Controlled Exercise

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KEYWORDS

• Controlled exercise • Equine • Rehabilitation

KEY POINTS

- Controlled exercise is a fundamental and critical component of any rehabilitation program for the equine athlete.
- An ideal controlled exercise program complements and enhances the normal tissue reparative response after the injury.
- The best program is designed after accurate diagnosis regarding injury type and severity is determined and periodically adapted based on the quality of tissue healing.
- In general, a program starts with complete rest followed by stall rest with gradual and systematic increases in exercise intensity.
- A well designed, injury-directed, controlled exercise program enhances tissue healing during rehabilitation.

INTRODUCTION

Controlled exercise therapy is a standard fundamental part of almost all rehabilitation programs. It is time honored, deeply engrained in tradition, and considered routine practice for the injured equine athlete. Despite being the backbone of a rehabilitation program, there are few controlled studies in horses investigating the therapeutic effects of controlled exercise on musculoskeletal injuries. Most of what is known and practiced is based on intuition, common sense, and experience.[1]

In the human literature, therapeutic exercise is an effective and beneficial treatment for a variety of musculoskeletal problems.[2,3] Controlled mobilization (exercise) after injury produces better quality healing of muscles, tendons, and ligaments.[4] The goals of a rehabilitation program are to prevent further injury and enhance tissue healing. An ideal program relies on the basic understanding of the normal tissue response after the injury.

TISSUE HEALING AFTER INJURY

Tissue healing is an intricate process, and the rate and quality of healing are related to the intrinsic properties of the injured tissue. The process is complex and highly

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susceptible to failure, especially when postinjury regimens are too much too soon for the healing tissue. Equally important is not prolonging the healing process. Huge economic costs are attributed to loss of use of the horse[5] and protracted recuperation periods add to these financial losses. Having an understanding of the phases of wound healing enhances the clinician's ability to apply an appropriate controlled exercise program in alignment with the healing process of the injured tissue.

In general, tissue healing is divided into predicable phases: hemostasis, inflammation, proliferation, and maturation. This basic principle applies to all tissues. Within the first minutes of injury, platelet and accompanying platelet activation result in clot formation. The formed fibrin acts as a glue to prevent further bleeding. Once hemostasis is achieved, blood vessels dilate, and there is an influx of erythrocytes and inflammatory cells, particularly neutrophils cells. In the next 24 to 48 hours, monocytes and macrophages predominate, and phagocytosis of necrotic material occurs. Vasoactive and chemotactic factors are released with increased vascular permeability, initiation of angiogenesis, stimulation of cell proliferation, and recruitment of more inflammatory cells. This acute inflammatory phase occurs during the first 7 days after injury.

The proliferative phase (about days 7–21) is characterized by proliferation of fibroblasts, myofibroplasts, synovial cells, and capillaries. Capillary beds start to grow; fibroblasts produce new collagen, and granulation tissue replaces the originally formed clot. Myofibroblastic activity causes wound contraction, and depending on the size of the injury, wound closure usually occurs within 5 to 8 days in muscle and 3 to 6 weeks in tendon and ligaments. During this stage of healing, the immature connective tissue is thin and unorganized. It is extremely fragile and easily injured if overstressed. Proper growth and arrangement of the healing tissue can be stimulated by tensile loading in alignment of normal stresses of the injured injury. At the same time, adhesion formation to surrounding tissues can be minimized.

Maturation and remodeling start at around day 21 after injury and continues for the next weeks to months. Collagen fibers start to reorganize themselves into normal orientation and begin to withstand normal stresses. The duration of the maturation process depends on the type of tissue injured. The entire process takes months and up to 1 to 2 years for tendon and ligament injuries.

Specific Tissue Injuries

Muscle

Muscle injury occurs through a variety of mechanisms, including direct trauma (lacerations, contusions, and strains) and indirect causes (ischemia and neurologic dysfunction). The different phases of healing occurring within the damaged muscle are similar among various types of muscle injuries, but the functional recovery of the injured muscle varies from one type of injury to another. Mechanical trauma destroys the integrity of the myofiber plasma membrane, resulting in local swelling and hematoma formation. Blood vessel invasion, mononuclear cells, activated macrophages, and T-lymphocytes closely follow. Muscle regeneration starts 7 to 10 days after injury, peaks at 2 weeks, and then decreases 3 to 4 weeks after injury. The formation of scar tissue (fibrosis) begins between 2 to 3 weeks after injury. Scar tissue contraction and reorganization, and the recovery of muscle function, occur over time. Immobilization is indicated for the first 4 to 7 days after injury[6] and helps to avoid rerupture of muscle fibers during acute phases of healing. This stage is followed by the gradual introduction of a controlled exercise program. A progressively intensified exercise program optimizes the healing by restoring the strength of the injured muscle and preventing muscle atrophy. Minor muscle injuries will heal within 4 weeks,