

## PRINCIPLES OF INJURY PREVENTION

The sports medicine professional is concerned with the well being of the athlete and generally assumes the responsibility for overseeing the total health care for the athlete. Participation in sports places the athlete in a situation in which injury is likely to occur. Fortunately, most injuries are not serious and lend themselves to rapid rehabilitation, but the sports medicine professional must be capable of dealing with any type of trauma or catastrophic injury.

### A. Physical Conditioning

Physical conditioning is a key principle of injury prevention. Appropriate conditioning programmes decrease the risk of injury, decrease the severity of an injury should it occur, and can help prevent re-injury. Maximising the chance for safe athletic performance requires adequate muscular strength and balance, power, endurance, neuromuscular coordination, joint flexibility, cardiovascular endurance, and good body composition for sport.

Improving specific components of fitness and conditioning reduces the risk of injuries. For example, strengthening the muscles of a joint helps reduce injuries to the area; regular exercise can significantly increase the strength of the ligaments surrounding the knee and prevent knee injuries; development provides increased strength that helps to stabilise joints; and improved movement skill is important in avoiding injury.

#### 1. Strength

To improve muscle strength, stress must be progressive and gradually challenged or placed under additional loading. A conditioning programme's effects are specific to the type of stress applied. The SAID principle (Specific Adaptation to Imposed Demands) states that as the body is placed under stress of varying intensities and durations, it attempts to overcome the stress by adapting specifically to the imposed demands. For example, muscles around a joint can be developed and conditioned to provide optimal stabilisation of the joint. Likewise, when a muscle primarily produces motion of a joint, proper conditioning can prevent the muscle from undergoing an unwanted movement. The demands of a specific athletic event must be a progressive stress applied in that athlete's training.

Other components of strength conditioning that contribute to injury prevention are the ability of the muscle to contract or exert force at an accelerated speed, and muscular endurance, which allows the athlete to maintain an appropriate strength level over a period of time.

#### 2. Balance

Proprioceptive or kinesthetic sense through balance training enhances motor control, which is needed to decrease the risk of injury or re-injury during practice or competition. When injury to a joint or musculo-tendinous structure occurs,

somato-sensory information is altered, adversely affecting motor control. Hence, rehabilitation should emphasise restoring the athlete's balance strategies. This will also decrease the risk of recurrent injury. The balance training tasks must be specific to the type of balance strategies required by the athlete's event.

### 3. Flexibility

Efficient performance requires a full range of motion, and adequate joint flexibility also decreases an athlete's susceptibility to injury. Normal muscular length-tension and adequate extensibility upon stretch aid in protecting the body from injury. The athlete's entire body is able to work more efficiently and safely after a period of warm-up, stretching, and skill-drills that are related to the athlete's event.

The warm-up period before practice or competition increases the body's tissue temperature prior to subjecting the musculo-tendinous structures to repeated stretch and contraction. Connective tissue has visco-elastic properties, which allow elongation of the tissue. Temperature has a significant influence on the mechanical behaviour of connective tissue under tensile stretch. Higher temperatures at low loads produce the greatest elongation with the least damage to connective tissue. Increased connective tissue temperature also increases extensibility.

Optimal stretching occurs only when voluntary and reflex muscle resistance is eliminated. Ballistic stretching is not a favorable method because as the muscles stretch rapidly, the intrafusal muscle spindles may be activated, causing a reflex protective muscle contraction. Forceful ballistic stretching can also cause micro-trauma of muscle fibres.

### 4. Endurance

Cardiovascular endurance is also a factor in injury prevention. The cardiovascular and respiratory systems must be adequately conditioned to delay the onset of fatigue. A fatigued athlete becomes vulnerable to injury when the nervous and muscular systems are unable to respond adequately to an injury-producing situation.

## B. Appropriate Training Methods

Ensuring proper, efficient mechanics requires practice and effective coaching, including a systematic series of specific, repetitive, and progressive exercises and drills. Faulty mechanics must be corrected and good fundamentals ingrained. Exercises should include strength, relaxation, and flexibility specifically geared to the demands made on the body. (See Chapter 3, Part 1, *Principles of Training*.)

## C. Rest and Recovery

Adequate sleep is important for general good mental and physical health, and becomes critical for recovery after intensive workouts. Chronic overexertion and fatigue can make the athlete susceptible to injury. (See Chapter 3, Part 2, *Restoration, Recovery, and Overtraining*.)

### D. Muscle Soreness

Muscular over-exertion may present as muscle soreness, muscle stiffness, and muscle spasm. According to the *muscle spasm hypothesis* of muscle soreness, ischemia to the muscles releases pain substances from the muscle fibres and stimulates the pain receptors, resulting in reflex spastic contractions and a continued cycle of ischemia and pain. Stretching the muscles helps reduce the spasms and associated pain. According to the *tissue damage hypothesis*, micro-tears occur and pain/soreness results from the nerve-endings being stimulated by muscle tissue swelling. Proper massage may aid in reducing tissue oedema and decreasing accompanying muscle spasm. Ice applications or other forms of cryotherapy, and pool training, may facilitate the body's healing response. Appropriate rest will allow microscopic damage of the tissue to heal.

### E. Appropriate Equipment

Shoes are the most critical piece of a track and field athlete's equipment and should be individually and carefully selected. Proper fitting shoes can mean the difference between a low and a high risk of injury for a track and field competitor. Training in improperly fitted shoes can result in chronic abnormal pressures to the foot and cause stress injuries or structural deformities. Minor skin irritations such as calluses and blisters can prove to be major hindrances to a runner. Improperly fitted or worn-out shoes can lead to mechanical disturbances and postural, muscular, and joint dysfunctions.

The recent revolution in shoe research, design, and production has created a plethora of shoes from which to choose. However, the athlete's shoes must meet the biomechanical requirements and adapt to the demands of the individual's event. Shoe surveys can be useful in analysing the specific qualities of shock absorbency, foot control, and flexibility, but athletes and coaches must be aware that new shoe models have produced new injury syndromes.

Field event implements must meet use and safety specifications. Every member of the sports team (coach, official, sports medicine personnel, athlete) must be aware of any hazardous field situation where the field event practices and competitions take place, and take action to assure the highest level of safety. (See Chapter 2, Part 4, *Sports Rules and Athlete Safety*.)

### F. Psychological Factors

Athletes need to be psychologically prepared for practices and competition in order to reduce the risk of injury. Research has demonstrated a positive relationship between stressful life situations, especially those with high negative stress, and injury occurrence. In understanding the stress-injury relationship, Nideffer (1983) points out that muscle tension increases in response to stress. Increased tension in the antagonist and agonist muscle groups results in reduced flexibility and loss of motor coordination. Increased muscular tension also slows reaction time, which reduces the athlete's ability to respond.

Mental as well as physical fatigue can contribute to injury occurrence. The attention factor—the ability to maintain a high level of concentration—requires a large amount of energy; when combined with a rigorous training programme, reduced attention can result. This may lead to slowed reaction times and loss of neuromuscular coordination, thus increasing the potential for injury.

Athletes who have sustained an injury realise that they have to be mentally ready for return to sport to avoid risking re-injury. The role of attentional focus and muscular tension can be a major problem. Fear and/or worry about a second injury can cause stress and increased muscular tension. Preliminary studies have addressed hardiness (commitment, control, and challenge) of the athlete as a moderating factor in the stress-injury relationship. Athletes who exhibit greater qualities of this trait may be better able to control the attentional processing of information and in turn reduce the potential for occurrence of a second injury.

### G. Training in Extreme Conditions

Athletes and coaches should take into account the temperature and humidity during training, and the need to acclimate after travel to a different, extreme climate or altitude. Extreme heat and humidity, cold, and altitude can adversely affect performance in many athletic events (see Chapter 11, *Environmental Factors Affecting Human Performance*). To avoid dehydration and the fatigue that can occur from inadequate fluid replenishment, athletes must drink extra water, juices, and other fluids (see Chapter 6, Part 1, *Nutrition and Athlete Health*). Athletes should learn to drink before they feel thirsty—by the time an individual is aware of thirst, they've lost 1% of their body weight; by 2% dehydration, the athlete may have reduced his or her work capacity by 10–15%. Assuring adequate water, and juices or sports drinks, helps keep the participant energised, focused, and better able to concentrate.

The health and safety of the athlete must be the number one priority in any practice or competitive situation. If unsafe climatic conditions occur, training should be curtailed, and practice or competition times re-scheduled to allow the safest environment for all participants (see Chapter 2, Part 4, *Sports Rules and Athlete Safety*).

### References

1. Clark, N. Fluids, Dehydration and Thirst Quenchers. Sports Nutrition Sports Medicine Systems, Inc.
2. Irrgang, J., S. Whitney, and E. Cox. Balance and proprioceptive training for rehabilitation of the lower extremity. *J. of Sport Rehab.* 3:68-93, 1994.
3. Lamb, D. R. *Physiology of Exercise, Responses and Adaptations* (2nd edition), p. 322. New York: Macmillan, 1978.
4. Nideffer, R. M. The injured athlete: psychological factors in treatment. *Orthop. Clin. North Am.* 14:373-385, 1983.

5. Pease, D. G. Psychologic factors of rehabilitation. *In* Physical Rehabilitation of the Injured Athlete (2nd edition), Andrews, J. R., and G. L. Harrelson (eds.), pp.1-12. Philadelphia: W. B. Saunders Co., 1996.
6. Prentice, W. Arnheim's Principles of Athletic Training (12th edition). Boston: McGraw Hill, 2005.

