

## Canine Treadmill Rehabilitation – How Much, and Why?

The young and burgeoning field of canine rehabilitation is changing the way in which more and more dogs recover from injury and surgery, with rehab centers springing up across the country. The outmoded approaches of yesteryear, wherein animals were kept inactive through cage confinement or unmitigated pain, are disappearing, in favor of the more enlightened approaches adopted in human rehabilitation decades ago. Veterinarians are now looking for more than just a good surgical outcome, seeking earlier return of neuromuscular control and function through active engagement of both the patient and client. Rehabilitation procedures typically practiced on dogs include underwater or land-based treadmill exercise, passive range of motion and stretching movements, electrical stimulation, therapeutic ultrasound, proprioceptive training techniques, massage or other manual therapy maneuvers, swimming, and more, depending on the inclinations and training of the available therapists.

Although evidence is beginning to emerge in both human and veterinary physical therapy, human physical therapists and canine rehabilitators alike readily acknowledge the dearth of high quality, randomized, controlled, sufficiently powered trials individually evaluating each component of a multifaceted rehab protocol. Such studies would lend insight into the relative value of each component or modality and provide answers to some of the many persistent questions concerning rehabilitation. For example, some studies indicate that structured physiotherapy programs may provide advantages over typical restricted exercise routines. Dogs receiving physical therapy treatments after stifle surgery demonstrated larger thigh circumference, fewer bony changes on joint radiographs, better scores on lameness evaluations, improved limb function on force-plate analysis, and greater range of motion in the stifle joint.<sup>1</sup> However, a randomized, controlled human trial published recently in the *American Journal of Sports Medicine* found that a minimally supervised, home-based (patient-directed) rehabilitation program was actually **more** effective in achieving acceptable range of motion after anterior cruciate ligament reconstruction than that provided in a standard physical therapy program.<sup>2</sup>

One of the most obvious risks to patients during exercise is damage to the cardiovascular system, arising from either a thrombogenic or cardiac event. While moderate exercise reduces the risk of cardiovascular disease, strenuous and sporadic exercise at least transiently elevates the risk of primary cardiac arrest and major vascular thrombotic events. Strenuous exercise encourages epinephrine release and initiates a cascade of reactions leading to platelet aggregation. Furthermore, exhaustive exercise causes over-

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<sup>1</sup> Monk ML, Preston CA, and McGowan CM. Effects of early intensive postoperative physiotherapy on limb function after tibial plateau leveling osteotomy in dogs with deficiency of the cranial cruciate ligament. *AJVR*. 2006;67(3):529-536.

<sup>2</sup> Grant JA, Mohtadi NGH, Maitland ME, et al. Comparison of home versus physical therapy-supervised rehabilitation programs after anterior cruciate ligament reconstruction. A randomized clinical trial. *American Journal of Sports Medicine*. 2005;33(9):1288-1297.

production of reactive oxygen species (ROS).<sup>3</sup> Exercise-induced oxidative stress (EIOS) arises when free radical production outstrips the compensatory capacity of antioxidant mechanisms to cope with the free radical load. Tests such as the ethane breath test are being developed to monitor EIOS in dogs, horses, and humans, as a means to measure real-time oxidative stress in a non-invasive manner.<sup>4</sup> Perhaps rehab centers in the future will possess various non-invasive means to monitor the ongoing physiologic changes occurring in dogs undergoing exercise, thereby maximizing safety.

In the meantime, regular assessment of vital signs and astute monitoring for pain and fatigue should be an absolute minimum standard for all patients. Dogs with congestive heart failure (CHF) may do poorly on an exercise regimen, when previously unrecognized or underappreciated exercise intolerance becomes more pronounced.<sup>5</sup> Pump failure, peripheral vasoconstriction, and abnormal lactate responses may lead to reduced blood flow and/or early muscle fatigue. Dogs prone to ventricular fibrillation will demonstrate a greater than normal initial increase in heart rate at the onset of exercise, due to elevated cardiac sympathetic activation.<sup>6</sup> The rate of heart rate recovery following exercise may help identify which dogs are at higher risk for ventricular fibrillation, as the heart rate of dogs at lower risk will slow sooner following exercise.<sup>7</sup> A rehabilitation provider who is unfamiliar with cardiac disease in dogs may fail to identify signs of decompensation during exercise, and force an animal to continue exercising to reach a predetermined endpoint, unaware of the dangers at hand. This highlights a big difference between human and canine rehabilitation; that is, the ability of the patient to stop when they have had enough or are experiencing pain, fatigue, or potentially life-threatening symptoms. In light of the absence of verbal feedback, therapists should begin with short exercise bouts lasting no more than 3-5 minutes.<sup>8</sup>

As in dogs with heart failure, hypothyroid dogs may have reduced endurance and strength when undergoing exercise. This may be due to lowered concentrations of Na<sup>+</sup>, K<sup>+</sup>-ATPase capacity in the skeletal muscle pool, resulting in hyperkalemia and decreased muscle contractile performance.<sup>9</sup>

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<sup>3</sup> Cavas L. Does underwater rugby stimulate the over-production of reactive oxygen species? *Cell Biochemistry and Function*. 2005;23:59-63.

<sup>4</sup> Wyse C, Cathcart A, Sutherland R, et al. Effect of maximal dynamic exercise on exhaled ethane and carbon monoxide levels in human, equine, and canine athletes. *Comparative Biochemistry and Physiology, Part A*. 2005;141:239-246.

<sup>5</sup> Boddy KN, Roche BM, Schwartz DS, et al. Evaluation of the six-minute walk test in dogs. *AJVR*. 2004;65(3):311-313.

<sup>6</sup> Billman GE. Heart rate response to onset of exercise: evidence for enhanced cardiac sympathetic activity in animals susceptible to ventricular fibrillation. *Am J Physiol Heart Circ Physiol*. 2006;291:H429-H435.

<sup>7</sup> Smith LL, Kukielka M, and Billman GE. Heart rate recovery after exercise: a predictor of ventricular fibrillation susceptibility after myocardial infarction. *Am J Physiol Heart Circ Physiol*. 2005;288:H1763-H1769.

<sup>8</sup> Davidson JR, Kerwin SC, and Millis DC. Rehabilitation for the orthopedic patient. *Veterinary Clinics of North America. Small Animal Practice*. 2005;35(6):1357-1388.

<sup>9</sup> Schaafsma IA, van Ernst MG, Kooistra HS, et al. Exercise-induced hyperkalemia in hypothyroid dogs. *Domestic Animal Endocrinology*. 2002;22:113-125.

Dogs with other ailments require special consideration for their particular problem. Those with myofascial pain problems should receive extra caution as to their appropriate “dose” of exercise, as excessive amounts can cause a flare in muscle soreness.<sup>10</sup> Canine patients who have already lost muscle mass may require protein supplementation as their bodies rebuild skeletal muscle.<sup>11 12</sup> They may further benefit from antioxidant supplementation, to counteract the negative effects of ROS generated during exercise.

Rehabilitation programs must be tailored to the individual, and not considered “one-size-fits-all”. The putative health benefits and risks change with exercise type, intensity, frequency, and patient condition. Dogs with cardiovascular disease, degenerative joint disease, neurologic impairment, deconditioning, etc., have additional challenges to overcome. Serious injuries have resulted in dogs that have either been inadequately supervised or were exercised beyond their capacity. Veterinarians in charge of animals undergoing physiotherapy have an important role to play before, during, and after rehabilitation. Rather than routinely “referring for rehab”, veterinarians need to evaluate dogs carefully prior to sending them for a series of potentially taxing exercise sessions. Intermittent rechecks of the patient will serve to ensure 1) that recovery is progressing and 2) that concomitant conditions, such as arthritis in other joints, are not being exacerbated by the physical therapy. Reviewing records and objective measurements of improvement document progress, but ongoing dialogue with the clients, asking how they think their animal is doing during the program, is likewise vital. Is the animal enjoying the workout, or are they reluctant to enter the facility? Is the client allowed to attend the sessions to advocate for their animal, should they be experiencing fatigue and need to stop, or are they discouraged from observing? Is a veterinarian in the facility and directly supervising non-veterinarians performing the rehabilitation, or only present one or two days per week? While the human physical therapist or technician trainer may have completed coursework in canine rehabilitation, the responsibility for ensuring the safety of the animal remains with the veterinarian in charge.

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<sup>10</sup> Jones KD, Adams D, Winters-Stone K, et al. A comprehensive review of 46 exercise treatment studies in fibromyalgia (1988-2005). *Health and Quality of Life Outcomes*. 2006;4:67.

<sup>11</sup> Holm L, Esmarck B, Mizuno M, et al. The effect of protein and carbohydrate supplementation on strength training outcome of rehabilitation in ACL patients. *Journal of Orthopaedic Research*. October 2006; [Epub ahead of print].

<sup>12</sup> Miller MD, Crotty M, Whitehead C, et al. Nutritional supplementation and resistance training in nutritionally at risk older adults following lower limb fracture: a randomized controlled trial. *Clinical Rehabilitation*. 2006;20:311-323.