RESEARCH NOTE

Using Additional Eccentric Loads to Increase Concentric Performance in the Bench Throw

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Abstract

Sheppard, JM and Young, K. Using additional eccentric loads to increase concentric performance in the bench throw. *J Strength Cond Res* 24(10): 2853–2856, 2010—The purpose of this study was to determine whether superior concentric performance could be achieved in the bench throw with the use of additional eccentric loads. Fourteen male subjects performed bench throws in a smith machine with an eccentric–concentric load of 40-kg (40–40), and 40-kg concentric with additional eccentric loads of 20 (60–40), 30 (70–40), and 40 kg (80–40). A linear position transducer was used to record displacement–time characteristics, allowing for determination of maximum displacement of the barbell. Differences between the conditions were accepted when $p < 0.05$. Barbell displacements in the 60- to 40-, 70- to 40-, and 80- to 40-kg eccentric–concentric conditions were all significantly greater than for the 40- to 40-kg eccentric–concentric equated load condition, but no significant difference was observed between each eccentric–concentric load condition. Superior concentric peak barbell displacement can be achieved with additional eccentric loads in the 40-kg bench throw when compared to an equated eccentric–concentric 40- to 40-kg condition, possibly because of greater muscle tension and crossbridging during the eccentric action. Strength and conditioning coaches can use accentuated eccentric load bench throws to elicit greater concentric bench throw performance in athletes.

Key Words strength, power, testing, upper body

Introduction

Explosive strength in the upper body is an important aspect of performance in several sports (2,4,12,15,16,20). A common exercise for developing explosive strength in the upper body is the bench throw (4), which is generally performed in a smith machine. The purpose of the bench throw exercise is to explosively press the barbell from the chest as far away from the athlete as possible, hence the term 'throw.' This differs from the bench press exercise, where the barbell is pressed to a lock-out position and thus involves a larger deceleration component (9). The strength and conditioning coach can use the bench throw with a variety of loads to target various aspects of the force–velocity continuum, and in this way, the bench throw exercise is also used as a reliable and valid general assessment of upper body explosive strength performance against different inertial loads (1,3,5).

Using an additional (accentuated) eccentric load in the training of lower body power movements can provide a greater concentric performance when compared to conditions where the eccentric and concentric loads are equal (21). Greater acute maximal strength performance has been observed with additional eccentric load in the bench press (13), and greater kinetic and kinematic values have been obtained in submaximal bench pressing with an additional eccentric load (19). However, it is unclear whether additional eccentric loads elicit superior concentric performance in the bench throw exercise, and if so, whether a highly specific additional eccentric load must be used to enhance performance. Therefore, the purpose of this study was to determine whether greater than normal concentric performance, as measured by peak barbell displacement in the bench throw, could be achieved with the use of additional eccentric loads (accentuated eccentric) and, if so, to determine whether this load was individual specific and related to general strength performance.

Methods

Experimental Approach to the Problem

This study employed a within-subjects (randomized to control for order effect) comparison of concentric performance in the 40-kg bench throw when using 40-, 60-, 70-, and 80-kg eccentric conditions, to elucidate whether accentuated eccentric loading (60, 70, and 80 kg) produced superior concentric performance to that of the eccentric–concentric equated condition (40-kg eccentric–40-kg concentric). The data were also analyzed to determine whether the load that produced a superior concentric performance was individual specific and, if so, whether this 'optimal' eccentric load related

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to general strength performance as determined by the 1 repetition maximum (1RM) bench press.

Subjects

Fourteen male subjects (age, 25.0 ± 1.0 years; height, 184.4 ± 6.3 cm; weight, 81.0 ± 4.2 kg), who were highly familiar with the bench throw exercise, participated in this study. Subjects were members of a national sports training academy, from the sports of field hockey, gymnastics, rugby, surfing, volleyball, and water polo. The investigation was approved by institutional ethics, and subjects were informed of the experimental risks and benefits of participation before signing the informed consent.

Procedures

After a 10-minute standardized warm-up involving low-intensity cycling, medicine ball passing drills, and 3–4 refamiliarization efforts, all subjects performed bench throws in a non–counterbalanced smith machine, with an eccentric–concentric load of 40-kg (40–40 kg), and 40-kg concentric with additional eccentric loads of 20 kg (60–40 kg), 30 kg (70–40 kg), and 40 kg (80–40 kg), presented in a randomized order. The concentric load of 40 kg was chosen for this study because this was the load that was used the most in previous training programs for the athletes involved in the study.

The subjects performed a single repetition for each trial, and 2 trials were performed for each condition. Two minutes' rest was provided between trials. The best trial, as determined by maximum displacement of the bar, was used for analysis. Three days later, the subjects were assessed on their 1RM for the bench press exercise.

The eccentric load was applied with height-adjustable clamps (Elite FTS, Auckland, New Zealand). When adjusted appropriately for each individual, the clamps fell off the barbell at the lowest position of the bench throw (when the bar contacted the subject's chest). A linear position transducer and software interface (Ballistic Measurement Systems, Adelaide, Australia) was used to record displacement–time characteristics, allowing for determination of displacement of the barbell.

Statistical Analyses

Differences between the eccentric–concentric equated 40- to 40-kg condition were compared with each of the accentuated eccentric bench throw conditions (60–40, 70–40, and 80–40) using paired *t*-tests, with an associated Bonferroni correction. A further analysis was conducted to assess the difference between bar displacement in the 40–40 condition and that of the best bar displacement from the 60–40, 70–40, or 80–40 condition for each subject using a paired *t*-test. The eccentric load at which the best concentric performance was achieved in the 5 strongest subjects was compared to that of the 5 weakest subjects (as determined by 1RM bench press), using an independent *t*-test. All statistical significance was accepted when $p \leq 0.05$. Additionally, Cohen's effect size statistics (Cohen's *d*) were applied to assess the magnitude of the difference between conditions and between the stronger and weaker groups, according to the criterion of >0.70 large; 0.40–0.70 moderate; <0.40 small (11).

Population-specific and load-specific reliability data were established through initial test–retest sessions. Peak displacement was found to be highly reliable, with intraclass correlations (typical error in parentheses) calculated as 0.98 (0.01 m).

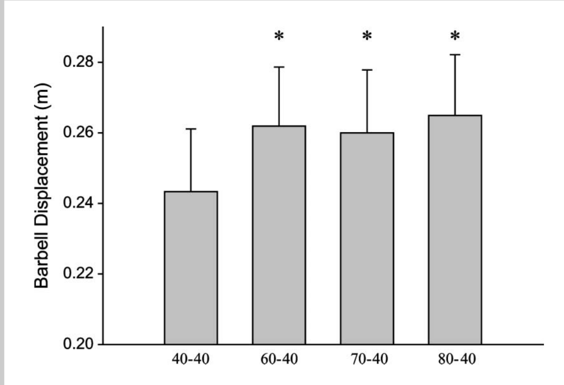

Figure 1. Mean (±*SE*) of maximum barbell displacement of the 40- to 40-, 60- to 40-, 70- to 40-, and 80- to 40-kg eccentric–concentric condition in the bench throw. *Significantly ($p < 0.05$) different from the 40–40 condition.

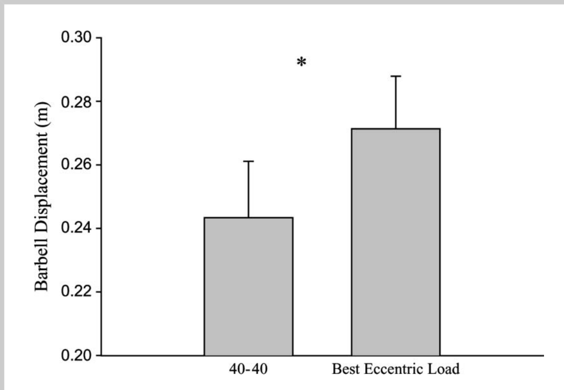

Figure 2. Mean (±*SE*) of maximum barbell displacement of the 40- to 40-kg eccentric–concentric condition compared to the best performance from the 60- to 40-, 70- to 40-, or 80- to 40-kg condition in the bench throw. *Significant ($p < 0.05$) difference between conditions.

Results

Barbell displacement in the 60- to 40-, 70- to 40-, and 80- to 40-kg eccentric–concentric conditions were all significantly greater than for the 40- to 40-kg eccentric–concentric equated load condition, with a small magnitude of effect ($p < 0.01$,

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TABLE 1. Comparison of the 5 strongest and 5 weakest subjects and the eccentric load that elicits the best bench throw performance during a 40-kg concentric bench throw.*

	Strongest (n = 5) (kg)	Weakest (n = 5) (kg)	p Value	Effect size
1RM bench press	111.5 ± 6.5	93.0 ± 2.7	<0.01	6.76
Best eccentric load	74.0 ± 8.9	62.0 ± 4.5	0.03	2.68

*1RM = 1 repetition maximum.

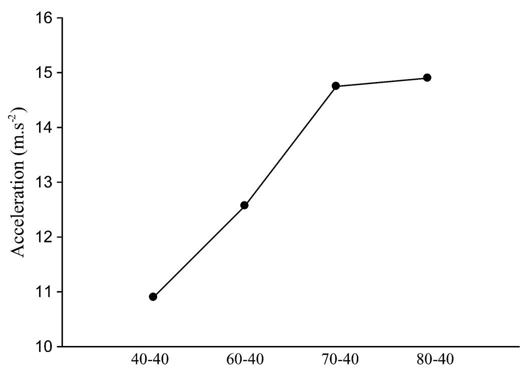

Figure 3. Peak concentric acceleration ($m \cdot s^{-2}$) during the 40- to 40-, 60- to 40-, 70- to 40-, and 80- to 40-kg eccentric–concentric condition in the bench throw for a typical subject.

$d = 0.30$; $p = 0.02$, $d = 0.25$; and $p < 0.01$, $d = 0.33$, respectively) (Figure 1). There were no significant differences between the accentuated eccentric loaded conditions. Figure 2 illustrates the moderate ($d = 0.45$) difference ($p < 0.01$) between the 40- to 40-kg eccentric–concentric condition and that of the best performance from either the 60- to 40-, 70- to 40-, or 80- to 40-kg eccentric–concentric condition. As outlined in Table 1, the eccentric load at which the best concentric performance was achieved in the 5 strongest subjects (mean 1RM bench press 111.5 ± 6.5 kg, eccentric load of 74.0 ± 8.9 kg) was significantly ($p = 0.03$) greater than that of the 5 weakest subjects (mean 1RM bench press 93.0 ± 2.7 kg, eccentric load of 62.0 ± 4.5 kg), with a large magnitude of effect ($d = 2.68$).

DISCUSSION

An accentuated eccentric load can enhance concentric performance in the bench throw exercise. Our present findings are similar to previous investigations with the lower body, where greater jump heights were observed when using accentuated eccentric jumps (21,22) and when assessing 1RM bench press strength (13) and submaximal bench press kinetic and kinematic performance variables (19).

The observed effect of greater than normal concentric outputs with an additional eccentric load is likely in only a small part because of an increase in neurogenic stimulation, as no differences in eccentric depth (magnitude) occur in the bench throw and no significant ($p > 0.05$) difference in eccentric velocity (rate) occurred during the countermovement across conditions, 2 components that produce large prestretch augmentation in the stretch-shortening cycle (14,18). It is likely that the increases in concentric bench throw height observed with additional eccentric loads were because of myogenic factors, namely, greater muscle tension and crossbridging during the eccentric action because of the increase force required (6,8,14,17). This increased muscle contractile state may in turn provide greater acceleration of the concentric mass and a greater maximum displacement. This is illustrated in Figure 3, where for this typical subject, peak acceleration for each accentuated eccentric condition was higher than that of the 40- to 40-kg condition.

Although it appears as though there is an individual-specific eccentric load that elicits the highest peak displacement for each individual, all subjects had superior peak displacement with all of the additional eccentric load conditions compared to their own 40- to 40-kg condition. In other words, the subjects in this study all achieved a higher peak displacement of the barbell with all 3 additional eccentric loads in comparison to the eccentric–concentric equated load, but that athletes differed in that the single best peak displacement was achieved at 60–40 for 5 subjects, 70–40 for 4 subjects, and 80–40 for 5 subjects. This finding is similar in nature to previous findings in the bench press exercise, where a specific additional eccentric load was found to elicit higher power outputs in comparison to equated eccentric–concentric loading (19).

In the present study, heavier additional eccentric loads elicited the best concentric barbell displacement for the strongest subjects whereas the weakest athletes benefited most from lower eccentric loads ($p < 0.01$; ES 2.68, large). It could be that stronger athletes benefit more from the greater eccentric load, because they have more capability to tolerate higher tension with lower inhibitory reflexes and greater tension capability in the precontractile state (7,10,14).

When expressed as relative to 1RM bench press, the eccentric load that elicited the best concentric barbell displacement for 40 kg was 66% of 1RM bench press for both the stronger and weaker groups. This figure may provide a reasonable starting point for determining an athlete's specific additional eccentric load for bench throw. However,

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this figure of 66% was simply the mean load found in our study to elicit the best bench throw performance, and individual variations existed. Further, it cannot be assumed that 66% of 1RM bench press is a load that is suitable for the concentric bench throw when loads other than 40 kg are used, because the present findings are restricted to testing with 40-kg concentric only, and with a relatively homogeneous group of athletes.

Practical Applications

Bench throws with additional eccentric loads can be used to provide an enhanced concentric performance. Strength and conditioning coaches can use accentuated eccentric load bench throws to elicit greater concentric bench throw performance in athletes and are encouraged to determine this athlete-specific eccentric load to ensure the highest level of enhancement of concentric performance in the bench throw.

References

1. Alemany, JA, Pandorf, CE, Montain, SJ, Castellani, JW, Tuckow, AP, and Nindl, BC. Reliability assessment of ballistic jump squats and bench throws. *J Strength Cond Res* 19: 33–38, 2005.
2. Baker, D. Comparison of upper-body strength and power between professional and college-aged rugby league players. *J Strength Cond Res* 15: 30–35, 2001.
3. Baker, D. Differences in strength and power among junior-high, senior-high, college-aged, and elite professional rugby league players. *J Strength Cond Res* 16: 581–585, 2002.
4. Baker, D and Newton, RU. Methods to increase the effectiveness of maximal power training for the upper body. *Strength Cond J* 27: 24–32, 2005.
5. Baker, D and Newton, RU. Adaptations in upper-body maximal strength and power output resulting from long-term resistance training in experienced strength-power athletes. *J Strength Cond Res* 20: 541–546, 2006.
6. Bobbert, MF, Mackay, M, Schinkelshoek, D, Huijing, PA, and Van Ingen Schenau, GJ. Biomechanical analysis of drop and countermovement jumps. *Eur J Appl Physiol* 54: 566–573, 1986.
7. Bobbert, MF and Van Soest, AJ. Effects of muscle strengthening on vertical jump height: A simulation study. *Med Sci Sports Exerc* 26: 1012–1020, 1994.
8. Bosco, C and Komi, PV. Prestretch potentiation of human skeletal muscle during ballistic movement. *Acta Physiol Scand* 111: 135–140, 1981.
9. Clark, RA, Bryant, AL, and Humphries, B. A comparison of force curve profiles between the bench press and ballistic bench throws. *J Strength Cond Res* 22: 1755–1759, 2008.
10. Clutch, D and Wilton, M. The effect of depth jumps and weight training on leg strength and vertical jump. 54: 5–10, 1983.
11. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: L. Erlbaum Associates, 1988.
12. DeRenne, C and Szymanski, DJ. Effects of baseball weighted implement training: A brief review. *Strength Cond J* 31: 30–37, 2009.
13. Doan, BK, Newton, RU, Marsit, JL, Triplett-McBride, TN, Koziris, PL, Fry, AC, and Kraemer, WJ. Effects of increased eccentric loading on bench press 1RM. *J Strength Cond Res* 16: 9–13, 2002.
14. Enoka, R. *Neuromechanics of Human Movement.* Champaign, IL: Human Kinetics, 2000.
15. Feltner, ME, Fraschetti, DJ, and Crisp, RJ. Upper extremity augmentation of lower extremity kinetics during countermovement vertical jumps. *J Sports Sci* 17: 449–466, 1999.
16. Ghigiarelli, JJ, Nagle, EF, Gross, FL, Robertson, RJ, Irrgang, JJ, and Myslinski, T. The effects of a 7-week heavy elastic band and weight chain program on upper-body strength and upper-body power in a sample of division 1-AA football players. *J Strength Cond Res* 23: 756–764, 2009.
17. Giovanni, A, Cavagna, A, Dusman, B, and Margaria, R. Positive work done by a previously stretched muscle. *J Appl Physiol* 24: 21–32, 1968.
18. Komi, PV and Bosco, C. Utilization of stored elastic energy in leg extensor muscles by men and women. *Med Sci Sports Exerc* 10: 261–265, 1978.
19. Ojatso, T and Häkkinen, K. Effects of different accentuated eccentric load level in eccentric–concentric actions on acute neuromuscular, maximal force, and power responses. *J Strength Cond Res* 23: 996–1004, 2009.
20. Prokopy, MP, Ingersoll, CD, Nordenschild, E, Katch, FI, Gaesser, GA, and Weltman, A. Closed-kinetic chain upper-body training improves performance of NCAA division 1 softball players. *J Strength Cond Res* 22: 1790–1798, 2008.
21. Sheppard, JM, Hobson, S, Chapman, D, Taylor, KL, McGuigan, M, and Newton, RU. The effect of training with accentuated eccentric load counter-movement jumps on strength and power characteristics of high-performance volleyball players. *Int J Sports Sci Coach* 3: 355–363, 2008.
22. Sheppard, JM, McGuigan, M, and Newton, RU. The effect of accentuated eccentric load on vertical jump kinetics kinematics in elite male athletes. *Int J Sports Sci Coach* 2: 267–273, 2007.

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