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I began to understand that momentum-assisted weight training reduced the role of the target muscles, which made the exercise less productive. It did not take too long before I realized that momentum-assisted weight training also increased the risk of injuries.  Several years later, I learned that momentum was not the only problem associated with fast movement speeds. After performing dozens of standardized strength tests on a state-of-the-art isokinetic computer, I noted a consistent pattern. Without exception, as the movement speed increased the movement force decreased. For example, at a two-second lifting speed (60 degrees/second), my right quadriceps produced 174 pounds of muscle force. However, at a one- second lifting speed (120 degrees/second) my right quadriceps produced only 132 pounds of muscle force.  To further examine this speed/strength relationship, I conducted a small study with six previously untrained women between 18 and 36 years of age (Westcott 1986). The subjects trained their left leg at a slow speed (60 degrees/second) and their right leg at a fast speed (240 degrees/second). After nine training sessions the subjects were evaluated for strength improvements. As presented in Table 1, the slow training produced significant strength gains at both movement speeds, whereas the fast training did not increase strength at either movement speed. Although the number of subjects was too small to make generalized conclusions, the women in this study responded better to the slower training speed.  More recently, I examined the effects of four different movement speeds on strength development using Nautilus machines (Westcott 1994). All of the subjects (198 previously untrained men and women) exercised in small classes in our research center. The participants were carefully instructed and supervised, and trained in exactly the same manner except for their exercise speed.  Group A performed each repetition in four seconds (2 seconds up/2 seconds down). They averaged 10 repetitions per set for a total time of about 40 seconds per exercise.  Group B performed each repetition in six seconds (2 seconds up/4 seconds down). They averaged 10 repetitions per set for a total time of about 60 seconds per exercise.  Group C performed each repetition in eight seconds (4 seconds up/4 seconds down). They averaged 10 repetitions per set for a total time of about 80 seconds per exercise.  Group D performed each repetition in 14 seconds (10 seconds up/4 seconds down). They averaged 5 repetitions per set for a total time of about 70 seconds per exercise.  All four training groups used a resistance that fatigued the target muscle group within the anaerobic energy system (40-80 seconds). They all performed one set of the following Nautilus machines: (1) leg extension; (2) leg curl; (3) leg press; (4) chest cross; (5) decline press; (6) compound row; (7) overhead press; (8) biceps curl; (9) triceps extension; (10) low back; (11) abdominal; (12) neck flexion; and (13) neck extension.  After eight weeks of training the strength gains in all 13 exercises were averaged and compared for the four training groups. As shown in Table 2, all four training speeds produced significant improvements in overall muscle strength. Although there were no statistical differences between the four groups, the slower movement speeds appeared to be more effective for stimulating strength gains.  Discussion  The training groups involved in the Nautilus study used moderate to very slow movement speeds, all of which produced excellent strength increases. The 14-second protocol required a very slow (10-second) lifting movement that minimized momentum and maximized muscle tension. It is possible that the very slow muscle contractions are advantageous for strength development. However, due to the tough and tedious nature of very slow lifting movements, this training technique typically requires close supervision for best results.  Based on the findings of this study, it would appear that there is a range of moderate to very slow movement speeds that are effective for strength development. Also, as there were no exercise- related injuries to any of the subjects, the four-second, six-second, eight-second and 14-second repetitions seemed to represent safe training speeds.  My personal preference is six-second repetitions, with a two-second lifting phase and a four- second lowering phase. This is the standard Nautilus training protocol, going slower on the lowering movement to emphasize the negative muscle contraction.  The main consideration is to train at a controlled movement speed, so that you are lifting the weight rather than allowing the weight to lift you. One way to check this is to have trainer say "stop" at some point during your repetition. If the weight keeps moving your movement speed is probably too fast, thereby placing more emphasis on momentum than on muscle control.  There are at least four reasons for training with controlled movement speeds. First, controlled movement speeds reduce momentum, permitting the target muscles to do their job. Second, controlled movement speeds avoid abrupt acceleration and deceleration forces, reducing tissue trauma and injury risk. Third, controlled movement speeds provide more muscle tension throughout each repetition. Fourth, controlled movement speeds produce more muscle force output.  If you are a competitive weightlifter, then you need to train with fast movement speeds to be successful in this explosive-action sport. However, if you are performing strength exercise for the purpose of muscular fitness, I recommend using controlled movement speeds no faster than four seconds per repetition.  -------------------  Wayne L. Westcott, Ph.D., is fitness/research director at the South Shore YMCA in Quincy, MA, and author of the college textbook, Strength Fitness: Physiological Principles and Training Techniques. | |