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Resistance training with slow speed of movement is better for hypertrophy and muscle strength gains than fast speed of movement.

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ABSTRACT:

Repetition speed is an important variable during resistance training. However, the effects of different speeds on the muscular strength and hypertrophy in isotonic resistance training are not clear. The study compared fast speed with slow speed of isotonic resistance training on muscular strength and hypertrophy in well-trained adults. Twelve healthy adults were randomly assigned into two groups: fast speed (FS) and low speed (SS). Muscle hypertrophy was measured by an ultrasound examination of the cross-sectional area of the brachial biceps muscle. Muscular strength was verified by 1 RM test. To check the possible differences in strength and hypertrophy between pre and post training and between groups there were compared by two-way ANOVA for repeated measurements and the effect size (ES) was calculated. Improvement in the cross-sectional area ($P=0.019$) and muscular strength ($P=0.021$) in the SS group between pre and post training was verified. The SS group had bigger effect sizes than FS group for hypertrophy and strength from pre to post training. SS training was more effective to improve hypertrophy and muscle strength in well-trained adults.

KEY WORDS: strength training, isotonic contraction, muscle strength

INTRODUCTION

Hypertrophy and muscular strength are two common goals in resistance training. Optimal hypertrophy and strength response depend on

variables manipulation, such as: load, volume, exercise order, exercise selection, rest between sets and amplitude of movement [1]. One training variable that is often neglected and is



essential to achieve the goals established is the repetition speed [2, 3].

Repetition speed alters important factors involved in hypertrophy and strength development, like time under tension, metabolic and hormonal response, and muscle activation [4]. Thus, the adequate manipulation of speed of each repetition may maximize hypertrophy and strength responses to resistance training.

Despite the importance of repetition speed, the effects of different repetition speed on muscular strength and hypertrophy in isotonic resistance training are not clear, since many studies have used the isokinetic exercise [3, 5-7].

Studies assessing the adaptations promoted by strength training performed at different speeds of repetitions in isokinetic exercise found that fast speed provides greater strength gains and muscle hypertrophy than the slow speed [5-7]. In opposite, with slow speed the muscles stay more time under tension, which is important for hypertrophy and strength gains [8]. Then, studies are needed using isotonic resistance training, since it is the most common type of resistance training. Furthermore, the cost is generally more feasible when compared with isokinetic equipment. In addition the response of different repetition speed in trained subjects is not clear. Knowing that this population is highly adapted to training stimulus and consequently have low trainability. It is necessary to know what the best strategies to reach their goals are.

Therefore, we aimed to compare distinct repetition speed of isotonic resistance training on hypertrophy and muscular strength in subjects with experience in resistance training.

METHODS

Experimental design

This is a randomized controlled clinical study. Twelve men were randomly assigned to groups: the Fast Speed (FS) or Slow Speed (SS). Before the beginning of the resistance training all subjects performed an ultrasound assessment of

the brachial biceps to check the cross-sectional area, underwent tests of 1 repetition maximum (1RM) and both groups had 2 weeks of familiarization with the speed execution of training, under the guidance of a physical educator. After 12 weeks of resistance training the volunteers were again subjected to an ultrasound of the biceps brachial and remade the 1 RM tests. The present study is in accordance with the standards of the Helsinki Declaration (2008) and approved by the ethics committee of Federal University of São Paulo.

Subjects

Twelve healthy adults were randomly assigned in the FS and SS groups (Table 1). The inclusion criteria established for participation of the subjects in the study were: resistance training time equal to or greater than twelve months; the absence of diseases that compromise the health of the subjects; use of any type of sports supplement or anabolic agents; absence of aerobic training.

Body Composition

The subjects were submitted to the assessment of total body mass (kg), fat mass (kg) and body fat percentage by means of skinfolds. The protocol was used according to the proposed by Jackson and Pollock [9].

Evaluation of maximum strength

Maximum strength was evaluated through the 1RM test. Before starting the 1RM test all subjects performed a specific muscular warm-up composed of 20 repetitions with load of 40% to 50% of the subjective perception of effort. After the warm up the 1RM test started. The initial load was estimate through the perceived exertion of the subject based on the training loads before the study. The 1RM test was execute for Scott curl with bar. A maximum of five attempts were executed out with increasing loads, and five-minute intervals between retries. The 1RM test was remade after 12 weeks of training with the same parameters used at the beginning of the program to determine the strength gains.

Transverse section area

Thickness of biceps brachial muscle was measured before and after 12 weeks of training by ultrasound. The thickness of biceps brachial was measured between the external muscle boundary and the definitive band of connective tissue that runs longitudinally down the middle of the muscle. This measure was made 5 cm from the right-hand edge of the image (i.e., 6–7 cm proximal to the crease of the elbow). The ultrasound system used was the Toshiba Xario (Toshiba, Tokyo, Japan), with an electronic linear array probe of 12 MHz frequency, to determine the cross-sectional area. With the transducer coated with water-soluble gel, ultrasound probe was oriented transverse mode with regard to location, and the images were recorded with the subjects sitting with the right arm slightly flexed and totally relaxed, with the forearm fully supported on the right thigh.

All evaluations were conducted in the same time of day and the participants were instructed to hydrate themselves normally 24hrs before the tests. At all times, the same researcher, a physician with experience in ultrasound, performed the measurements.

Training Protocol

The training had 12 weeks, 2 times a week, always respecting minimum 48-hour interval between stimuli. The subjects were instructed to perform 3 sets of 8 repetitions maximum, if the subject made less than 8 reps or more than 8 reps, the weight load was adjusted the next training session. The training consisted of Scott curl exercise. Rest interval between sets was of two minutes.

The speed of the repetition of movement was different between the groups. The FS group performed repeating the following cadence: 1s in the concentric phase, 0s in the transitional phase from the concentric for the eccentric

phase, 1s in the eccentric phase and 0s in the transitional phase from the eccentric to the concentric phase (1010). The SS group performed the repetitions with 1s in the concentric phase, 0s in the transitional phase from the concentric for the eccentric phase, 4s in the eccentric phase and 0s in the transitional phase from the eccentric to the concentric phase (1040).

Statistical analysis

For the data presentation, a descriptive statistics (mean \pm standard deviation) was used. ANOVA for repeated measured was used to verify possible differences in strength and hypertrophy gains between time and groups. The Mauchly's sphericity test was applied and correction, when necessary, was made by Greenhouse-Geisser. Significance P-level 0.05 was accepted. When the F test was significant, complement analysis by Bonferroni's multiple comparison tests was made.

The Hedge's g approach was used to calculate effect size (ES) and data was shown with their respective 95% Confidence Interval (CI) [10]. Effect size was classified according to the scale proposed by Rhea [11].

STATISTICAL RESULTS

No significant differences (P 0.05) were observed in the sample characteristics before training between FS and SS groups (Table 1).

Comparisons pre and post training and between groups for the cross-sectional area and maximum repetition on the Scott curl are shown in Table 2. There was a difference between the SS group moments of pre and post training in cross-sectional area (P = 0.019) and strength (P = 0.021).

The ES was greater for the SS group than FS group for CSA and 1RM test (Table 3).

Figure 1. Demo Should be in image format.

Table 1. Sample characteristics.

	FS (n=6)	SS (n=6)
Age (years)	28.3 ± 8.2	30.3 ± 5.6
Height (cm)	172.3 ± 5.3	172.6 ± 4.8
Weight (kg)	72.3 ± 9.3	73.8 ± 5.1
Body fat (%)	17.3 ± 2.2	19.3 ± 0.9

Values presented as mean ± standard deviation. FS = fast speed; SS = slow speed.

Table 2. Cross-sectional area of the biceps brachial muscle and 1 repetition maximum on the Scott curl exercise before and after 12 weeks of training.

	FS (n=6)		SS (n=6)	
	Pre	Post	Pre	Post
CSA (cm ²)	30.4 ± 3.3	32.3 ± 3.5	29.0 ± 3.4	33.8 ± 3.4*
1 RM Scott curl (kg)	49.0 ± 6.4	58.3 ± 14.9	46.3 ± 6.8	61.3 ± 8.0*

Values presented as mean ± standard deviation. CSA = cross-sectional area; RM = repetition maximum. FS = fast speed; SS = slow speed. * P<0.05 - Pre vs. Pos.

Table 3. Effect size for the cross-sectional area and 1 repetition maximum on the Scott curl exercise before and after 12 weeks of training.

	FS (n=6)	SS (n=6)
Cross-sectional area	-0.5 (CI: -2.4 to 1.4)	-1.3 (CI: -3.2 to 0.6)
1 RM Scott curl	-1.46 (CI: -7.8 to 5.0)	-2.0 (CI: -4.3 to 0.2)

CSA = cross-sectional area; RM = repetition maximum. FS = fast speed; SS = slow speed; CI = confidence interval.

DISCUSSION

We verified the influence of repetition speed during isotonic resistance training to induce hypertrophy and muscular strength in well-trained men. No differences were verified in hypertrophy and muscle strength between FS and SS groups. The ES was bigger to SS than to

FS for hypertrophy and muscular strength gains. By ES it is possible to check the changes caused by the same treatment in independent groups or different treatments within the same group, allowing the verification of the effectiveness of each method to be determined [12]. These results show us the superiority of

SS to improve hypertrophy and muscle strength.

The improved hypertrophy in SS group could be explained by a longer time under tension, especially with a slower eccentric phase [13]. It causes higher muscular tension, with a higher stress on a small number of active fibers, leading to greater muscle damage (especially fast twitch fibers, that are more hypertrophy prone) [13]. This promotes greater activation of satellite cells, which are related to muscle hypertrophy [14, 15]. A longer time under tension also increases acute mitochondrial, sarcoplasmic and myofibrillar protein synthesis after resistance exercise, stimulating hypertrophy response [8]. Furthermore, a longer time under tension promotes compressed blood vessels for a longer period of time that leads to vascular occlusion and metabolic stress, contributing to the increased hypertrophy response [14, 15]. Therefore, controlled repetitions with slow eccentric phase promotes greater muscular hypertrophy, in a balance between significant metabolic stress and muscle tension [13].

This increase in hypertrophy in SS group can explain the greater strength response post training from this group, since muscle hypertrophy plays an important role in strength development, in conjunction with neural adaptations [16]. These neural adaptations, like higher firing frequency and motor unit synchronization, increases strength and can be best developed in well trained individuals through training with both faster (lifting as fast as possible) [17-19] and slower accelerations (unintentional slow) [20]. Unintentional slow velocity is present in repetitions in which either a heavy load or fatigue is responsible for the repetition length [20].

The concept of “move as fast as possible independent of the resistance” can benefit strength development [21]. Knowing that strength can be defined as the product of mass times acceleration [22], an individual can develop strength through increases in both variables of the equation. Thus, training with high loads and unintentional slow speed

(traditional powerlifting training) [2, 13, 20] or training with lower loads lifting as fast as possible can both develop strength [17-19].

Then strength can be increased through different mechanisms. The SS group had a slower repetition length that favored muscular hypertrophy and as a consequence, strength development. On the other hand, the velocity used by FS group did not provide either the most adequate stimulus for increased hypertrophy or strength through neural enhancement, as evidenced by the results. A repetition length “as fast as possible” could have provided better stimulus for neural adaptations that would lead to greater strength levels post training, even in the short term [21].

An optimal approach for enhanced resistance training responses is periodization, with variations in training variables, allowing continuous training adaptations [20, 22]. Thus, despite a greater response in muscle hypertrophy in SS group, training could involve faster repetition length too, with less priority. This type of training have important hypertrophy mechanisms too, leading to higher muscle activation and lactate increases [4]. Higher concentration of lactate can make regulate protein synthesis go up through increased cell swelling and mediate anabolic hormones and cytokines elevations [13]. Moreover, hormonal and metabolic responses are similar within moderate velocity range [22]. Then, a variety of repetition length could be used to develop hypertrophy and strength [20].

This range of different velocities can be assigned to untrained individuals too [20]. A wide range of repetition length works well for untrained individuals [20, 23] with similar results between fast and slow repetition length [24]. This variety of positive responses by different repetition length can be explained by the high trainability of untrained subjects. Thus, both fast and slow velocity results in strength and hypertrophy. Strength is developed more quickly through a rapid starting period of neural adaptation (first weeks) and hypertrophy increases more after this initial period [25].

In summary, no differences were found between groups for hypertrophy and muscular strength. However, the effect size for SS is greater than FS, pointing to a greater effectiveness of slow muscular actions for induction of muscular strength and hypertrophy. Thus, we conclude that SS training is more effective to improve hypertrophy in well-trained adults. Consequently, this causes an increase in strength levels, which can be developed through different mechanisms and repetition lengths. Finally, variety of stimulus in periodization is needed to optimize resistance-training programs.

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