based proposal for the conservative management of cruciate deficiency in dogs.

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