Interset Stretching Does Not Influence the Kinematic Profile of Consecutive Bench-Press Sets

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Abstract

García-López, D, Izquierdo, M, Rodríguez, S, González-Calvo, G, Sainz, N, Abadía, O, and Herrero, AJ. Interset stretching does not influence the kinematic profile of consecutive bench-press sets. *J Strength Cond Res* 24(x): 000–000, 2010—This study was undertaken to examine the role of interset stretching on the time course of acceleration portion AP and mean velocity profile during the concentric phase of 2 bench-press sets with a submaximal load (60% of the 1 repetition maximum). Twenty-five college students carried out, in 3 different days, 2 consecutive bench-press sets leading to failure, performing between sets static stretching, ballistic stretching, or no stretching. Acceleration portion and lifting velocity patterns of the concentric phase were not altered during the second set, regardless of the stretching treatment performed. However, when velocity was expressed in absolute terms, static stretching reduced significantly ($p < 0.05$) the average lifting velocity during the second set compared to the first one. Therefore, if maintenance of a high absolute velocity over consecutive sets is important for training-related adaptations, static stretching should be avoided or replaced by ballistic stretching.

Key Words acceleration, mean velocity, static stretching, ballistic stretching, bench press

Introduction

Kinematics associated with resistance exercises (e.g., velocity and acceleration) have been proposed as some of the most important stimuli for strength and muscle power resistance training–induced adaptations (28). In this line, coaches and athletes are in constant search for strategies to enhance their workouts. The velocity of movement will affect the training stimulus and subsequently the adaptations to training. It has been suggested, therefore, that athletes should try to perform exercises "explosively" at a velocity allowed by the resistance used in a volitional manner (3). Velocity and acceleration profiles will differ according to different loading regimens for overall set performance and velocity (19). In this line, we have recently demonstrated that the acceleration portion (AP) of the concentric phase and the lifting velocity decline patterns of the concentric phase are not altered during a second set to failure, regardless of resting period duration (16). However, much less attention has been paid to the activity performed during these recovery times. Thus, although the effects of interset massage (6) or low-intensity pedaling (8) over resistance exercise performance have been studied, to the best of our knowledge there are no studies analyzing the influence of interset stretching on exercise kinematics, even though it is usual to see lifters performing stretching between consecutive resistance training sets, both in sport- or recreational-related facilities. Hypothetically, these strategies aim to improve the recovery by reducing lactate and hydrogen ions and to help the muscle return to its basal length.

Recent studies have shown that strength and power production are reduced when stretching is performed during the warm-up (35). In this line, various authors have demonstrated that static stretching (SS) has a negative effect on subsequent maximal voluntary isometric contraction (MVIC) (35), isokinetic peak torque (10,12,27,30), muscle power output (47), vertical jump height (5,9,42), and surface integrated electromyographic (iEMG) activity (27,34). Decreases in muscle performance have also been observed after ballistic stretching (BS) (31); however, this technique has been much less studied. Ballistic stretching is a bouncing rhythmic motion that uses the momentum of a swinging body segment to lengthen the muscle (26). In contrast, several studies have not reported any decrease in force, power production, or vertical jump height after SS (11,45,46,48) or BS (5,40,45). Part of this ambiguity related to the acute effects of SS and BS on force-related performance can be attributed

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Figure 1. Stretching exercises. (A) Flexed-elbow chest stretch for left pectoralis; (B) behind-neck stretch (similar for static and ballistic treatments); and (C) arm swing back ballistic stretching.

to the many different intensities, frequencies, and durations of stretches and to the different training status of the subjects analyzed in the different studies. In addition, the majority of these studies analyze the muscular performance during a single-action isometric or isokinetic protocol, even though resistance training is usually carried out through dynamic constant external load actions in multiple repetitions and sets approaches. In this context, the impact of interset stretching on kinematics over consecutive resistance training sets remains to be elucidated. Therefore, the purpose of the present study was to analyze the effect of interset static and ballistic stretching over acceleration–deceleration and lifting velocity profiles during 2 consecutive bench-press sets leading to failure. Based on the existing literature, it was hypothesized that stretching would induce differences on the kinematic profile of a second set to failure compared to the first one.

Methods

Experimental Approach to the Problem

Stretching between sets and exercises is a common practice among lifters, but its effects over different kinematic profiles of the subsequent sets are unknown. This study was designed to assess the effect of interset static and ballistic stretching over the accelerative portion and mean velocity of the concentric phase on 2 consecutive bench-press sets to failure. Data collection took place over a period of 5 weeks with 1 testing session each week. College students participate in the study. The first 2 sessions were used to familiarize subjects with testing procedures and to assess the subjects' 1 repetition maximum (1RM). During each of the next 3 testing sessions, 2 sets of the bench press were performed at 60% of 1RM, leading to failure and allowing a 4-minute resting period between sets. During such a resting period, 1 of the 3 treatments designed was performed: SS, BS, and no stretching (NS). A counterbalance procedure was used to determine the treatment for each testing session.

Subjects

Twenty-five healthy college students (18 men and 7 women) volunteered for the study. The subjects' mean ($\pm SD$) age, height, body mass, and bench-press 1RM were 23.8 ($\pm$3.0) years, 176.2 ($\pm$10.3) cm, 76.0 ($\pm$17.7) kg, and 63.4 ($\pm$20.7) kg, respectively. Subjects were physically active, and all of them averaged at least 3 months of experience with free-weight resistance exercises and training leading to failure. Their normal workouts typically lasted just less than 90 minutes and entailed training of multiple body parts and exercises. However, at the time of the study and from 2 months before, none were engaged in any regular or organized stretching and/or resistance training program. Prior to data collection subjects were informed of the requirements associated with participation and provided written informed consent. Moreover, subjects did not allow their sleeping, eating, and drinking habits to change throughout study participation. The research project was conducted according to the Declaration of Helsinki and it was approved by the University Review Board for Use of Human Subjects.

Procedures

Data collection took place over a period of 5 weeks with 1 testing session each week. In the first session, instructions regarding preparation for the 1RM testing and proper form and lifting technique for the Smith machine bench press were given to each participant. During the second experimental session, 1RM for the bench press was determined. During each of the next 3 testing sessions, 2 sets of the bench press were performed to failure, allowing a 4-minute resting period between sets. During such a resting period, 1 of the 3 treatments designed was performed: SS, BS, or NS. A counterbalance procedure was used to determine the treatment for each testing session. Thus, at the end of the experimental phase, all the subjects had been tested for the 3 treatments. Testing sessions were carried out the same day of the week at the same time of the day in all cases.

Maximal Strength Measurement. The 1RM bench press was assessed using a previously established protocol (37). Briefly, after a light warm-up on the bench press using a Smith machine (Telju, Toledo, Spain), subjects attempted to lift a progressively increasing load, allowing 3 minutes of resting periods between attempts. The 1RM value was obtained using as few attempts as possible (5 attempts as maximum). For bench-press repetitions, subjects lowered the bar until the chest was touched lightly, approximately 3 cm superior to the xiphoid process. Hand spacing was set at 165–200% of biacromial width, which has been shown to provide the highest force values for the supine bench press (41). The elbows were extended equally with the head, hips, and feet remaining in contact with the floor throughout the lift. No bouncing or arching of the back was allowed. Bench-press technique and settings were maintained throughout the whole experimental phase.

Bench-Press Protocols. Each bench-press protocol consisted of performing 2 sets to failure, with a load equivalent to subject's 60% of 1RM and an interset resting period of 4 minutes. The 4-minute resting period was selected to ensure time enough to perform the stretching treatments selected. Moreover, previous results have demonstrated that 4 minutes of resting between consecutive sets to failure do not affect the kinematic pattern of the second set (16). Subjects began with a warm-up consisting of 5 minutes of low-resistance cycling on an ergometer followed by 2 bench-press sets. The first warm-up set consisted of 10 repetitions at 30% 1RM, and the second warm-up set consisted of 10 repetitions at 50% 1RM, allowing 1 minute of resting between sets. Two minutes after the warm-up, individuals began the bench-press sets to failure at 60% of 1RM. Thus, they were asked to move the barbell as fast as possible during the concentric phase of each repetition, until volitional exhaustion. Failure was defined, according to a previously established criterion (19), as the time point when the barbell ceased to move, if the subject paused more than 1 second when the arms were in the extended position, or if the subject was unable to reach the full extension position of the arms. Kinematic parameters of each repetition were monitored by linking a rotary encoder (Globus Real Power, Globus, Codogne, Italy) to the end of the barbell. The rotary encoder recorded the position of the barbell within an accuracy of 0.1 mm and time events with an accuracy of 0.001 s. Total repetitions for each set, and average velocity for each repetition and percentage of time in which the barbell was accelerated (during the concentric phase of each repetition), were analyzed. For comparison purposes, number of repetitions was expressed as percentage of total number of repetitions (10%, 20%, 30%,…100%). The test-retest intraclass correlation coefficients for all dependent

Table 1. Average repetition velocity (AV) and percentage of the concentric phase in which barbell is accelerated (AP) during set 1 (average of the 3 testing days). Number of repetitions is expressed as a percentage of total number of repetitions completed. Values are means ± *SD*.

	Number of repetitions (% of total number of repetitions)									
	10	20	30	40	50	60	70	80	90	100
AV (m/s^{-1})	0.62 ± 0.06	0.60 ± 0.07	0.57 ± 0.06	0.53 ± 0.06	0.49 ± 0.07*	0.46 ± 0.07*	0.41 ± 0.07*	0.35 ± 0.06*	0.27 ± 0.06*	0.19 ± 0.04*
AP (%)	65.5 ± 3.8	64.8 ± 3.0	63.9 ± 3.7	59.9 ± 7.0	56.1 ± 7.9	52.9 ± 7.6*	49.2 ± 8.3*	43.6 ± 7.9*	37.9 ± 7.6*	34.0 ± 6.5*

*Significantly different from highest value ($p < 0.05$).

variables were greater than 0.81, and the coefficients of variation (CV) ranged from 0.9% to 2.3%.

During the interset resting period (4 minutes), 1 of the 3 treatments designed was performed, as explained later. Then, a second bench-press set to failure was performed.

Stretching Treatments. SS and BS were selected for this study because, on the sport field, the 2 most commonly used stretching techniques are static and ballistic stretching (26). Moreover, these techniques do not require any assistance, unlike proprioceptive neuromuscular facilitation (PNF) stretching, which requires a partner.

Static Stretching. A sequence of 4 stretches (right pectoralis stretching, left pectoralis stretching, right triceps brachii stretching, and left triceps brachii stretching) was repeated for 2 sets. The researcher demonstrated the proper technique prior to each stretching routine and monitored the subjects' movements throughout stretching to ensure that each stretch was performed correctly. Subjects were informed that the holding point of the stretch was stablished at the point "just before discomfort" (40). Each stretch was held for 25 seconds followed by a 5-second relaxation period for a total stretching period of 200 seconds (50 seconds per muscle). This duration is similar to that typically used by athletes (33). A counterbalance procedure was used to determine the order of stretches. The stretching exercises selected were the flexed-elbow chest stretch (Figure 1A) and the behind-neck stretch (Figure 1B).

Ballistic Stretching. A sequence of 3 stretches (bilateral chest stretching, right triceps brachii stretching, and left triceps brachii stretching) was repeated for 2 sets. Each BS exercise consisted of continuous contractions of the target-muscle antagonist once the subject had reached the initial stretched position. Thus, they were asked to bounce up and down or forward and backward at a pace of 1 bob per second for 25 seconds, followed by a 5-second relaxation period. The subjects were asked to keep the joint-angle displacement for each bob at approximately 2–5 degrees (31). Thus, a total stretching period of 180 seconds was followed by a 60-second final relaxation period so as to reduce the fatigue induced by BS. The exercises selected for bilateral chest stretching was the arm swing back (the subject contracted the shoulder horizontal abductors in a standing position, swinging the arms back, as far as possible (Figure 1C). The exercise selected for triceps brachii stretching was the behind-neck stretch (Figure 1B) performed in a bouncing form.

No Stretching. This control condition did not involve any type of stretching or exercise and consisted of 4 minutes of quiet sitting.

Statistical Analyses

Normality of the dependent variables (accelerative portion, average velocity, and number of repetitions) was checked and subsequently confirmed using the Kolmogorov–Smirnov test. Sample independence and homogeneity of variance were met before the analysis (20). Then, a 3-way analysis of variance was performed. The 3 factors considered were stretching treatment (ST: SS, BS, or NS), set (set 1 vs. set 2), and percentage of the total number of repetitions (10, 20, 30,… or 100%). When a significant *F*-value was achieved, pairwise comparisons were performed using a Bonferroni post hoc procedure. Statistical significance was set at $p \leq 0.05$.

Results

Accelerative Portion

The AP profile was similar in the first set compared to the second set, regardless of the stretching treatment. No set × ST interaction was detected in the AP profile. During the first set, the repetition with the highest AP (65.8%) corresponded to the second or the third repetition. The AP decreased significantly ($p < 0.01$) throughout the first set (Table 1), with no statistical differences when comparing throughout the 3 experimental days. The repetition at which a significant decrease in the AP took place corresponded to 55% of the total number of repetitions achieved. During the last

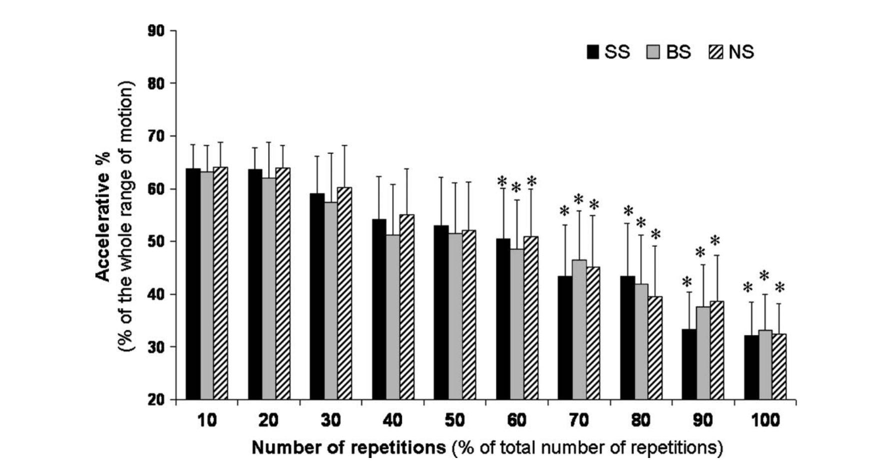

Figure 2. Percentage of the concentric phase in which barbell is accelerated, during set 2, for all stretching treatment (ST) conditions. Number of repetitions is expressed as a percentage of total number of repetitions completed. Values are means ± *SD*. *Significantly different from repetition with the highest acceleration portion (AP) ($p < 0.05$).

repetition, the barbell was accelerated for 34% of the concentric movement. The AP decreased significantly ($p < 0.01$) also during the second set (Figure 2). Thus, the repetition at which a significant decrease in AP occurred corresponded to 57%, 55%, and 58% of the total number of repetitions achieved in SS, BS, and NS conditions, respectively. Again, the repetition with the highest AP corresponded to the second or the third repetition. The AP of the last repetition performed during the second set was 32 ± 6%, 32 ± 6%, and 33 ± 7% in SS, BS, and NS conditions, respectively.

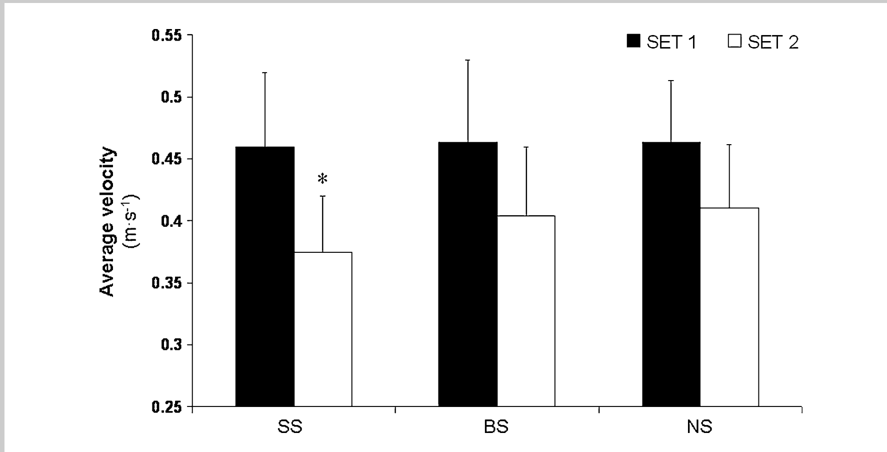

Figure 3. Average repetition velocity during set 1 and set 2 for all stretching treatment (ST) conditions. Values are means ± *SD*. *Significantly different from set 1 ($p < 0.05$).

Lifting Velocity

Figure 3 displays average lifting velocity for all stretching treatments. A significant set effect ($p < 0.001$) concerning average lifting velocity in absolute values was observed. There was a significant set × ST interaction ($F_{1,25} = 57.4$; $p < 0.05$), with a significant decrease of the velocity during the second set compared to the first one in SS condition (18%; $p < 0.01$). In fact, in SS condition, post hoc test results showed a significant lower velocity during the second set for repetitions corresponding to 10, 30, 40, 50, and 60% of the total number of repetitions performed in comparison to the corresponding first-set repetition (Figure 4). Although slight decreases were also detected in BS (13%) and NS (11%) conditions, the difference did not reach statistical significance. However, when velocity was expressed as a percentage of maximal value, no significant set effect ($F(1,25) = 4.21$; $p = 0.145$) nor set × ST interaction ($F(1,25) = 1.053$; $p = 0.445$) were observed.

As showed in Table 1, average velocity decreased ($p < 0.01$) throughout the first set. Maximal mean velocity (0.61 ± 0.07 m/s^{-1}) was achieved within the first 3 repetitions. The repetition at which a significant decrease in the initial relative velocity occurred (repetition number 10) corresponded to 47% of the total number of repetitions achieved. The average velocity attained during the last repetition performed (0.19 ± 0.04 m/s^{-1}) corresponded to 31% of the average velocity attained during the initial 3 repetitions.

During the second set, the repetition at which a significant decrease in the initial relative velocity occurred corresponded to 49%, 51%, and 50% of the total number of repetitions achieved during the second in SS, BS, and NS conditions, respectively (Figure 4). The average velocity attained in the last repetition performed during the second set was 0.19 ± 0.04 m/s^{-1}, 0.18 ± 0.04 m/s^{-1}, and 0.19 ± 0.04 m/s^{-1} in SS, BS, and NS conditions, respectively. Thus, the velocity

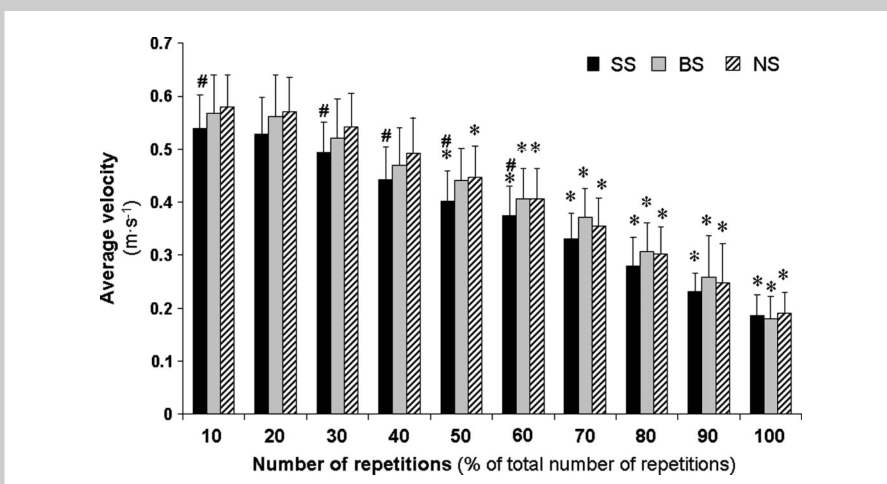

Figure 4. Average repetition velocity, during set 2, for all stretching treatment (ST) conditions. Number of repetitions is expressed as a percentage of total number of repetitions completed. Values are means ± *SD*. *Significantly different from the repetition with the highest acceleration portion (AP) ($p < 0.05$). #Significantly different from corresponding first-set repetition.

attained during the last repetition of the second set ranged from 31% to 34% of the average velocity attained during the initial 3 repetitions, with no set × ST interaction.

Number of Repetitions

During the first set (averaging the results of the 3 testing days), the number of repetitions achieved was 21.3 ± 3.2. A significant set effect ($F(1,25) = 69.5$; $p < 0.01$) was observed regarding number of repetitions achieved; that is, the number of repetitions decreased significantly during set 2 when compared to set 1 in SS (30%; $p < 0.01$), BS (29%; $p < 0.01$), and NS (28%; $p < 0.01$) conditions. No set × ST interaction was observed; that is, the relative decay in the number of repetitions was similar when comparing the 3 experimental conditions.

Discussion

Kinematics of an entire resistance training session, and therefore its acute responses, can be influenced by some aspects related to the time gap existing between consecutive sets (i.e., duration and type of activity performed during such periods). To the best of our knowledge, this is the first study analyzing the effect of interset stretching on acceleration–deceleration and lifting velocity profiles on 2 consecutive bench-press sets to failure. The main finding of the present study was that both AP and lifting velocity decline patterns are not altered over consecutive bench-press sets to failure when static or ballistic stretches are performed during the interset resting period. However, when lifting velocity is expressed in absolute values, SS reduces the average lifting velocity during a second set, leading to failure.

Similar to the present study, it has been recently suggested that performing SS during recovery periods between consecutive 20-m sprints may negatively influence running performance (1), mainly during the first 5 m of the sprints. This result could be explained by a stretching-related impairment of the force-producing capacity of lower-limb muscles during the initial takeoff. A limited number of studies have examined the effects of stretching over muscular performance during dynamic constant external resistance exercises. The present results are in line with data showed by Fry and coworkers (14), who also found a significant decrease (26%) in mean velocity during the bench press at 85% of 1RM performed by high school athletes immediately after an SS routine. Reductions in vertical jump height (5,9,42) and reductions in power output during leg extension under various loads (47) have also been reported after SS routines. However, specific literature also includes studies that have not demonstrated a negative effect of SS on vertical jump performance (7,22,34) or leg-press power output (48). Aspects related to stretching period duration could explain this lack of agreement among authors. In this line, in the present study each target muscle was stretched for 50 seconds, whereas Yamaguchi and Ishii (46) used 30 seconds of SS. As the authors indicate, 30 seconds of SS are probably not enough to induce significant alterations on neuromuscular properties. However, methodological differences existing between Yamaguchi and Ishii's study and the present research make it difficult to establish direct comparisons. These differences are related to the exercise tested (leg press vs. bench press) and number of repetitions (isolate-repetition model vs. repetitions-to-failure model). Moreover, it should be noted that the experimental approach of these studies included the stretching routine during the warm-up, whereas the present research was focused on the effects of interset stretching.

Regarding results related with BS, it is necessary to point out that BS does not seem to be used as frequently as SS. It has been stated that ballistic stretching is disadvantageous for improving range of motion and that it may even be harmful (36). To our knowledge, there has been a limited number of studies that have looked at the effects of BS on strength-related performance, and none have included the stretching protocol in the interset period. The present results indicate that BS performed between 2 consecutive bench-press sets to failure neither improves nor reduces mean velocity. In the same line, previous studies have pointed out that BS routines ranging from 3 to 10 minutes do not induce any acute effect on vertical jump performance (5,40,45). However, Nelson and Kokkonen (31) observed a significant decrease in 1RM performance for both knee flexion and knee extension after 20 minutes of active and passive BS of the hip, thigh, and calf muscle groups. As suggested by Nelson and Kokkonen (31), the great volume of stretching performed could be the possible reason for the decrease in maximal strength. It is also likely that this type of stretching for this length of time is very unrealistic to be carried out between consecutive resistance training sets.

Although the literature is inconclusive, it has been suggested that mechanisms causing decrement of muscular performance after stretching involve both neural and mechanical changes (35). Neural changes following SS are related to decreases in neuromuscular activity levels (2,13,34). Some studies analyzing MVC, iEMG activity, and muscle inactivation as measured by the interpolated twitch technique (ITT) after SS have observed decreases in MVC associated with a significant decrease in ITT, which indicates the possibility of a neurological deficit (2,34). Mechanical changes induced by acute stretching may be related to reductions in viscoelastic properties of muscle–tendon structures (12,13,18,30). In this sense, the stiffness of the tendinous structures, which is reduced by acute stretching, is strongly linked to muscle performance during maximal isometric and dynamic contractions (4). Therefore, the stretching may alter the length-tension relationship or the plastic deformation of connective tissues such that the maximal force–producing capabilities of the muscle could be limited (13). Wilson and coworkers (44) concluded that a more compliant series elastic component increased the ability to store and release elastic energy during the rebound bench press lift. However, bouncing during the bench-press series was not allowed in the present study. Although it has been hypothesized that the time course of such alterations seems to be related to duration and intensity of stretching, it is not clear how long the depression in motor neuron excitability or the mechanical alterations may persist after stretching. In this line, Fowles and coworkers (13) measured the EMG during maximal isometric muscle actions of the plantar flexors 5, 15, 30, 45, and 60 minutes after prolonged stretching (30 minutes total). They found that muscle activation was depressed immediately poststretching but recovered within 15 minutes. Therefore, most of the decreases in muscle strength could be attributable to intrinsic mechanical properties of the musculotendinous unit, rather than neural factors. However, in a different study and using a more common stretching period (3 stretches of 45 seconds), it was observed that SS of hamstring muscles resulted in an instantaneous viscoelastic stress relaxation that was immediately recovered (25). Finally, we should not forget the potential role of BS on removing lactate. Results obtained from past investigations indicate that performance may be adversely affected by high blood lactate concentration (38). In this sense, active recovery (low-intensity pedaling) between consecutive parallel squat sets has been proved to reduce the lactate accumulation (8). Although different in nature, BS could have induced a similar effect. However, given that we did not carry out any lactate concentration measurement, we cannot conclude that BS performed between bench-press sets reduces the lactate concentration.

As fatigue increases, performance of repetitions becomes progressively more difficult, which explains the natural decay in lifting velocity observed during a set to failure in the present study and others (15,16,19,29). The evolution of lifting velocity throughout a set to failure is similar to that showed by elite junior kayakers and basketball players in previous studies (16,19). On the contrary, in the present research the AP showed a significant reduction at 55% of total repetitions completed, whereas elite junior kayakers showed a significant decrease in AP at 80% of total repetitions performed. It makes sense to suppose that subjects with a large muscular-endurance training background (i.e., elite kayakers) would maintain the kinematic patterns at high levels for a longer time throughout a set to failure in comparison to college students. The current data support partially this hypothesis, given that the bench-press lifting velocity pattern is apparently similar in elite junior kayakers and active college students, whereas AP is maintained for a longer time in elite kayakers.

Regarding number of repetitions completed, our data pointed out that interset SS or BS does not modify the natural decay observed in number of repetitions performed during a second set to failure in comparison to the first one. Other authors found similar results using a different exercise (leg curl) but the same relative load (60% 1RM) and a similar stretching time (60 seconds for each target muscle) (24). On the contrary, Nelson and coworkers found a significant decrease (28%) in number of leg curls completed after an intense SS protocol ($\sim$15 minutes) (32). Differences regarding stretching time could explain the lack of unanimity existing between Nelson and coworkers' study and the present data. Finally, it could have been expected that the more active nature of BS would have induced a lower decay in number of repetitions, based on a hypothetic reduction of lactate concentration. Corder and coworkers (8) observed how low-intensity pedaling performed during the interset recovery period reduced significantly the natural decay in the number of repetitions in subsequent parallel-squat sets. Our results do not support this hypothesis. It is possible that BS does not involve an activity as dynamic as pedaling.

In summary, the present study shows that both AP and lifting velocity decline patterns are not altered over consecutive bench-press sets to failure when static or ballistic stretches are performed during an interset resting period of 4 minutes. However, when velocity is expressed in absolute terms, static stretching appears to maintain the average lifting velocity during a second set to failure when compared to the first one. Finally, the present data indicate that stretching between consecutive sets to failure does not affect the number of repetitions completed during the second bout.

Practical Applications

Stretching routines are included not only in flexibility training programs, but also during strength or cardiovascular training sessions. In fact, stretching before or during participation in sport activities is a common practice among athletes, coaches, and recreational exercisers. Classically, lifters perform stretching between consecutive resistance training sets, both in sport- or recreational-related facilities. Hypothetically, stretching between consecutive sets is performed to improve the recovery and to help the muscle returns to its basal length. The results of the present study may be useful for recreational lifters who are used to stretching between consecutive resistance training sets. In this line, if maintaining a high absolute velocity over such sets is important, then SS should be avoided or replaced by BS. Future research may analyze different stretching parameters (e.g., stretching time), and different resistance training exercises (e.g., squat) to reinforce the current data.

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