

Effective Eccentric Training

Using eccentric training routines to increase patient strength following numerous lower-extremity injuries

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Operationally, strength is the development of force through the active tension produced by the skeletal muscles. The skeletal muscles can generate active tension through one of three modes of muscular contraction: isometric, concentric and eccentric.

In terms of the force-producing capabilities, eccentric phase contraction is the strongest mode of muscular contraction, followed by isometric and concentric mode contractions.

Strength is vital to athletic performance and injury-free sports participation. It's also critical to the performance of activities of daily living. The ability to produce adequate levels of strength may result in functional limitations in an individual's ability to interact effectively within his environment.

Due to muscle loss associated with aging,

injury or illness, functional independence often begins to decrease in older adults and individuals with degenerative disorders of the central nervous system.

One effective approach to increasing both eccentric and concentric strength at the lower extremities is with lower-body eccentric training routines. Eccentric training routines consist of exercises that emphasize the lengthening aspect of a muscle contraction under load (e.g., Nordic hamstring exercises or standing calf raises emphasizing a slow return to the dorsiflexed position). Eccentric training allows for the production of higher forces (enabling greater overload to the muscles involved in the exercise) and a lesser metabolic cost than traditional training programs.¹

Compared to concentric training, high-intensity eccentric exercise results in a

significant increase in total strength, eccentric strength and muscle mass.² These gains are a result of the higher loads developed during eccentric contractions.²

Lower-extremity eccentric strength is essential to many activities of daily living such as descending stairs and moving from a standing-to-sitting position in a controlled manner.³ In these types of movement situations, variability (unsteadiness) of eccentric muscular force production may have important functional consequences in elderly adults.⁴ Coupled with age-related strength and power declines, this has the potential to increase susceptibility to falls.

For decades, strength and conditioning practitioners have commonly employed eccentric training routines to increase the strength and power of athletes. However, in recent years, studies have demonstrated the benefits of lower-extremity eccentric training routines in other populations such as the elderly, individuals suffering with degenerative disorders of the central nervous system and those engaged in rehabilitation programs resulting from surgical repair (e.g., total knee arthroplasty).

The high force and minimum metabolic cost attributes of eccentric exercises make them ideal for energetically impaired populations such as the elderly.¹ One concern in the past with eccentric training in the elderly was the development of delayed-onset muscle soreness (DOMS). However, in a current study, researchers have suggested that preconditioning of the muscle group with low-intensity eccentric contractions helps attenuate muscle damage induced by subsequent maximum eccentric exercises.⁵

Implementing Eccentric Training

In the elderly, lower-extremity eccentric

training increases walking speed, sit-to-stand, balance and knee extensor and flexor strength.⁶⁻⁸ In a group of elderly participants, investigators observed that 11 weeks of high-intensity eccentric training of the lower extremities using a leg-cycle ergometer significantly improved strength, balance and stair-descent abilities by 60%, 7% and 21%, respectfully.⁷ The participants (between 70 and 90 years of age) in the 11-week program were engaged in the exercise three times a week, with each session lasting 10 to 20 minutes.⁷ The researchers in this study also found that this particular high-intensity, lower-extremity eccentric training was more effective than traditional lower-extremity, resistance-training routines using a combination of machine and free weights over the same period.

Lower-extremity eccentric training routines are also beneficial in populations suffering with degenerative disorders of the central nervous system. In individuals with idiopathic Parkinson's disease, one of the most common degenerative disorders of the central nervous system,⁹ reports have indicated that lower-extremity eccentric training improves the level of function for those suffering from this debilitating, degenerative disorder.

Recently it was reported that 12 weeks of a high-intensity, lower-extremity eccentric training program resulted in reduced bradykinesia, increased muscular strength, and improvements in quality of life in persons with mild to moderate Parkinson's disease.¹⁰ Researchers have found high-intensity eccentric training at the lower extremities not only to be effective in increasing function, but also a safe and feasible approach for people with mild to moderate Parkinson's disease.¹¹

Clinicians can implement this type of high-intensity eccentric training routine in this patient population safely and feasibly through the use of a lower-extremity eccentric ergometer.¹¹ Although more research is required, it appears that eccentric training combined with other therapeutic exercises is beneficial in slowing the decay of muscular strength in people with Parkinson's disease. Researchers have shown that lower-extremity, high-intensity eccentric training combined with standard exercises (e.g., stretching, walking on a treadmill, upper-extremity resistance training) three days a week (each session lasting from 45 to 60 minutes) is an effective training routine within this patient population over a 12-week period.¹⁰

Effects After Surgery

As it relates to a post-surgical patient population, reports indicate positive patient outcomes using eccentric training routines post-total knee arthroplasty and anterior cruciate ligament reconstruction.¹²⁻¹⁵ In a recent study, an eccentric-biased rehabilitation program for post-total knee arthroplasty resulted in improvements in the SF-36 component summary and the 6-minute walk test with increases of 59% and 47%, respectively.¹⁵ Knee extension strength

and power also increased by 107% and 93%. Clinicians can facilitate eccentric training of the lower extremities using isokinetic instrumentation and common manual muscle resistant exercises for the hamstrings and quadriceps. Another option is the use of a recumbent eccentric ergometer that resembles a stepper ergometer.¹⁵

In terms of ACL reconstruction surgery in athletic populations, eccentric training routines are necessary to prepare athletes for the rigors of sports competition post-repair. During athletic maneuvers, eccentric muscle contraction often works to decelerate limb movements and to dampen impact forces when running or landing from a jump. Clinical investigators have shown that implementing eccentric lower-extremity ergometer training routines with a standard rehabilitation plan three weeks after anterior cruciate ligament reconstruction surgery significantly increased quadriceps femoris and gluteus maximus muscle function and volume as compared to standard rehabilitation alone.¹³ Researchers have shown these gains are still evident one year post-surgical repair.

Take Home

As a certified athletic trainer and certified strength and conditioning specialist, I've used lower-extremity eccentric training routines to increase patient strength following numerous injuries, such as ankle sprains, hamstring strains and post-anterior cruciate ligament reconstruction. I've found eccentric training to be an effective method of not only restoring strength, but also facilitating overall muscle function.

I have particularly found the use of multi-joint eccentric exercises beneficial in preparing individuals to successfully interact within their daily environments. Eccentric strength remains a critical component of muscular function in activities of daily living (moving from standing to sitting, stair descent) and high-order movement tasks performed in athletic competition.

Clinicians can safely implement eccentric training into rehabilitation programs in order to reestablish full function prior to return-to-play (or work) for restriction-free activity. Correctly performed and implemented at the appropriate phase of rehabilitation, eccentric training can be a safe method for increasing overall strength and muscle mass in both the elderly and athlete patient populations. ■

References available at www.advancweb.com/PT.

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