



Isokinetic Muscle Loading

Definition

An isokinetic muscle contraction occurs when the velocity of the muscle contraction remains constant while the length of the muscle changes. The force exerted by the muscle is not fixed, and can vary depending on the position of the joint in its range of motion and the participation effort of the subject.

Isokinetic muscle loading can be either concentric or eccentric. In an isokinetic concentric contraction, the muscle shortens while under load. In an isokinetic eccentric contraction, the muscle lengthens while under load.

Historic Applications

Isokinetic systems were first introduced in the late 1960's/early 1970's as research tools. Because of the ability to adapt to various strength levels, these system began to work their way into the rehabilitation and athletic training field. This was the first step into computerized testing and rehabilitation, and since these devices only worked isokinetically, that mode was quickly adopted as the standard for dynamic muscle testing.

The benefits of “accommodating resistance” included:

- Maximally loading the muscle through range.
- Good isolation of specific muscle groups and joint functions.
- Providing resistance that matched the level of force generated by the subject.

However, because these systems worked best with isolated muscle groups and in an isolated plane of motion, isokinetic machines were never adopted as functional rehabilitation systems. They remain primarily research tools and sports rehabilitation tools. In recent years, even the sports applications have seen a marked decline due to the development of better technologies.¹

Alternatives to Isokinetic Resistance

As technology has advanced, the development of systems that could perform isotonic resistance became possible. The natural way the body moves is under an isotonic load, so it makes sense that systems providing this type of resistance quickly began replacing older isokinetic technology.

Nearly every task we perform over the course of a day is isotonic. This includes sports activities, as well as work and daily living activities. 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).² 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 provides faster, more effective results.

Research

Much of the current research that looks at the effectiveness of isokinetic training programs in comparison to the isotonic training program has shown the superior results isotonic programs can give.² In addition; there are renewed safety concerns due to the excessive loading on the joint during isokinetic exercise. Studies show that up to 9 times a person's body weight can be placed on the joint during peak isokinetic loads.³ The potential detrimental results of this is demonstrated by an article that appeared in the *Baltimore Sun* in July of 1986. This article reports... "the injuries suffered to Major League Baseball player, Eddie Murray, were described as a "crusher". Mr. Murray confirmed that during an isokinetic test he "blew out" his hamstring on a Cybex isokinetic device while being tested." This turned a short rehabilitation stint into a season ending injury.

Additional research shows that Isometric strength testing using portable fixed dynamometry is as effective isokinetic strength testing, at a much lower cost.⁴

Summary

While isokinetic systems still have limited application in research, the integration in rehabilitation and strength training has dropped considerably since its peak popularity in the 1970's and 80's. Since that time, technology advancements have made more functional and safer systems available. Isotonic resistance devices, due to their effectiveness at reproducing a natural muscle movement while under a fixed load, are quickly replacing older isokinetic technology. The ability to make objective performance measurements during natural movements is a huge leap forward in the field of rehabilitation and athletic performance.

¹ 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

² Kovalski JE, Heitman RH, Trundle TL, Gilley WF (June 1995). "Isotonic preload versus isokinetic knee extension resistance training" *Med Science Sports Exerc.* 27(6):895-9

³ Nisell R, Ericson M (May 1992) "Patellar forces during isokinetic knee extension" *Clin Biomed,* 7(2): 104-8

⁴ Kollock RO, Van Lunen B, Linza JL, Onate JA (Nov 2013) "Comparison of Isometric Portable Fixed Dynamometry to Isokinetic Dynamometry for Assessment of Hip Strength" *Int J of Athletic Therapy & Aquatics,* 18(6):1-6