Orthopedic Rehabilitation: Clinical Application of Motor-Learning Principles

R. BARRY DALE, PhD, PT, ATC, CSCS • University of South Alabama

Incorporating motor-learning principles into clinical practice might appear a bit daunting to many clinicians. Perhaps this is because of limited opportunities to study and practice the motor-learning principles in traditional allied-health curricula. Even so, most rehabilitation professionals already use at least some motor principles in everyday clinical practice. The purpose of this article is to consider the principles of motor learning discussed in the previous article as they are applied in clinical practice. The concepts are addressed in the acute, subacute, and chronic soft-tissue-injury rehabilitation time frames. The injury process and its effects on motor function are first addressed.

Injury and Motor Learning

Injury, or tissue damage, causes many physiological events to occur. Because of these processes, manifestations such as pain and soft-tissue swelling appear. The association of joint effusion and pain with muscle inhibition is well documented. Furthermore, joint range of motion and muscle strength are perpetually diminished by a secondary protective response typified by guarding or voluntarily limiting activity within the involved tissues. Because joint mobility and muscle activity are required for movement, physical functioning and performance become hampered. Increased injury severity, such as that following a surgical procedure, increases the manifestations of pain and joint effusion and, thus, the negative sequelae associated with them. The athlete might guard the body part by avoiding activity altogether or develop movement patterns that compensate for the injured tissue. Compensational patterns predispose the athlete to overuse injuries of unaffected tissue, but, most notably, the affected tissue will not undergo adequate rehabilitation as long as it is protected from activity.

Essentially, applying motor-learning principles during physical rehabilitation improves physical performance of a task and relearning of a movement. It is important to realize that the physical performance of an activity might not necessarily facilitate the athlete’s ability to relearn movement skills with a previously injured body part. In other words, techniques that improve short-term performance often do little to foster long-term skill retention. Moreover, motor-learning principles applied to enhance long-term learning might not enhance the quality of short-term physical performance. The challenge for clinicians is to implement motor-learning principles in a manner that enhances performance quality and learning in each rehabilitation phase.

Motor-learning principles promote the reacquisition of proper movement patterns by
various methods and techniques. This article applies motor-learning principles outlined in the preceding article to the acute, subacute, and chronic/return-to-sport rehabilitation phases. It is important to point out that the time periods presented in these rehabilitation phases are not absolute and that specific injuries and their severity dictate the time spent in each phase (Figure 1). The clinician, therefore, must evaluate and treat each athlete with the expectation that individual variability will cause time-period differences in rehabilitation phases.

The Acute Phase

The acute phase of injury rehabilitation is associated with the earliest periods of soft-tissue healing. The beginning of the acute phase occurs immediately after the injury. Its duration, however, is variable, depending on numerous factors such as the extent of the injury and whether early inflammation is adequately controlled or becomes exacerbated. Ideally, the acute phase should have completed most of its course within 4–6 days.

Inflammation in affected tissues largely occurs during the acute phase of healing. Cardinal signs of inflammation include swelling (edema and/or joint effusion), pain, heat, loss of function, and redness. Swelling, pain, and loss of function are most detrimental to the rehabilitation process and should be addressed immediately. Heat and redness are associated with vasodilation, as is swelling, which should decrease as vasodilation subsides. Swelling and pain are addressed with the typical treatment course of protection, rest, ice, compression, elevation, and support (PRICES), but what about loss of function? How can we prevent this adverse tissue-injury manifestation from occurring excessively during the acute phase?

In addition to addressing inflammation with PRICES and therapeutic modalities, controlled passive motion of the affected tissue and gentle muscle-setting activities have been shown to benefit rehabilitation in the acute phase. Safe quantities of range-of-motion and muscle-setting activities vary according to the individual athlete, however. The rule of thumb is to keep activity dosages (intensity and duration) below the threshold of increasing inflammation and pain, which is often easier said than done. Nonetheless, in the first 4–6 days, controlled activities might counter the loss of function associated with tissue injury. Principles of motor learning are useful during early motion and muscle-setting activities for reactivating muscles affected by reflex inhibition or patient apprehension.

If an athlete is apprehensive about participating in activity, he or she will spend a significant amount of cognitive energy attending to the task. For example, the athlete thinks about moving the affected extremity more than he or she normally would in a noninjured state. Similar to the cognitive phase of motor learning, the athlete tries to capture a feel for the activity within the confines of the new injury-induced restrictions that affect range of motion and muscle activity. The athlete learns regulatory constraints for the activity, such as what muscles are required and the relative amount of force necessary for the activity, and begins to develop a motor program. Feedback, discussed later in the article, is important for the athlete to redevelop motor skills. The rehabilitation specialist can facilitate motor or cognitive learning by asking the athlete questions such as How did that feel? and by offering manual assistance or guidance during the performance of a given activity. Augmented feedback is given frequently to facilitate physical performance of activities or exercises, particularly during the acute phase of rehabilitation. Nonetheless, the clinician should exercise caution to prevent the athlete from becoming dependent on feedback for task performance by gradually reducing extrinsic feedback.

Motor-learning principles for the acute and subacute phases are similar because the duration of the