Principles of Postoperative Rehabilitation for Fractures

Liz LaFond, DVM, DACVS, CCRP University of Minnesota

Saint Paul, MN

Patients recovering from fracture repair have specialized needs during the recovery process and can benefit greatly from a tailored rehabilitation program. This talk will focus on the principles of postoperative rehabilitation for fracture patients in veterinary medicine and will assist practitioners to tailor their postoperative rehabilitation protocols for fractures and provide a safe and effective road to recovery.

Physiologic response to injury and disuse

The most important tissue types making up the musculoskeletal system include bone, ligaments and tendons, cartilage, and muscle. Fractures occur when there is a sudden stress that is too great for the bone to overcome. All of the tissue types that make up the musculoskeletal system become injured or compromised to some degree after fracture, and it is important to recognize that these tissues have different responses to injury or immobility.

Bone

Unlike other musculoskeletal tissues, bone can regain 100% of its pre-injury strength given the right conditions. When immobilized, bone will weaken or resorb. With controlled weight-bearing, bone healing will be stimulated and bone also continues to remodel over years in response to the stresses it experiences.

Muscle

Decrease in contraction strength is directly related to the degree of injury to muscle and the development of fibrous tissue. Most injuries involving muscle occur near the musculotendinous junction where tissues are weakest. With disuse, muscle loses force production in addition to losing muscle mass. There can be a loss of up to 1/3 of muscle mass on an affected limb following surgery for cranial cruciate ligament rupture. A rule of thumb is that, with reinstitution of muscle use, it takes twice as long to regain strength than it did to lose that strength secondary to disuse.

Cartilage

It is important to remember that damaged cartilage gets replaced with fibrocartilage, which does not have the mechanical properties of the original hyaline cartilage. Also, cartilage is poorly vascularized and gets its nutrient needs from synovial fluid. Therefore, some amount of motion of rehabilitating joints is necessary to ensure continued production of synovial fluid and distribution of that fluid throughout the joint.

Ligaments and tendons

In general, a consequence of ligament injury is joint instability, while tendon injury leads to a loss of power and muscle function. Both ligaments and tendons heal very slowly, regaining 50-80% of pre-injury strength at *one year*. There is variation in how different ligaments heal (collateral ligaments tend to heal well, while cruciate ligaments heal very poorly). Both ligaments and tendons require undergoing some stress in order to regain normal architecture (fibers are laid down in the direction that the stress is experienced).

Principles of rehabilitation interventions

Each physical rehabilitation intervention is prescribed to achieve specific objectives. These objectives are based on a patient's condition and the choice of intervention will depend on the nature and severity of impairment. Additionally, the needs of the patient and objectives of therapy will change over time as tissues heal. Objectives that may be considered by the therapist include: pain control or modulation; strength building or prevention of muscle atrophy; maintaining and improving joint range of motion; and restoring neuromuscular function. It is imperative that the rehabilitation practitioner consider what needs to be accomplished for a particular patient at that point in time. Patient needs for postoperative physical rehabilitation change as healing progresses. Early on, focus is on lifestyle management, managing inflammation and pain, and enhancing or maintaining joint range of motion (ROM). As an operative repair strengthens and the tissues can withstand increased forces, focus can turn to more aggressive strengthening and tissue stretching to facilitate patient return to optimal function. An often forgotten element of physical rehabilitation is proprioception enhancement and gait retraining, which must be an element of all stages of recovery.

Passive range of motion and stretching exercises

Passive range of motion exercises (PROM) involve no muscle contraction and therefore will do nothing for strength-building. PROM must be combined with active activities to achieve strengthening and to round out the rehabilitation program. Joint health can benefit from PROM as it limits cartilage damage and avoids collagen loss caused by tissue immobilization. Passive range of motion exercises that include additional pressure at the end of the available ROM result in tissue stretching. Like PROM, stretching exercises involve

no muscle contraction and therefore cannot aid in strengthening. Stretching can help to improve flexibility of joints and periarticular tissues.

Active exercises

Active exercises are excellent for building strength and enhancing coordination. They can be modified based on the degree of impairment to require different levels of coordination and nervous system input. For some patients, assisted standing for short periods of time may be a considerable challenge. As the patient's condition improves, introduction of activities that challenge balance and include obstacles may enhance coordination, stimulate neuronal firing and emphasize the development of normal function. It is important to understand the level of difficulty of specific activities as it may be counterproductive to introduce some challenging activities too early in the rehabilitation process.

There are a number of commonly used active exercises. Assisted sitting, standing and walking can provide early stimulation for balance control in moderately to severely affected patients and may even be important psychologically in recumbent patients. Exercises requiring a patient to sit and rise from sitting repeatedly can be very effective for coordination and strength building, but are actually fairly advanced activities that require significant baseline coordination and strength. Ambulation activities can vary from short walks on a flat surface to hill or stair walking. Techniques that can be used to increase the challenge of active exercises include: underwater treadmill walking (to increase resistance while at the same time providing buoyancy); obstacles such as cavaletti or weave cones; and substrate variation such as wading in water or walking through sand, high grass or snow. As a patient's level of function improves, there is virtually no limit to the degree of challenge that can be introduced with active exercises.

Therapeutic modalities

Cold packing and hot packing are two of the most universal rehabilitation therapy techniques available. In general, if there is active inflammation, such as immediately following traumatic injury or surgery, cold packing is highly beneficial for decreasing inflammation and controlling pain. In the chronic phase of an injury, there may be times when cold therapy is indicated to treat a "flare-up" or may be beneficial following aggressive physical therapy. Heat therapy will help to increase the elasticity of tissues and therefore can be very beneficial immediately prior to stretching that is prescribed to overcome tissue contracture. Both heat and cold can provide pain control when used appropriately. Other therapeutic modalities such as neuromuscular electrical stimulation (NMES), low level laser, or therapeutic ultrasound can be beneficial in isolated situations but may not be readily available in all practices. In addition, such modalities may require specific training.

Treatment Considerations	Acute Stage	Sub-acute Phase	Mid-stage	End-stage and return to work
	Weeks 1-3*	Weeks 2-5*	Weeks 4-12*	10+ Weeks*
Rest/Immobilization	Х			
Proprioception Enhancement	Х	Х	Х	Х
Exercise				
Maintenance (PROM)	Х			
Stretching		Gentle	Х	Х
Endurance		Gentle	Х	Х
Strengthening		Gentle	Х	Х
Modalities				
Cryotherapy	Х	Х	After Therapy	After Therapy
Heat		Before Treatment	Before Treatment	Before Treatment
Ultrasound		Х	Х	Х

Phases of healing and rehabilitation

Electrical Stimulation	Х	Х	
Medication (NSAIDs)	Х	(X)	

*Exact times will vary from patient to patient. Continual reassessment is mandatory for optimal and safe progression through rehabilitation program

Summary

There are many simple activities that, when prescribed and applied appropriately, can greatly benefit the impaired patient and aid in safe return to function. It is paramount that the therapist takes into consideration the specific objectives of a prescribed therapy and modifies the therapy program regularly as the needs of the patient change.