An inherent connection exists between proper conditioning and injury prevention. Conditioning prepares and trains the body for sport and everyday tasks. The more efficient and better conditioned the athlete, the less likely it is that an injury will occur. Thus an exercise program must balance the goal of conditioning the body with the goal of preventing injury. Athletes must have a purpose for entering and performing a specific exercise program, but they must also have an appreciation of the essential components of conditioning.

Unfortunately, many people take an impractical and poorly planned approach to exercise. They focus on training and pushing their bodies to the limit to reach a particular result, be it to lose weight or to improve sport-specific speed. But in training this way they overlook the long-term consequences of physical activity—that is, until an injury occurs.

To reach an ideal balance of conditioning that will allow them to achieve their goals while preventing injury, athletes must learn to condition the body functionally. Functional conditioning consists of exercises that incorporate balance, flexibility, stability, acceleration, and deceleration. In essence, functional conditioning trains movements rather than isolated muscles.

This chapter explains the concept of functional conditioning and introduces the elements involved in it. It also explores the roles these elements play in preventing injury and provides a guide for using the information presented to create an effective warm-up and exercise program. An understanding of the complexities of human activity is essential for engaging in appropriate conditioning and preventing injuries.

Understanding Functional Conditioning

According to Gary Gray (2000), a respected physical therapist and trainer, function is the "interaction between muscles, nerves, and joints, working together simultaneously to decelerate, accelerate, and stabilize both external and internal forces." Simply put, function is the outcome of any activity. Everyday functional movements include running, biking, throwing, walking, carrying a child, tying shoelaces, getting out of bed, and even switching from a sitting to a standing position. Thus, the benefits of functional conditioning are not limited to athletics. Its movements occur in some form in work, home, and sport environments. To perform these tasks, a chain reaction involving muscles, nerves, and joints occurs. If this chain reaction is interrupted because of inadequate flexibility or lack of strength in part of the chain, a breakdown results, leading to a decrease in performance and to possible injury.

Exercises to help condition the body for functional movements must meet all four of these criteria:

1. They must include movements in all three planes (sagittal, frontal, and transverse).
2. They must properly condition the body's nerves and muscles to develop muscle memory and help make movements "automatic."
3. They must condition for responding to external forces, allowing the body to make best use of outside influences such as gravity, ground reaction forces, and momentum.

4. They must condition biomotor abilities (flexibility, strength, power, endurance, agility, or coordination).

A quick look at these four criteria comfirms that functional conditioning works beyond the realm of physical fitness and benefits the body during the activities that most people, athletes and nonathletes alike, do every day.

Moving in Multiple Planes

To help prevent injury and to function effectively, conditioning must occur in the sagittal, frontal, and transverse planes (figure 1.1). An exercise that exemplifies movement in all three planes is the 3-D lunge, also known as the lunge matrix, which includes a forward and lateral lunge as well as a lunge with a rotational movement. The standard forward lunge works the sagittal plane. This requires taking a big step forward with one leg and squatting straight downward until the other knee almost touches the floor before returning to the starting position. In the lateral lunge the athlete stands straight up and steps out to the side with one leg, bending the stepping leg's knee while keeping the other leg relaxed. The transverse plane is emphasized in the 3-D lunge, in which the athlete adds a rotational movement by twisting the back while performing a forward lunge. Many motions in everyday life require postural control through multiple planes of motion and at different speeds. For example, a mother carrying a newborn baby requires postural control to keep the child securely in her arms.

Moving forward and backward, such as running, works the sagittal plane. Side-to-side movement, such as sidestepping or shuffling, uses the frontal plane. Rotational movements, such as the twisting motion of throwing or hitting a baseball, occur in the transverse plane.

Unfortunately, most exercise conditioning programs and equipment focus primarily on the sagittal plane (forward and backward). For example,

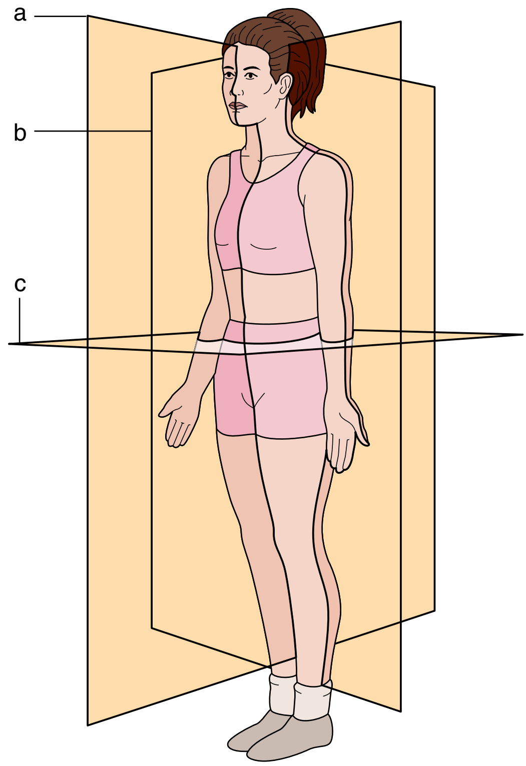

Figure 1.1 Conditioning movements occurring in the *(a)* sagittal, *(b)* frontal, and *(c)* transverse planes improve performance and help prevent injuries.

Adapted, by permission, from E. Harman, 2000, The biomechanics of resistance exercise. In *Essentials of strength training and conditioning,* 2nd ed., edited by T.R. Baechle and R.W. Earle (Champaign, IL: Human Kinetics), 34.

the hamstring curl is performed on a fixed piece of equipment. The athlete lies down and inserts the heel under the pull pad, lifts up the foot, angles the knee, and then lowers the leg down to its initial position to repeat the process. The exercise targets the hamstring muscles. Although performed on a machine, the exercise is not useless or ineffective. Such a piece of equipment can supplement a workout by strengthening the hamstrings. However, training with a hamstring curl machine alone is not functional conditioning because lifting the legs up and down allows only the targeted muscle and joint to operate within the sagittal plane. This means the hamstring curl has little carryover in improving overall sport-specific performance. For instance, the hamstring curl might benefit a bodybuilder trying to increase the muscle size of the hamstring, but because the exercise isolates the hamstring, it does not develop the athlete's quickness, speed, body control, awareness, and overall athletic performance. Likewise, research indicates that most injuries occur in the transverse plane during eccentric, decelerating muscle contractions (National Academy of Sports Medicine 2003). Examples include tearing the ACL (anterior cruciate ligament) upon landing after shooting a basketball lay-up and throwing the back out while bending over to pick up an object.

Whether you are playing basketball or doing yardwork, multiplanar conditioning movements play an integral role in avoiding injury. All foundational functional movement patterns, such as throwing, running, leaping, squatting, crawling, jumping, hopping, pushing, pulling, lifting, twisting, and carrying, are multiplanar and involve multiple joints. Conditioning the body in this fashion and conditioning the foundational movement patterns is essential for preventing injury, rehabilitating an injury, and improving athletic development.

Conditioning the Neuromuscular System

Functional conditioning requires the training of the nervous system. For example, when someone bends down to pick an object off the ground, he or she is unaware of *how* the body executes this movement. The flexing and rotating of the spine, hips, knees, and ankles are not premeditated actions. Rather, the nervous system plays an integral role in this process. The body's nerves send messages to the muscles, telling them when, how, and at what speed to move. To clarify how this occurs, we should examine the neurological mechanisms of the nervous system that are used during movement and their relation to functional conditioning and preventing injury.

The brain learns movement by developing motor programs. According to physical therapist Gray Cook, motor programs are ways that the brain stores information about movement. So, every time someone learns how to shoot a basketball or ride a bike, the brain creates a motor program that allows the athlete to repeat the activity without relearning the mechanics each time (Cook 2003). This is the nervous system's way of running efficiently. Improving the way the body develops motor programs and helping the neuromuscular system operate to its highest potential require conditioning the neural network through repeated functional movements.

Conditioning the nervous system through repetitive functional movements improves the feedback of proprioceptors to the muscles in the body. Proprioceptors are sensory receptors located within joints, muscles, and tendons. They deal with the physical state of the body, constantly informing the central nervous system about muscle tone and the coordination of certain movements. Likewise, the way the body senses both touch and movement is referred to as proprioception, which means "sense of self." Through proprioception, the body communicates with itself at a subconscious level. For example, people do not have to think about maintaining a particular posture or how to position body parts during a particular movement. Their proprioceptors govern the spatial and temporal relations of their body and limbs in space, freeing the conscious mind to focus on other matters.

Two of the most important proprioceptors are muscle spindles and the Golgi tendon organs (GTOs; figure 1.2). Muscle spindles keep the muscle in a state of readiness by monitoring the strength, length, and tension of the muscle in which they are embedded so the muscle can relax or contract to permit proper movement. Also, these sensors initiate a muscle's contraction in order to reduce stretch in the muscle. Spindles make muscle activation possible. Meanwhile, the GTOs inhibit muscle activation to protect the muscle from a perceived injury by responding to tension within the tendon by sending signals to the spine to convey the change in tension. When the tension goes beyond a certain threshold, a reaction is triggered

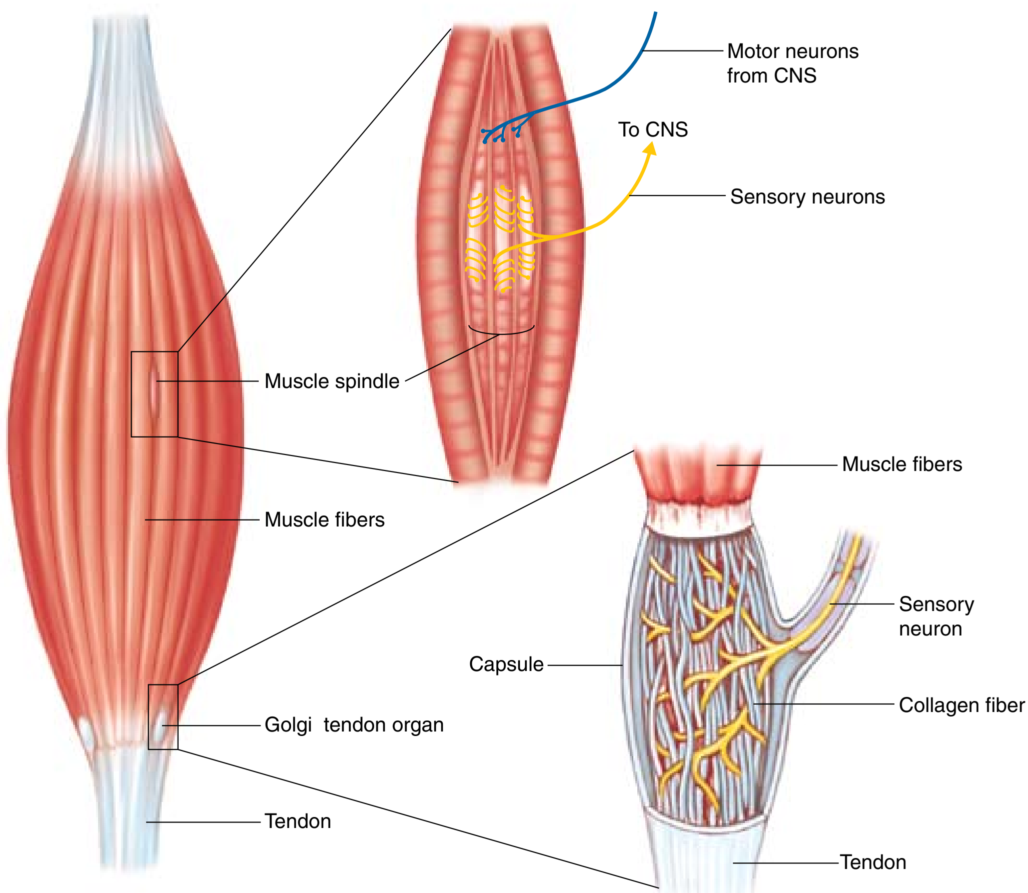

Figure 1.2 Muscle spindles and Golgi tendon organs monitor muscle tension and initiate contraction and relaxation, respectively.

that inhibits muscles from contracting and causes them to relax. Overall, these sensors are responsible for function itself.

With conditioned proprioceptors, an athlete is in better position to react, as joints and muscles respond automatically to protect the body from injury and other physical problems (Cook 2003). For instance, someone with highly conditioned proprioception can slip on ice and land on the ground without turning an ankle. According to Mark Verstegen, founder and president of Athletes' Performance, using a physioball (also known as a Swiss, balance, or stability ball) in exercise routines helps to condition proprioceptors (Verstegen and Williams 2004; figure 1.3). For example, a sit-up performed on a physioball relies on different parts of the neuromuscular system than a regular sit-up does. The unstable surface forces the athlete to maintain balance, which calls the muscles into action, enabling the athlete to help control and stabilize the body. Physioball exercises develop strength and stability in the shoulders, hips, and core and improve the activation and elongation of muscles. As a result, enhancement occurs in both the physical and neurological realms. Essentially, to improve the nervous system's response to movement, it is necessary to implement a conditioning

Figure 1.3 Physioball exercises such as the *(a)* crunch, *(b)* push-up, and *(c)* split squat condition the neuromuscular system.