Muscle Endurance

Definition

In order to thoroughly evaluate muscle performance in training and/or rehabilitation, it is important to look at all aspects of the affected muscle group versus the unaffected group, or in the area of training, dominant versus non-dominant. The most common way to achieve this is to look at the various ways a muscle group is required to perform, utilizing:

- Strength
- Power
- Endurance

Strength can be defined as the maximum force output at which a muscle contracts under load; it can be performed in either isometric or dynamic manner. Power can be described as how efficient strength is being used under explosive movement in a dynamic activity, either concentrically or eccentrically.[1] Endurance is how long the strength can be used before fatiguing. Endurance is slower paced, under lighter loads over prolonged periods of time.[2] The difference between strength and power versus endurance is the type of muscle fibers being used within the muscle bundles. Type I, or slow twitch muscle fibers are smaller and more fatigue resistant which is better suited for low levels of force over longer periods of time. While Type II or fast twitch muscle fibers are designed for quick powerful contractions and are prone to fatigue quickly under maximum loads. [3]

Evaluating muscle endurance

Our muscles are being used for many activities including running, walking, sitting and even sleeping. There are muscle groups built for quick explosive activity such as running and jumping and others built for endurance; lighter loads over long periods of time. An example would be our postural muscles required to keep us in an upright position while sitting or standing. All muscles fatigue if they are overused, some more quickly than others. It is quite possible for someone returning from an injury to have recovered strength and power but lack the endurance to perform an activity at the level required to return to work or sport. Regardless of the activity the individual is trying to go back to, endurance is a prime consideration for tasks which require repeated movement at a submaximal level. This is an important component of function since the majority of muscles are required to work on a continuous basis during most activities. By measuring the amount of work generated, or length of time an activity is sustained, the duration of muscle performance can be quantified.[4]

Applications for the PrimusRS

When using the PrimusRS for evaluating muscle endurance, it is important to control the rate of speed at which the person works. Therefore, it is necessary to make sure he or she works at the same speed with each extremity, in order to insure the level of fatigue is consistent between the affected vs, unaffected groups. To help control the subject's speed, a timing cycle should be utilized. The subject performs one complete repetition for each cycle. It was found that for motions involving up to 90 degrees of shaft rotation, a good pace is 45-60 cycles (repetitions) per minute. With motions involving greater than 90 degrees, acceptable paces range from 30 to 45 cycles (repetitions) per minute. An optimum performance level is established at the beginning of the evaluation. Once the pace is established the subject continues the movement until their power falls below 75% of the optimum performance level for two consecutive five second intervals. This indicates they have reached fatigue, and are no longer able to keep up with the established pace. A general guideline for establishing the evaluation resistance is 30% of their maximum isometric strength for the weaker of the two sides.[1]

Summary

The advantages of using lighter loads for longer periods of time are physiologically beneficial for increasing endurance for the type I slow twitch fibers. The added benefits of using technology like the PrimusRS are twofold. Not only can you accurately evaluate the level of fatigue, you can also set up a treatment plan to isolate the areas of imbalance or asymmetry and continue to challenge the subject by monitoring progress per session, and increasing time or force on a regular basis. The importance of adequately assessing muscle endurance is paramount in establishing the appropriate treatment plan. Having well-conditioned muscles is important in everyday life, the quicker a muscle fatigues the greater the opportunity for muscle related injuries.

[1] Abernethy P, Wilson G, Logan P; Strength and power assessment. Issues, controversies and challenges. *Sports Med* 1995;(19):401-17.

[2] Ebben WP, Kindler AG, Chirdon KA, Jenkins NC, Polichnowski AJ, Ng AV.; The effect of high load VS repetition training on endurance. J Strength Cond, Res 2004 Aug; 18(3) 513-7

[3] Martini, F. H.; Fundamentals of anatomy and physiology text book, Chapter 10, pages 292-293.

[4] Campos GE, Luecke TJ, Wendeln HK, Toma K, Hagerman FC, Murray TF, Ragg KE, Ratamess NA, Kraemer WJ, Staron RS; Muscular adaptations in response to three different resistance-training regimens: specificity of repetition maximum training zones. Department of Biomedical Sciences, College of Osteopathic Medicine, Ohio University, Irvine Hall, rm 430, Athens, OH 45701, USA.