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THERMAL EFFECT ON STRETCHING

Comparative study of stretching modalities in healthy women: Heating and application time

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Summary A lack of muscle flexibility affects the functionality of the human body, making it difficult to carry out certain activities of daily living.

The aim of the present study was to compare the technique of passive static stretching on hamstring muscles in isolation, or combined with heating techniques and different application times.

Fifty women were randomly assigned to 5 groups ($n = 10$ each): The Microwave Diathermy Group had the hamstrings heated by microwave before stretching; Treadmill Group, in which warm-up walking was performed before stretching; 30-Second Group, in which 30 s of stretching was performed; 10-Minute Group, which involved stretching for 10 min and Control Group. In all groups, the leg extension range of motion was assessed, and the flexibility by the third finger-ground test was performed before and after application. The individuals in the experimental groups performed three stretching sessions on three consecutive days. All statistical analysis was performed with $p \leq 0.05$.

The results showed that all treatments were effective compared to the control group. The Treadmill Group and the 10-Minute group were superior for an acute effect (soon after the stretch — related to a decreased muscular viscoelasticity). The 10-Minute Group was the most effective for the chronic effect (long lasting — related to increased numbers of sarcomeres).

A 10-minute stretch, when performed over four subsequent days, is suggested for faster increase in flexibility. The results could suggest a systemic warming (such as the one provided by a treadmill workout) before stretching for an acute gain of flexibility in the same day. It was possible to identify the inefficiencies associated with the use of microwaves in terms of stretching to gain flexibility. In fact, the values recorded were similar to stretching without any heat at all.

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Introduction

One of the major causes of movement dysfunction in sedentary individuals is a decrease or lack of muscle flexibility that interferes with the human body function, making it difficult to carry out certain activities of daily living (Rosário et al., 2004). The performance of everyday tasks depends on a range of motion, without pain or restrictions, and flexibility. When these components of normal human function are limited, the individual is predisposed to various musculoskeletal injuries (Thacker et al., 2003) which may lead to injuries (Bonvicine et al., 2005). A stretching technique can be applied to improve flexibility. This is a general term used to describe any therapeutic maneuver designed to increase the length of muscular tissue which is shortened in order to increase the amplitude of movement (Bonvicine et al., 2005). Among the wide variety of methods of stretching, one technique that is easily applied is static stretching, which involves the slow application of isometric tension to a muscle at its widest extension and maintaining that position for a period of time (Kisner and Colby, 2007).

Factors that affect flexibility can be divided into endogenous and exogenous. The following are endogenous factors: gender; age; somatotype; biological individuality; physical condition; breathing and concentration. In contrast, the following are exogenous factors: the temperature and time of day (Badaro et al., 2007); speed; intensity and duration of the force of stretching (Bonvicine et al., 2005). Previous studies have shown that stretching for 30 s is more effective than stretching for 15 s and as effective as stretching for 60 or 120 s (Rosário et al., 2004; Madding et al., 1987; Bandy and Irion, 1994). According to Kisner and Colby (2007), when performing short duration stretching, the flexibility gains obtained are transitory and are assigned to a temporary gap between actin and myosin in sarcomeres. However, stretching for 20 min or longer, for example, would lead to longer-lasting gains (Kisner and Colby, 2007).

A number of authors recommend the use of a heating mode to improve the range of motion (Nakano et al., 2012; Brukner and Khan, 2002). It is believed that this heating serves as preparation for the activity and leads to more efficient stretching, due to a decrease in viscoelasticity, as well as helping in the prevention of injuries (di Alencar and Matias, 2010). One method of producing a passive warming is by microwave diathermy. By generating an electromagnetic field, microwave diathermy produces molecular collisions, which are sources of heat (Fox and Sharp, 2007). Active heating, like walking or running, generally produces several benefits such as: increased temperature and muscle energy metabolism; increased production of synovial fluid; increased elasticity of the tissue; increased cardiac output and peripheral blood flow; improved neuromuscular motor unit recruitment and central nervous system function (di Alencar and Matias, 2010).

Therefore, the aim of the present study was to assess some of the exogenous factors which can be easily changed, namely: active heat using a treadmill, passive heat produced by a Microwave and the application time of passive static stretching on the hamstring muscles of a group of sedentary young adult women. Since stretching for a long time has never been studied, the present study specifically intended to confirm the efficacy of a stretch that was longer than the 2 min tested by Bandy and Irion (1994), bearing in mind that Kisner and Colby (2007) stated that a longer stretch could work better due to the physical properties of the muscular tissue, but has never been scientifically tested before.

Methods

The present study included volunteers who did not perform any physical activity and had hamstring muscle shortening, with a knee extension angle below 150° while the hip was maintained in 90° flexion. All of the volunteers signed a statement of informed consent. The exclusion criteria were as follows: any recent lower limb injuries; use of a cardiac pacemaker; cardiopulmonary problems; metallic implants; cancer; infection; inflammation; sensitivity disturbance (Silva et al., 2007; Greve, 1995) and those who missed a stretching session. The present study was conducted at the State University of the Center-West and received approval from the Human Research Ethics Committee of this University under protocol number 342/2011.

The study initially had 59 sedentary participants, female, aged between 18 and 28 years old. Nine participants were excluded from the research because they did not satisfy the inclusion criteria.

The following assessments were carried out:

- Goniometry of the right knee extension: The volunteer was placed in the supine position with the right hip flexed to 90° and the left leg extended. The right knee was extended, with the fixed arm of the goniometer pointing to the greater trochanter, the fulcrum in the center of the knee joint following the line of the lateral epicondyle of the femur, and the movable arm pointing to the lateral malleolus (Rosário et al., 2008).
- The 3rd finger-ground test: the volunteer stood erect with their feet parallel and then performed trunk flexion, keeping the arms and head relaxed. The examiner measured the perpendicular distance from the third finger of the right hand to the ground. The 3rd finger-ground test measures the overall flexibility of the posterior musculature, where the hamstrings play an important role.

After the evaluation the volunteers were randomly assigned to one of five groups: The Microwave group received passive heating before passive stretching; the Treadmill Group involved active warming before stretching; the 30-Second Group received only passive stretching without any kind of warming; the 10-Minute Group received passive stretching for 10 min; and a Control Group which simply assessed the volunteers. The randomization process consisted in the volunteer picking up one of the fifty folded pieces of paper. The name of one of the groups was written on the internal part (10 for each group). The drawn paper was thrown out after being selected by one of the volunteers. After the fiftieth volunteer, ten more piece of papers (2 for each group) were produced.