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Changes in Lower-Body Force Characteristics Following Short-term Autoregulatory Progressive Resistance Exercise

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ABSTRACT

Autoregulatory progressive resistance exercise (APRE) programs dynamically adjust training intensity based on individual performance. The use of an APRE training program may provide further insight into the mechanisms that contribute to acceleration in strength gains and muscular hypertrophy. These mechanisms can be examined through the change in rate of force development (RFD) and cross-sectional area (CSA) following a mid-thigh pull (MTP). Previous APRE studies have shown better results than traditional linear periodization. Although, relative percentage-based protocols could produce similar or better results. **Purpose:** The purpose of this study was to examine changes in muscle morphology, peak force (PF), and RFD in the VL following a traditional and relative 4-week APRE training program. **Methods:** Fifteen resistance trained males (age: 21.3 ± 2.2yrs; height: 176.1 ± 7.0cm; weight: 86.4 ± 21.4kg) were randomly assigned to a relative (r-APRE; n = 9) and absolute (a-APRE; n = 6) 4-week APRE training regimen program using traditional (CON) adjustments based on absolute weight changes (0 lbs, ±5 lbs, ±10 lbs) and relative (EXP) adjustments based on changes made according to Brzycki equation. Participants were taken to absolute fatigue for 2 sets using approximately 85% of 1RM for compound lifts such as the squat, bench, deadlift, and overhead press. Pre and post measures were recorded during an isometric mid-thigh pull to compare peak force and RFD during the early phase of force production (0-50ms, 50-100ms, and 100-150ms). Ultrasound images were also taken to compare the changes in CSA in the VL following the training study. Separate repeated measured analyses of variance (ANOVA) were used to compare the pre and post measurements for CSA and PF. Furthermore, a 3-way mixed factorial ANOVA (group [EXP v CON] x time [pre v post] x RFD [0-50ms v 50-100ms v 100-150ms]) was used to compare RFD in 50ms epochs during the early phase of the MTP. **Results:** There were no significant group x time interactions or main effects for group or time for CSA (p = 0.595; 0.526; 0.447; respectively). There were no significant group x time interactions or main effects for group or time for PF (p = 0.288; p = 0.241; p = 0.547; respectively). There were no significant group x time x phase interactions (p = 0.930) or main effects for group (p = 0.614) or time (p = 0.141) for RFD during the isometric MTP. However, as shown in Table 1, there was a significant main effect for the 50ms epoch phases during the isometric MTP (p = 0.012) (0-50ms [4179.669 ± 646.752], 50-100ms [6458.401 ± 721.367], 100-150ms [4068.635 ± 575.591]) when collapsed by group and time. In particular, the 50-100ms phase was significantly greater than the 0-50ms and 100-150ms phases. **Conclusion:** The results suggest the program did not yield significant changes in muscle morphology, likely due to the participants' training style and brevity of training duration. There were no significant differences in lower-body force characteristics for group or time. Suggesting both traditional APRE and relative APRE may be ineffective for increasing muscle CSA, RFD, and PF. Further research should explore training protocols lasting longer than four weeks.

INTRODUCTION

Autoregulatory progressive resistance exercise (APRE) programs dynamically adjust training intensity based on individual performance. The mechanisms that contribute to strength and hypertrophy can be examined through the change in peak force, rate of force development, and cross-sectional area following a mid-thigh pull.

PURPOSE

The purpose of this study was to examine changes in muscle morphology, peak force, and rate of force development in the vastus lateralis following a traditional and relative 4-week APRE training program

METHODS

Participants:

- Fifteen resistance trained males (age: 21.3 ± 2.2yrs; height: 176.1 ± 7.0cm; weight: 86.4 ± 21.4kg) were randomly assigned to a relative (r-APRE; n = 9) and absolute (a-APRE; n = 6) 4-week APRE training regimen program.

Training Regimen Program:

- Traditional (CON) adjustments based on absolute weight changes (0 lbs, ±5 lbs, ±10 lbs) and relative (EXP) adjustments based on changes made according to Brzycki equation.
 - Taken to absolute fatigue for 2 sets using approximately 85% of 1RM:
 - Squat
 - Bench Press
 - Deadlift
 - Overhead Press

Testing Measures:

- Isometric mid-thigh pull:
 - Peak Force (PF)
 - Rate of Force Development (RFD)
 - 0-50ms
 - 50-100ms
 - 100-150ms
- Ultrasonography:
 - Cross-sectional area (CSA)

Statistical Analysis:

- Separate repeated measured analyses of variance were used to compare the pre and post measurements for PF and CSA (group [EXP v CON] x time [pre v post]).
- A 3-way mixed factorial ANOVA (group [EXP v CON] x time [pre v post] x RFD [0-50ms v 50-100ms v 100-150ms]) was used to compare RFD in 50ms epochs during the early phase of the mid-thigh pull (MTP).

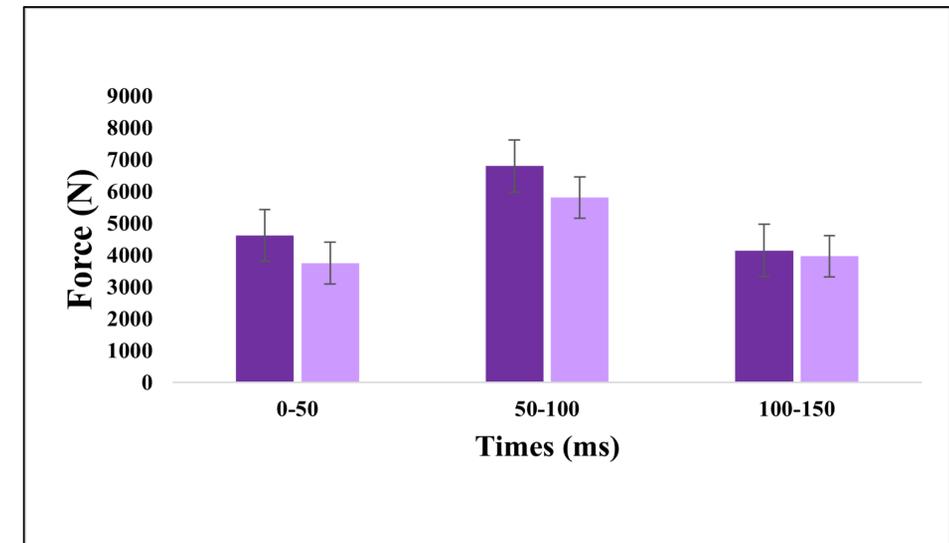
RESULTS

- There were no significant group x time interactions or main effects for group or time for PF (p = 0.288; p = 0.241; p = 0.547; respectively) or CSA (p = 0.595; 0.526; 0.447; respectively).
- There were no significant group x time x phase interactions (p = 0.930) or main effects for group (p = 0.614) or time (p = 0.141) for RFD during the isometric MTP.
- However, there was a significant main effect for the 50ms epoch phases during the isometric MTP (p = 0.012) (0-50ms [4179.669 ± 646.752], 50-100ms [6458.401 ± 721.367], 100-150ms [4068.635 ± 575.591]) when collapsed by group and time. In particular, the 50-100ms phase was significantly greater than the 0-50ms and 100-150ms phases.

TABLE 1

Variable	ANOVA	p-value	F-value	Effect size
Peak Force (PF)	Group	0.241	1.152	0.104
	Time	0.547	0.382	0.029
	Group x Time	0.288	1.229	0.086
Rate of Force Development (RFD)	Group	0.614	0.268	0.020
	Time	0.141	2.460	0.159
	Phase	0.012	6.605	0.337
	Group x Time	0.089	3.389	0.207
	Group x Phase	0.461	0.700	0.051
	Time x Phase	0.609	0.474	0.035
Muscle Cross Sectional Area (mCSA)	Group	0.526	0.425	0.032
	Time	0.447	0.616	0.045
	Group x Time	0.595	0.298	0.022

GRAPH 1: RFD



CONCLUSION

There were no significant differences in lower-body force characteristics for group or time. Suggesting both traditional APRE and relative APRE may be ineffective for increasing muscle CSA, RFD, and PF. Further research should explore training protocols lasting longer than four weeks.

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