

Veterinary Rehabilitation Science - A Review

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Abstract

Aim of physical rehabilitation is to maximize recovery from disease processes and surgical procedures while improving function and overall well-being of the patient. Rehabilitation therapies are classified into manual therapy, physical therapy and therapy with emerging modalities. The manual therapy is further classified into Massage, Joint mobilization exercises and Acupuncture. The physical therapies include thermal agents, prosthetics, orthotics, aquatic therapy, electrical stimulation and therapeutic exercises. Thermal therapy is further divided into hot and cold therapies. Therapeutic exercise includes various type physical exercises. Orthotics are applied externally to rehabilitate patients and include various splints and slings, whereas, prosthetics are artificial replacements (e.g., artificial limb). Emerging modalities in rehabilitation includes laser therapy, pulsed magnetic field therapy and extracorporeal shock wave therapy. Outcome assessment of rehabilitation therapy is done by assessing pain, vital signs, body condition and composition, range of motion, muscle strength and gait of the patient. Rehabilitation is a very broad field including physiotherapy using manual and physical therapy. It is very old science used regularly in human medicine but is under-utilized in veterinary sciences especially in India. If used in conjunction with standard medicinal and surgical treatment, rehabilitation can be very useful, as they increase the rate of recovery.

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1. Introduction

The term rehabilitation stems from latin word *rehabilitare* meaning “to restore the ability” and is primarily used to treat orthopedic and neurological disease. It encompasses the use of physical or mechanical agents, such as light, thermotherapy (heat and cold), water, electricity, massage and exercise (Knap *et al.*, 2007). The field of human physical therapy began during World War 1, whereas, equine rehabilitation began in the 1960's with the advent of increased interest in equine sporting events. In Western countries, canine rehabilitation became main stream in the 1980's (Van Dyke, 2011), but as far as India is concerned veterinary rehabilitation science is still in its infancy stage.

The rehabilitation modalities provide options for treatment and symptomatic relief of patients, resulting in an improved quality of life. Rehabilitation therapies/modalities can be classified mainly into

different types i.e Manual therapy, Physical therapy and Emerging modalities.

2. Manual Therapy

The manual therapy is further classified into Massage, Joint motion exercises and Acupuncture (Saunders *et al.*, 2005).

2.1 Massage

Massage is the gentle manipulation of muscles and soft tissues. It is effective in both moving fluid into the lymphatic system and also moving fluid from the extremities to the central body core in patients with distal extremity edema. Massage help in dilation of superficial blood vessels and increases the rate of blood flow, which increases nutrient delivery and removal of waste from various tissues (Geoffrey, 1994; Hourdebaigt, 2004). There are various massage techniques like compression, effleurage, petrissage,

friction, tapotement or percussion and vibration movement (Shumway, 2007).

2.2 Joint Mobilization

It is measured in range of motion (ROM) which is the degrees of a circle, through which a joint can be extended and flexed. When performed by physiotherapist, it is passive range of motion (PROM). It is performed by placing hands above and below the affected joint and gently flexing and extending the joint while supporting the limb, taking care not to force the motion beyond a comfortable level (Knap *et al.*, 2007).

Maitland described four grades (I–IV) of mobilization and manipulation, increasing from low to high range of motion. Grade V mobilization is a sudden passive movement that cannot be prevented by the patient and is typically performed near the end of available ROM (Maitland, 1991; Saunders *et al.*, 2005).

2.3 Acupuncture

Acupuncture is derived from latin words *Acus* (needle) and *Punctura* (to prick). Acupuncture may be considered as one of the principle elements used in Traditional Chinese Medicine (TCM) which involves the application of fine needles to specific points throughout the body for the management of many conditions such as musculoskeletal pain, respiratory, endocrine and immune conditions (Lindley and Cummings, 2006). Acupoints are also called as Trigger points or areas of increased sensitivity or areas of least resistance within the muscle. The meridians or channels in which the energy flows the specific points where they come to the surface are considered to be the acupuncture points. There are 12 main meridians, related to and named for the organs through which they run, such as liver, gallbladder lung, etc. (Lakshmipti and Ramakrishna, 2002). The levels of neurotransmitters such as endomorphin-1, beta endorphin, enkephalin, and serotonin increase in plasma and brain tissue through acupuncture application which causes analgesia, sedation and recovery in motor functions (Mogilevsky, 2010).

Acupuncture techniques are broadly classified into two methods invasive and non-invasive. Invasive are classified further into dry-needling, aqua-puncture, electro-acupuncture method. Electro-acupuncture includes high frequency electro-acupuncture, medium frequency electro-acupuncture and low frequency electro-acupuncture. In non-invasive method, needling is done and it includes acu-pressure, trans-cutaneous electric stimulation, moxibustion, patch, pellets etc. Clinical application includes hind quarter weakness, hind quarter paralysis; arthritis or vertebral disc pathology, hip dysplasia, skin problems, such as lick

granuloma, in emergency and shock GV26 is stimulated. Acupuncture therapy has been used for the treatment of posterior paresis in canines (Pawde *et al.*, 2000; Jeong *et al.*, 2013).

3. Physical Therapy

These are further classified into Thermal therapy, Electrical stimulation, Therapeutic exercises, and Prosthetics and Orthotics.

3.1 Thermal Therapy

It is further divided into Cold therapy and Heat therapy.

3.1.1 Cold Therapy

Cold therapy, also known as Cryotherapy, refers to the application of cold that withdraws heat from the body through the use of mild superficial cooling agents and is mainly indicated in acute injury or inflammatory conditions (first 24 to 72 hours) and also to provide emergency care for burns. It can be achieved by conduction (e.g., cold packs, ice massage, cryopressure garments combining cold with compression, bags of frozen corn), convection (e.g., cold whirlpool immersion, contrast baths), or evaporation (e.g., vapocoolant sprays) (Vannatta *et al.*, 2004). It decreases the blood flow because of vasoconstriction. The application of cold may decrease nociceptive input and pain perception through local and central nervous system mechanisms (Cameron, 2003). The primary precaution while using cryotherapy is avoidance of frost bite. Covering of ice packs with at least one layer of moist towel is indicated (Downer, 1978).

3.1.2 Heat Therapy

It includes the use of superficial or deep heating agents in sub acute and chronic traumatic conditions, chronic inflammatory conditions and decreased ROM attributable to stiffness and/or contracture and pain relief. With mild increases in tissue temperature, the oxygen-hemoglobin dissociation curve shifts to the right, making more oxygen available for tissue repair. Also, an increase in enzymatic activity increase oxygen uptake by the cell, thus enhancing healing (Allen, 2006).

3.1.2.1 Superficial Heating Agents

Include hot packs, heat wraps, hosing with warm water, whirlpools, paraffin baths, circulating warm water blankets, electric heating pads, and infrared lamps. Hot packs provide a limited depth of heating, approximately 1 cm and therefore, do not significantly warm the muscles; superficial joint capsules and ligaments may be effectively warmed.

3.1.2.2 Deep-Heating Agents

Deep heating agents are capable of producing temperature elevations at tissue depths of 3 cm or greater through conversion of a non-thermal energy source into heat within tissue. Deep heating agents include therapeutic ultrasound and shortwave diathermy (Doyle, 2004).

3.1.2.3 Therapeutic Ultrasound

Ultrasonic energy causes increased molecular motion leads to microfriction, thus increasing tissue temperature. To achieve the thermal effects, the tissue temperature should be raised 1°C to 4°C, depending on the desired outcome. It produces localized heating in deeper tissues and the duration of therapy is short, approximately 10 minutes (Steiss and Levine, 2005). Use of therapeutic ultrasound has been reported to increase wound healing and bone healing. Furthermore, it is used in the treatment of tendinitis and bursitis and has been demonstrated to increase hock flexion after an ultrasound and stretching treatment (Warden, 2003).

3.1.2.4 Diathermy

Diathermy is application of high-frequency, short wavelength (3-30 m, frequency 10-100 MHz) or microwave (wavelength 0.001-1 m, frequency 300 MHz to 300 GHz) electromagnetic energy used to generate heat in body tissues in deeper and larger area. It can heat larger areas than other penetrating agents (e.g., ultrasound). Shortwave energy can be delivered as continuous shortwave diathermy (CSWD) for deep heating of soft tissue or in pulsed form pulsed shortwave diathermy (PSWD) to induce non-thermal effects. In thermal effect temperature increases 1°C which reduce mild inflammation and increase metabolism. Whereas it increase 2 to 3°C which decreased pain and muscle spasm and increase 3 to 4 °C which increases tissue extensibility (Belanger, 2002; Charles *et al.*, 2009).

CSWD, increased average molecular kinetic energy leads physiologically to thermal heating effects of vasodilation, increased rate of nerve conduction, increased collagen extensibility, acceleration of enzymatic activity, changes in skeletal muscle strength, and possibly increased nociceptive threshold and used for management of muscle strains, contusions, ligament sprains, joint contractures and stiffness, increased extensibility of collagen fibers, increased circulation, decrease sub-acute and chronic pain. Ansari *et al.* (2012) reported that early neurological recovery was recorded in dogs subjected to SWD along with conventional drug therapy (CDT), followed by ultrasound along with CDT as compared to CDT alone.

3.2 Electrical Stimulation (ES)

The use of ES to stimulate a motor nerve and cause a muscle contraction is termed neuromuscular electrical stimulation (NMES). The use of ES to excite denervated muscle directly, such as in patients with spinal cord injuries, is called electrical muscle stimulation (EMS). The term transcutaneous electrical nerve stimulation (TENS) is the use of an electrical stimulator for pain control (Schils, 2009) and can be used for treatment of musculoskeletal inflammatory conditions.

Phonophoresis refers to the use of ultrasound to enhance the delivery of topically applied drugs to the underlying tissues (Steiss, 2000), whereas, iontophoresis is the procedure by which drugs which ionize in solution can be driven into the skin and underlying tissues by direct current applied through surface electrodes (Byl, 1995).

3.3 Therapeutic Exercises

Therapeutic exercise is the art of encouraging an animal to exercise appropriate muscle groups and to perform voluntary active motion of the affected joint or limb.

3.3.1 Standing Exercises

Standing exercises are recommended for debilitated and recumbent animals. This is achieved by supporting the animal by holding it physically under the abdomen or pelvis or use a sling, cart, or wheelchair (Knap *et al.*, 2007; Tyagi and Tyagi, 2010).

3.3.2 Balancing Exercises

Balancing exercises are used to encourage early limb usage, build muscle, and improve proprioception and body awareness.

3.3.3 Repetitive Sit to-Stand/Down-to-Stand Exercises

These are useful for strengthening the semi membranous, semi-tendinosus, and quadriceps muscles, whereas, *Repetitive down-to-stand* exercises are useful for strengthening the biceps and triceps muscle.

3.3.4 Gait Training or Patterning or Assisted Walk

These are used to encourage an animal to move its limbs in a walking motion.

3.3.5 Ground/Land Treadmill

These are helpful for rehabilitating orthopedic patients. *Controlled leash walks* allow the pet to move its limbs through a good active ROM.

3.3.6 Cavaletti Rails

These are placed in a row for animal to walk or trot over with obstacles.

3.3.7 Weaving and Circling

It helps re-educate the afferent nervous pathways to adjust to shift of weight and change of directions.

3.3.8 Hills and Stair Climbing

It strengthens the quadriceps, semitendinosus, semimembranosus and gluteal muscles. Descending a hill requires the dog to flex the hock, hip, and stifle.

3.3.9 Wheel Barrowing and Dancing, etc

Wheel barrowing and dancing, Jogging, Pulling or carrying weights, Toy batting and tug-of-war are other exercises which encourage the animal to use the limb differently than walking (Knap et al., 2007).

3.3.10 Underwater Treadmill

It is designed with a walk-through exercise chamber, a filtration and heating system and a holding tank. The water is heated, chlorinated and re-circulated. Buoyancy acting on the animal causes an apparent decrease in weight and reduces gravity. *Swimming* is also a great exercise with the primary benefit of elimination of concussive forces to the body and joints. Swimming is often used when the patient is completely healed, and therapy is concentrated on restoring normal function, stamina, and muscle mass (Levine et al., 2002).

3.4 Orthotics and Prosthetics

Orthotics are devices applied externally to restore or improve functional and structural characteristics of the musculoskeletal system. There are two general classifications of custom orthoses; static and dynamic. Static orthoses hold a body part in a fixed position and do not allow joint movement. Orthoses simply maintain the joint at a particular angle, providing support and proper positioning. Dynamic or functional orthoses are devices that permit motion by allowing or creating movement. These types of orthoses are used primarily to assist movement of weak muscles. Orthotic devices and aids are splints, slings (front limb, belly, hind limb), wheel-carts (Campana, 2006).

Functions of an orthoses aim to increase or decrease range of motion (ROM), immobilize an extremity to help promote tissue healing, apply traction either to correct or prevent contractures, protect an area of the body, assist in providing enhanced function, help correct deformities and/or block unwanted movement of a joint. Orthoses can encompass the entire limb from shoulder to toes, or can be as simple as a paw protector.

They can also range from protective helmet to cervical or hip braces.

Prosthetics act as artificial limb replacements. Prosthetics are used in case of partial to full limb amputations. Uses of prosthetics are prevent deformation and degeneration of existing joints, prevent gait deviations, maintain acts of daily living, decrease leg length discrepancies, increase exercise and activity levels, participation help in rehabilitation therapy (Johnson et al., 2003).

4. Therapy with Emerging Modalities

4.1 Low-Level Laser Therapy (LLLT)

LLLT also called cold lasers therapy help to modulate cellular processes, known as photobiomodulation. Most lasers used in physical rehabilitation are class 3A lasers with power less than 100 mW, and do not heat tissues with small treatment beam diameters up to 1 cm. It is necessary to hold the probe perpendicular to the treatment area. The basic types of lasers used for LLLT are gaseous helium-neon (HeNe) and gallium arsenide (GaAs) or gallium-aluminum-arsenide (GaAlAs) semiconductor or diode lasers. HeNe lasers emit a visible red light with a wavelength of 632.8 nm, whereas GaAs and GaAlAs emit invisible light near the infrared band with a wavelength of 820 to 904 nm (Ramey and Rollin, 2004). LLLT has been used for the treatment of osteoarthritis, muscle, ligament, and tendon injuries, ulcerations and open wounds and postsurgical and soft tissue trauma (Be' langer, 2002).

4.2 Extracorporeal Shock Wave Therapy (ESWT)

Shock waves are high-energy, high-amplitude acoustic pressure waves (20-100 MPa). It stimulates soft-tissue healing and also provide analgesia (Wang et al., 2003). However, they are not very useful clinically due to some side effects and limited use (Ogden et al., 2001; Bushberg et al., 2002).

4.3 Pulsed Magnetic Field Therapy (PMF)

PMF therapy utilizes the power of a pulsed magnetic field to aid in tissue repair, cellular wellness, and relaxation. Ions within the area of the pulsating magnetic field are influenced by the rhythm of the pulsation, improved ion exchange at the cellular membrane, and improved oxygen utilization within the cell. Indications for magnetic field therapy include fracture healing, degenerative diseases of the musculoskeletal system, disorders of the neurological system, muscle spasm, generalized pain, inflammation, poor circulation, and arthritis. Major contraindications

of PMF therapy are active hemorrhage and electrical implants, although pregnant patients should also avoid (Pipitone and Scott, 2001).

5. Assessment of Outcome

Outcome of rehabilitation can be assessed by various methods like (A) *Pain assessment and vital signs* which should be assessed and evaluated periodically using proper means so that analgesic requirements can be met and can be measured by subjective or objective methods (Cambridge et al., 2001; Grant, 2006; Surbhi et al., 2010). (B) *Body condition and composition*: Records of body weight and weight - height ratio are simple objective measures that can be readily incorporated into clinical practice (Hesbach, 2007). (C) *Measuring range of motion and/or joint angle (Goniometry)*: There is a need for data on the normal ranges for joint angles for individual breeds of dogs. (D) *Measuring muscle strength*: Morphometric (girth or circumferential) measurement of the muscle belly is a readily applicable indirect method of measurement of muscle strength that has been determined to correlate with peak torque in humans (thigh circumference with hamstring and

quadriceps peak torque) and actual muscle mass in dogs (with thigh circumference) (Millis, 2004) and (5) *Gait Analysis*: It can be done by two methods subjective and objective. Subjective methods include observation while standing, motion and moving toward, away, circles, whereas objective methods are related to kinetics and kinematics (McLaughlin, 2001).

6. Conclusions and Future Prospects

Rehabilitation is a very broad field that includes physiotherapy using manual and physical therapy. It is not a revolutionary science but is under-utilized in veterinary sciences and yet to find an appropriate place in veterinary practice, especially in India. If used in conjunction with standard medicinal and surgical treatment, rehabilitation can be very useful. Rehabilitation and physiotherapy should be instituted, as they increase the rate of recovery. Rehabilitation is a potential area to do research. Rehabilitation science needs to be included in curricula of veterinary sciences, in India. Rehabilitation centers, if opened in veterinary establishments, can be very helpful for the overall improvement of animal health.

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