Maintenance, Detraining, and Prolonged Inactivity

Most adaptations that result from both endurance and resistance training will be reversed if a person stops or reduces training. The greatest deterioration in physiologic function occurs during prolonged bed rest and immobilization by casts. A basic maintenance training program is necessary to prevent these losses in function.

Maintaining Fitness and Muscular Strength

Muscle strength and cardiorespiratory capacity are dependent on separate aspects of exercise. After a person has obtained gains in $\dot{V}O_2$ max by performing cardiorespiratory exercise six times per week, two to four times per week is the optimal frequency of training to maintain those gains (Hickson and Rosenkoetter 1981). Further, a substantial part of the gain can be retained when the duration of each session is reduced by as much as two-thirds, but only if the intensity during these abbreviated sessions is maintained at ≥70 percent of $\dot{V}O_2$max (Hickson et al. 1985). If training intensity is reduced by as little as one-third, however, a substantial reduction in $\dot{V}O_2$max can be expected over the next 15 weeks (Hickson et al. 1985). In previously untrained persons, gains in muscular strength can be sustained by as little as a single session per week of resistance training, but only if the intensity is not reduced (Graves et al. 1988)

Detraining

With complete cessation of exercise training, a significant reduction in $\dot{V}O_2$ max and a decrease in plasma volume occur within 2 weeks; all prior functional gains are dissipated within 2 to 8 months, even if routine low- to moderate-intensity physical activIty has taken the place of training (Shephard 1994). Muscular strength and power are reduced at a much slower rate than $\dot{V}O_2$max, particularly during the first few months after an athlete discontinues resistance training (Fleck and Kraemer 1987). In fact, no decrement in either strength or power may occur for the first 4 to 6 weeks after training

ends (Neufer et al. 1987). After 12 months, almost half of the strength gained might still be retained if the athlete remains moderately active (Wilmore and Costill 1994).

Prolonged Inactivity

he effects of prolonged inactivity have been studied by placing healthy young male athletes and sedentary volunteers in bed for up to 3 weeks after a control period during which baseline measurements were made. The resulting detrimental changes in physiologic function and performance are similar to those resulting from reduced gravitational forces during space flight and are more dramatic than those resulting from detraining studies in which routine daily activities in the upright position (e.g., walking, stair climbing, lifting, and carrying) are not restricted.

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Physical inactivity associated with bed rest or prolonged weightlessness also results in a progressive decrement in skeletal muscle mass (disuse atrophy) and strength, as well as an associated reduction in bone mineral density that is approximately proportional to the duration of immobilization or weightlessness (Bloomfield and Coyle 1993). The loss of muscle mass is not as great as that which

occurs with immobilization of a limb by a plaster cast, but it exceeds that associated with cessation of resistance exercise training. The muscle groups most affected by prolonged immobilization are the antigravity postural muscles of the lower extremities (Bloomfield and Coyle 1993). The loss of nor□mal mechanical strain patterns from contraction of these muscles results in a corresponding loss of density in the bones of the lower extremity, particularly the heel and the spine (Bloomfield and Coyle 1993). Muscles atrophy faster than bones lose their density. For example, 1 month of bed rest by healthy young men resulted in a 10 to 20 percent decrease in muscle fiber cross-sectional area and a 21 percent reduction in peak isokinetic torque of knee extensors (Bloomfield and Coyle 1993), whereas a simi□lar period of bed rest resulted in a reduction in bone mineral density of only 0.3 to 3 percent for the lumbar spine and 1.5 percent for the heel.

Quantitative histologic examination of muscle biopsies of the vastus lateralis of the leg following immobilization shows reduced cross-sectional area for both slow-twitch and fast-twitch fibers, actual necrotic changes in affected fibers, loss of capillary density, and a decline in aerobic enzyme activity, creatinine phosphate, and glycogen stores (Bloomfield and Coyle 1993). On resuming normal activity, reversibility of these decrements in cardiorespiratory, metabolic, and muscle function is fairly rapid (within days to weeks) (Bloomfield and Coyle 1993). By contrast, the reversal of the decrement of bone min□eral density requires weeks to months.