

# Muscle Memory and Motor Learning In Golf

Golf and other sports require learning complex muscle movements in proper sequence for optimal performance. The greater the reproducibility of this motion, the better the chance of engraining it into muscle memory or motor learning.

Motor learning does not involve isolating one individual muscle but learning how to train, sequence and provide proper timing for the movement of these muscles and joints. The coordination of these muscles and joints will provide the motor task within the sporting activity.

The golf swing incorporates the use of muscles and a golf club to strike a ball. The golf club is left to individual choice. The muscle groups are the same for all golfers. These muscle groups are divided into two groups the first being the large and the second being the small. The large muscle groups include the trunk, back, hips, legs and shoulders. The small muscle groups are the feet, forearms, wrists, hands and fingers.

The coordination of these large and small muscle groups is quite complex to achieve a fluid motion where the contracting and relaxing of muscle groups is such that it does not interfere with acceleration.

Motor learning of multiple muscles and joints is quite complex and cannot be learned in one lesson. Success is greater achieved by breaking down the movements into less complicated sequences and phases.

The golf swing can be broken down into four phases.

1. The four phases are the preparation of physical and mental during the stance phase. This provides for correct stability with proper placement of the feet in relationship to the shoulders as well as flexing and straightening the knees, hips, spine and neck in order to create a firm center of balance.
2. The second phase is the back swing, which brings the club to its highest position in preparation for acceleration.
3. Phase three is the downswing or the force produced movement where angular velocity creates club head speed.
4. Phase four is impact, follow through and recovery. This phase is the outcome and deceleration of the golf swing. The deceleration helps the muscles achieve the state of relaxation with least potential of trauma by making an abrupt stop.

There are two separate mechanisms that are important in the golf swing. The first mechanism is postural control for balance during the arm swing and the weight shift. The second involves the sequential fluid movement of the arms and hands throughout the golf swing.

The brain is the control center of the body where all information is processed and coordination of movement is made. The brain provides sensory feedback from physical, visual, vestibular and touch during the stance phase and the movement phase. In the stance phase tone is regulated primarily in the lower limbs pelvis and torso during the swing process. In the swing phase of movement the brain provides sequential turning on and off of muscles of the arms, shoulder and hips. Any dis-coordination in this phase will result in deceleration and loss of momentum at impact.

The brain distinguishes and gives priority to more actively contracting muscles than postural muscles. Therefore the brain activity is more prevalent in the movement of the muscles of the arms, shoulders and hips than adjusting for balance in muscle tone and stance.

An important concept in motor learning is that we place to muscle memory which most emotionally charged. The reason for this is that anatomically and physiologically that part of your brain, which is also responsible for emotion, converts short-term memory to long-term.

This may explain why we remember things from our past that hold the greatest emotional charged events.

Incorporating this concept, one should become emotionally charged with positive outcomes of performance. Unfortunately, most players place the greatest emotional charge on their mis-hits, especially missed putts and tee shots. For golfers who become emotionally charged with bad shots they place them in their motor learning and are doomed to repeat the same mistakes again.

Researchers at the University of Chicago have been studying professional golfers and muscle memory. Professional golfers were connected to an EEG machine that mapped electrical activity of the brain. During a putting exercise, golfers showed that during the visualization phase the left side of the brain showed activity as noted by spiky alpha waves. After the golfer visualized the shot and proceeded with the actual swing of the putt, then the brain activity switched to the right side of the brain showing smaller wave activity.

Similarly, as any other complex movement that requires precision reproducibility, one needs to practice only proper mechanics. Practice should be based on improving proper muscle memory, not the quantity of balls hit. One loses the exactness of muscle memory with mis-hits and fatigue.