A Preliminary Study: The Effect of Alternative Set Structures and Accentuated Eccentric Loading on Jump Techniques in Lower-body Complex Training

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INTRODUCTION

Complex training that incorporates heavy resistance exercises [i.e., back squat (BS)] followed by ballistic movements [e.g., countermovement jump (CMJ)] induces a post-activation performance enhancement (2,8). Alternative set structures (AS) using intra-set rests may expedite recovery after BS (7,9) while accentuated eccentric loading (AEL) with eccentric overload may potentiate the immediate concentric contraction during CMJ (5,10).

PURPOSE

The purpose of this preliminary study was to investigate potential changes in jump techniques such as jump depth (JD) and concentric contraction time (CT) altered by AS and AEL in lower-body complex training.

METHODS

In this preliminary study, 3 men and 3 women [n = 6; 20.7 ± 0.5 years; 1.62 ± 0.06 m; 67.2 ± 9.7 kg] participated. All subjects had proficient BS and CMJ technique with 113.2 ± 35.5 kg BS one repetition maximum (1RM) and 1.7 ± 0.3 times of body mass strength. On the first visit, subjects completed BS 1RM testing and CMJ familiarization using dumbbells (DB) (≈ 30% of body mass for both sexes) during an eccentric phase. On the second and third visits, all subjects completed one of the following conditions in a randomized and counterbalanced manner.

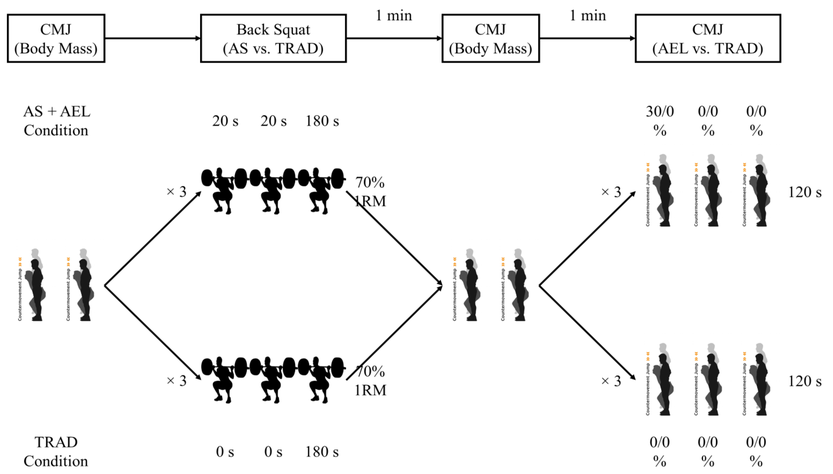
(a) AS + AEL
BS: 3 sets of (3 × 1) repetitions at 70% 1RM with 20 s inter-repetition and 180 s inter-set rests
CMJ: 3 sets of (1 × 3) repetitions with DB at ≈ 30% of body mass on the initial repetition only
(b) traditional methods (TRAD)
BS: 3 sets of (1 × 3) repetitions at 70% 1RM with 180 s inter-set rests
CMJ: 3 sets of (1 × 3) repetitions at body mass for the entire repetition

Data were collected using a linear position transducer (GymAware RS). In both conditions, CMJ was performed without DB before and 1 minute after BS (2 maximal attempts per time point). In an AS + AEL condition, CMJ was performed with DB 2 minutes, 4 minutes, and 6 minutes after BS (3 maximal attempts per time point). Due to the different number of levels across time points and unique study design, separate repeated measures analysis of variance was performed (e.g., 2 conditions × 2 time points × 2 trials for the first two time points and 2 conditions × 3 time points × 3 trials for the last three time points). Data were analyzed using the resampling technique (The R Project for Statistical Computing version 4.3.1). The level of significance was set to 0.05.

RESULTS

Across the first two time points (before BS and 1 minute after BS), there was a condition by time point interaction for concentric CT (p = 0.049) where AS resulted in shorter concentric CT than TRAD 1 minute post-exercise. Across the last three time points (2, 4, and 6 minutes after BS), no main effect of condition, condition by time point interaction, or condition by trial interaction was observed between AEL and TRAD.

EXPERIMENTAL DESIGN



MAIN FINDINGS

Table 1. The results of each trial across the first two time points

	Jump Depth (cm)			
	PRE		1-min Post	
AS	43.4 ± 5.1	45.3 ± 6.1	44.3 ± 6.0	47.4 ± 8.4
TRAD	43.4 ± 6.4	42.7 ± 8.1	45.8 ± 6.1	47.2 ± 7.3
	Concentric Contraction Time (s)			
	PRE		1-min Post*	
AS	0.53 ± 0.05	0.52 ± 0.06	0.49 ± 0.04	0.53 ± 0.06
TRAD	0.52 ± 0.07	0.52 ± 0.05	0.54 ± 0.04	0.54 ± 0.07

* statistically significant (p < 0.05) condition by time point interaction
Only trivial to small (g = 0.00 – 0.60) between-condition effect sizes observed

Table 2. The results of three trials collapsed across the last three time points

	Jump Depth (cm)		
	Trial 1	Trial 2	Trial 3
AEL	42.5 ± 4.1	45.6 ± 8.1	45.7 ± 7.8
TRAD	43.4 ± 7.8	44.0 ± 8.9	44.7 ± 8.5
	Concentric Contraction Time (s)		
	Trial 1	Trial 2	Trial 3
AEL	0.52 ± 0.04	0.50 ± 0.05	0.52 ± 0.06
TRAD	0.51 ± 0.06	0.52 ± 0.06	0.54 ± 0.06

Only trivial to small (g = 0.00 – 0.60) between-condition effect sizes observed

CONCLUSIONS

The results of this preliminary study suggest that AS can expedite recovery (3,4) as early as 1 minute as evidenced by lower concentric CT. However, AEL (1,6) does not impact spatial (JD) and temporal (concentric CT) aspects of jumping. A larger sample size is needed to shed light on the synergistic effect of AS and AEL.

PRACTICAL APPLICATIONS

Practitioners might consider 20 s of inter-repetition rests during back squat to shorten concentric contraction time during post-exercise countermovement jump. Given that contraction time is inversely related to velocity, this method can increase jump performance. However, using dumbbells with 30% of body mass during an eccentric phase may not have influence on jump techniques.

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