



Isotonic Muscle loading

Definition

An isotonic muscle contraction occurs when the force or tension in the muscle remains constant while the length of the muscle changes. The change in muscle length is not constrained by a specific speed, thus may move at any appropriate velocity. There are two types of isotonic contractions in muscle movement; concentric and eccentric. In a concentric muscle contraction, the tension generated by the muscle fibers is greater than the external force or load, thus resulting in movement with the muscle shortening. In an eccentric muscle contraction, the tension generated by the muscle fibers is less than the external force or load, thus resulting in movement with the muscle lengthening.

Isotonic muscle contraction provides an objective and functional way to look at two different muscle performance characteristics: power and endurance. Power (watts) is a measure of efficient a muscle uses its strength. It is the peak performance available from that muscle or muscle group. Endurance (work) is a measure of how long a muscle can use its strength until it reaches a fatigue point.

Used in everyday life

Nearly every task we perform over the course of a day is isotonic (the remainder being isometric). The natural way we move is under an isotonic load. Everything from lifting an item or turning a wrench to walking to sports is an isotonic activity. For an effective strengthening rehabilitation program, you must challenge the muscles in the same way they will be used outside of the clinic. Since this is the natural way muscles work, the rehabilitation benefits of an isotonic strengthening program provide better results than the alternative dynamic loading process – isokinetic resistance (constant velocity/variable resistance).¹ Isokinetic muscle loading has traditionally been used in sports applications, but more and more athletic trainers are recognizing that the natural loading of isotonic resistance provided faster, more effective results.²

Uses in early intervention

In early intervention, the load the client works against can be set to a very low level. This allows the clinician to objectively set a resistance that is within the client's performance capabilities. Isolating the affected area will focus on the joint motion or muscle group that has been affected by the injury. This targeted intervention can be very effective in rapid recovery and return to function.³

Uses in integration

While a very effective tool in strengthening isolated muscle groups, the true power of isotonic resistance comes in the form of functional integration. As stated in earlier, nearly every task we perform in life is under an isotonic load. So what better way to prepare an individual to perform a real-world activity than to have them train in the same manner they will be performing the activity outside your clinic?

Integration is the involvement of multiple muscle groups in one complex movement pattern that mimics the whole body participation in a functional activity. The benefits of whole body integration into an exercise training program include:

Better coordination
Increased stability
More natural movement
Greater sense of balance
and
An overall greater confidence in one's own abilities.

Variations and special applications

The PrimusRS isotonic mode also offers the unique ability to unsynchronize the concentric and eccentric forces. Setting unequal forces allows specialized applications such as high load eccentric muscle loading, plyometrics, rhythmic stabilization and vibration desensitization. The concentric/eccentric force ratio can be adjusted to achieve the desired effect – high load concentric-low load eccentric for vibration desensitization and rhythmic stabilization (up to a 10:1 ratio), and low load concentric-high load eccentric for plyometrics and eccentric strength training (1:2 or 1:3 ratio).⁴

As an evaluation tool, isotonic muscle loading provides a unique “snapshot” of performance. Measuring the velocity of muscle contraction under varying (submaximal) loads provides a safe test to measure maximal power output.⁵ The Torque vs. Speed test accomplishes this by setting three subject appropriate resistances, then measures velocity and range of motion, resulting in calculations of power and a measure of functional range of motion under varying loads. This unique test provides valuable insight to a subjects performance capabilities.

¹ Kovalski JE, Heitman RH, Trundle TL, Gilley WF. “Isotonic preload versus isokinetic knee extension resistance training.” *Med Science Sports Exerc.* June 1995; 27(6):895-9

² Schmitz RJ, Westwood KC. “Knee Extensor Electromyographic Activity-to-Work Ratio is Greater with Isotonic than Isokinetic Contractions. *Journal of Athletic Training* 2001; 36(4):384–387

³ Blackmore S, Beaulieu D, Petralia PB, Bruening L: A comparison study of three methods to determine exercise resistance and duration for the BTE Work Simulator. *J Hand Ther*, 1998 1(4):165

⁴ Hartsell HD, Spaulding SJ, “Eccentric/concentric ratios at selected velocities for the invertor and evertor muscles of the chronically unstable ankle.” *Br J Sports Med.* Aug 1999; 33(4): 255–258

⁵ Stauber WT, Barill ER, Stauber RE, Miller GR “Isotonic Dynamometry for the Assessment of Power and Fatigue in the Knee Extensor Muscles of Females.” *Clinical Physiology* 20(3) 2000