Indications and Contraindications for Neuromuscular Electrical Stimulation

Neuromuscular electrical stimulation is commonly used in the rehabilitation of human patients who have had orthopedic or neurologic injury. A few examples are patients recovering from fracture repair, ACL reconstruction, and meniscal debridement or repair. Patients with neurologic conditions, such as cerebrovascular accidents, closed head injuries, spinal cord injuries, or other neurologic disease involving paralysis or paresis, may also benefit from NMES. NMES has been used to increase joint mobility, decrease joint contracture, decrease edema, enhance circulation, minimize disuse atrophy, improve muscle strength, retard loss of volitional control, improve sensory awareness, decrease spasticity, diminish pain, and correct gait abnormalities. In human patients with low thoracic spinal cord injury, functional NMES has been used to produce knee extension with locking of the knees to allow weight bearing. Within 3 weeks of spinal cord injury, up to 50% of quadriceps muscle loss may occur. In one study NMES returned quadriceps muscle mass to near normal. In a patient with an incomplete quadriplegic spinal cord injury NMES was used to strengthen a paretic hand. Two weeks of NMES produced a 33% increase in muscle force with no loss of strength 4 weeks after the treatment was discontinued. Children with mild cerebral palsy treated with NMES had statistically significant improvements in gross motor, locomotor, and receipt/propulsion skills.10 Neuromuscular electrical stimulation has also been used on the tibial muscles of children with Duchenne and Becker muscular dystrophy. Neuromuscular electrical stimulation resulted in mild, short-term increases in muscle strength, but it did not alter muscle fatigue. Whether chronic stimulation produces beneficial long-term effects has yet to be determined.

In addition to the clinical use of NMES in people with neurologic and orthopedic disorders, it has been used in denervated muscle to retard atrophy and improve recovery after reinnervation in rats with surgically severed peroneal nerves. The use of NMES in improving reinnervation recovery in other species warrants further study because it may be useful to those with denervation injuries. There are a number of circumstances in which electrical stimulation should not be used (contraindications), and other circumstances in which electrical stimulation should be used only with caution (precautions).

Neuromuscular Electrical Stimulation Use and Clinical Recommendations in the Dog, Neuromuscular Electrical Stimulation Use in Veterinary Medicine

In establishing a rehabilitation program, the cost-benefit ratio must be assessed. For a program to be cost and labor effective there must be earlier or more protected return to function, increased joint ROM, increased muscle strength, and an overall improved outcome.6 Although cost is a major concern in veterinary medicine, of equal importance is how a rehabilitation program is applied to the dog. Obviously the use of crutches or other limb assistive devices are not directly applicable to the dog. However, external coaptation with soft padded bandages and cage rest, when needed, appear to be practical alternatives. Bicycling, weightlifting, proprioceptive training, and jumping rope, which are the mainstays

of rehabilitation in people, are generally either not possible in dogs, or are performed with modifications. A practical rehabilitation alternative to enhance operative outcome is needed for dogs. Electrical stimulation provides a cost- and labor-effective means of establishing early, protected return to function, as well as the possibility of decreased degenerative joint disease (DJD) and increased muscle mass.

Neuromuscular electrical stimulation is an effective means of rehabilitation of the ACL-deficient knee in people and is considered by some to be more effective than volitional exercise, especially during the early rehabilitation period. Because the CrCL-deficient dog has been used extensively as a model for ACL deficiency in humans, it logically follows that post-ACL reconstruction rehabilitation methods in humans could be applied to the dog. Rehabilitation of the stabilized knee determines the success of surgical outcome, especially in the physically active human patient. Appropriate rehabilitation seems especially important to enhancing surgical outcome in large working dogs used for hunting, obedience trials, service, tracking, or police work. Loss of function in the working dog not only affects the quality of life of the patient, but may also lead to economic losses associated with an animal's inability to work. Surgical stabilization of the stifle is the treatment of choice in large-breed dogs, but all affected stifles appear to develop DJD and joint laxity regardless of the surgical intervention.

Intensity, Treatment Time, and Frequency of Treatment

The intensity must always be adapted to the needs of the individual patient and their response to the treatment. To evaluate treatment success the pain level of the animal should be evaluated initially and during the course of treatment. This is necessary to monitor the effectiveness of the selected parameters, such as electrode position, intensity, and frequency, and the recovery of the animal. The intensity can be chosen according to the subjective evaluation of the patient, but it also depends on the desired painrelieving mechanism and the type of TENS. To make the animal comfortable with TENS the treatment is often started with an intensity of the current just below the sensory response threshold. In dogs this can be achieved by carefully increasing the intensity until the animal shows a reaction, such as glancing at the electrodes or tensing the limb muscles. The intensity is then decreased slightly just to the point that the animal stops reacting. Especially when treating animals it is always mandatory to start the treatment carefully and with patience. Each patient should have time to adapt to the treatment and relax. With increasing intensity the patient likely will feel a tingling sensation. This should be neither painful nor should it cause muscle contractions. A higher intensity is often not recommended and not tolerated by the animal. Accordingly a distinction is drawn between intensities below the motor threshold (no visible muscle contractions), at motor threshold (visible twitch contraction), and above it (wavelike muscle movements and contractions). There are different recommendations for treatment duration. For example, for treatment of OA using conventional TENS, treatment

times vary between 15-, 30-, and up to 60-minute68 sessions. Also, the timing of the treatment varies from three sessions daily for 3 weeks,68 to twice daily for 6 weeks, to twice weekly for 4 weeks. In general, the following recommendations may be applied. In acute stages, a lower-intensity, short treatment duration, and short intervals are suitable. Therefore, in an acute case, it is possible to treat the animal one to two times daily, with a 15-minute treatment duration. In chronic conditions, higher intensities with longer treatment durations and intervals between the treatments are recommended; for example, treatment two to three times per week, for 5 to 6 weeks, with each session lasting 30 minutes.