

Mechanical and Contractile Properties of Knee Joint Muscles Measured by the Method of Tensiomyography in Differently Trained Men and Women

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Abstract

Toskić, LD, Dopsaj, MJ, Marković, MR, Toskić, DR, Ignjatović, AM. Mechanical and contractile properties of knee joint muscles measured by the method of tensiomyography in differently trained men and women. *J Strength Cond Res* 36(6): 1532–1539, 2022—The aim of this study was to investigate the differences in mechanical and contractile properties of knee joint flexor and extensor muscles between differently trained men and women, using tensiomyography (TMG). The sample consisted of 159 subjects (84 men and 75 women), who were assigned to one of 5 groups according to the following levels and types of their physical activity: physically inactive, physically active nonathletes, strength and power athletes, endurance athletes, and team sports athletes. Measurements were performed on the following knee flexor and extensor muscles of the dominant leg: rectus femoris, vastus medialis, vastus lateralis, biceps femoris, and semitendinosus. The results showed significant differences in contraction time— T_c ($F = 1.911$, $p = 0.010$) and delay time— T_d ($F = 1.989$, $p = 0.007$) parameters between differently trained men and women, whereas in other TMG parameters, there were no differences between groups. It is indicated that physical activities characteristic of strength and power sports (combat sports and sprint disciplines) could lead to an increased speed of twitch force generation and fast twitch muscle fibers, and that almost any regular, systematic, and planned physical activity leads to increased muscle responsiveness. Obtained results also indicated that TMG parameters do not have enough specific discriminatory power for detecting differences between differently trained young adults.

Key Words: strength and power athletes, contraction time, delay time

Introduction

As mechanical and contractile properties of muscles are of great interest to experts in sports science, medicine, and other related professional and scientific fields, numerous methods have been developed for their assessment. One of the relatively novel methods that measure these properties in skeletal muscles is tensiomyography (TMG) (15,16,32).

Tensiomyography is a noninvasive measuring tool used to estimate the changes in muscle belly displacement caused by electrical stimulation (15,32,34). Lately, TMG has been widely used in sport (7,8,13,24,25) and has been proved to be valid and reliable in assessing various muscle properties, such as contraction velocity (V_c), stiffness, muscle fatigue, fiber type, responsiveness, and others (4,12,28,32).

So far, several studies have investigated muscle mechanical and contractile properties in differently trained people using TMG (6,13,30,31). Differences in TMG parameters have been established between strength and endurance athletes (EA) (6), power and EA (13), physically active and inactive individuals (30), and among strength and power athletes (SP), moderately physically active, and inactive individuals (31). However, none of the studies included all levels of physical activity (inactive, moderately active,

and athletes) or athletes from all structurally different sport groups (strength and power, endurance, and team sports) using all TMG parameters in both sexes. The information on how TMG parameters were affected by different types and levels of physical activity could provide insights into both the influence of particular physical activities and exercises on muscle mechanical and contractile properties, and the discriminative value of TMG, thus further contributing to the development of sports training technology, sports diagnostic, sports selection, injury prevention, physical therapy, and rehabilitation.

Accordingly, the aim of this study was to investigate the differences in mechanical and contractile properties of knee joint flexor and extensor muscles between differently trained men and women, as measured by TMG. Based on the results of previous studies, it was hypothesized that there would be significant differences in TMG parameters of contraction time (T_c), delay time (T_d), relaxation time (T_r), maximal displacement (D_m), sustain time (T_s), and V_c relative to differently trained men and women.

Methods

Experimental Approach to the Problem

A cross-sectional experimental design was applied to assess the differences in muscle mechanical and contractile properties

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