Short Communication

Relationship between power snatch throw and backward overhead medicine ball throw in college football players

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Objective: To evaluate the relationship between backward overhead medicine ball (BOMB) throw and power snatch throw (PST).

Design and Methods: NCAA Division-II college football players (n = 23; age = 21.0 ± 1.4 yrs, height = 184.6 ± 6.0 cm, weight = 105.6 ± 19.0 kg) were evaluated for 5 BOMB throws and 3 PSTs. PST was measured by an accelerometer attached to a specially designed Smith machine with a hydraulic catch system that allowed release of the bar at the top of the movement. A standard weight of 62.5 kg was used for PST in all players, with the best of 3 throws used to represent PST (1,737 ± 337 W). The BOMB test was performed using an 8-kg rubber medicine ball, with the best throw used for analysis (15.74 ± 1.88 m).

Results: Regression selected BOMB throw to estimate PST [PST (W) = 134.89 BOMB (m) – 441.6, r = 0.73, SEE = 233 W, CV% = 13.6%). Smallest worthwhile change (SWC) for the BOMB throw was 0.79 m or 5.1% to indicate meaningful improvement.

Conclusion: The higher correlation (r = 0.73, $p < 0.001$) between BOMB and PST than previously noted for vertical jump power (r = 0.63) supports the BOMB throw as a measure of overall power. Thus, the BOMB throw can provide a cost effective and time-saving test to assess total body explosive power.

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Key words: BOMB throw ■ Anaerobic power ■ Power prediction

INTRODUCTION

Production of power is a paramount feature of American football with various aspects of training devoted to increasing this parameter.[1] A unique aspect of American football is that skills such as blocking and tackling involve coordinated, whole-body expression of explosive power to successfully complete the skill. Consequently, preparation training programs focus on developing both muscular strength and power. While muscular strength and power may differ, they are interrelated.[2] Upper- and lower-body resistance exercises, such as bench press and squat, typically focus on development of absolute strength with the supposition that increases will transfer to greater explosive power.[3] "Whole-body" resistance exercises, such as power clean, power snatch, and push press, focus on development of explosive power but may rely as much on motor skill as on absolute strength.[4] Regardless of the approach of any strength and conditioning program for football, the development of total body explosive power is paramount for enhancing playing effectiveness (e.g., blocking momentum, agility, sprint speed).[5,6]

Field tests such as vertical jump have been used to estimate explosive power from jump height and body mass[5], although this test tends to focus more on leg power. More recently, the backward overhead medicine ball (BOMB) throw has received increasing attention for estimating total body explosive power[6,7]. The utility of the BOMB test is its capacity to be both a measurement instrument and training device for athletes of different size and athletic ability.[6,7] The technique involves grasping the medicine ball with both hands, descending into a squat position with the medicine ball passing between and behind the knees, before initiating leg extension followed by back extension, and finishing a high pull with both arms to complete the throw.[7] The medicine ball is released at the peak of an arching movement. Ultimately, the objective is to produce maximal explosive power with assessment indicated by the horizontal distance the ball travels.

The BOMB throw is a multi-dimensional task that integrates both strength and power to varying degrees depending on specific characteristics of the performer such as body size, movement speed, and dynamic strength[6]. Additionally, a technical element of the BOMB throw connects the horizontal travel distance to the movement pattern and release position of the ball. Although the BOMB throw may be a multi-dimensional task, previous investigations of its validity have utilized a criterion test (e.g., vertical jump) that may not be specific enough to assess the complexity of a total-body power movement. To date, the BOMB throw has not been compared to a test of total body explosive power that contains a signifi-

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cant technical movement pattern element to more fully understand its assessment value. The power snatch throw (PST) employs a weighted barbell with a movement pattern similar to a power clean and as such has the potential to measure whole-body power involving the entire range of motion of torso and arm extension. The movement pattern of the PST mimics that of the BOMB throw incorporating the element of skill level. Therefore, the purpose of this study was to evaluate the relationship between BOMB throw and PST test in college football players.

METHODS

Twenty-three NCAA Division-II college football players volunteered to participate in this study (age = 21.0 ± 1.4 yrs, height = 184.6 ± 6.0, cm, weight = 105.4 ± 19.0 kg). Players were involved in an intensive summer resistance training program at the time of the study. The study was approved by the institutional review board for the use of human subjects, and all subjects signed a consent document in accordance with the ethical standards of the Helsinki Declaration.

Each player completed BOMB throw and PST tests on the same day with test order randomized. There was a 10-minute recovery period between each test. Players were allowed several familiarization trials with each test prior to actual measurement. The BOMB test was conducted with an 8-kg rubber medicine ball, which represented an external load of 7.8 ± 1.4% of body weight. Procedures for BOMB throw have been described elsewhere.[7] Each player performed five BOMB throws with a five-minute recovery period between throws. The horizontal distance of each trial was recorded, and the best throw was used for analysis.

The PST test was performed on a specially designed Smith machine with a hydraulic catch system (CORMAX, Olympic Station 1000, Morehead, MN) that allows the bar to be released at the completion of the task. The PST was begun with the bar at knee level, pulled vertically as fast as possible and released overhead at the peak of arm extension. A standard weight of 62.5 kg (60 ± 11% body weight) was used for all players. Peak power, maximal velocity, and peak force were determined during the PST test using an accelerometer (Myotest Inc, Durango, CO) attached to the support arm of the Smith machine. Players were not allowed to use wrist wraps or any grip enhancement other than chalk. The test protocol consisted of three, single repetition trials with a five-minute recovery period between trials. Peak force, maximum velocity, and peak power were recorded for each throw and the results of the last three trials were averaged and used for analysis.

A *priori* analysis indicated 21 participants would be required for a correlation with a power of 0.90, an effect size = 0.60, and an alpha = 0.05.[8] Thus, the alpha level for the present analysis was set at 0.05. Repeated-measures analysis of variance (ANOVA) was used to assess the difference among trials with Bonferroni *post hoc* follow-up to determine differences. Trial-to-trial reliability for BOMB and PST were assessed using intraclass correlation coefficients ($ICC_{3,1}$). Typical error of measurement (TE) was computed by dividing the between trials SD by $\sqrt{2}$. Coefficient of variation (CV%) was determined by dividing the between trials SD by the mean of selected trials. Smallest worthwhile change (SWC) was calculated as $1.95 \times TE \times \sqrt{2}$. Percent smallest worthwhile change (SWC%) was calculated by dividing the smallest worthwhile change by the mean of successive trials. All analyses were conducted using SPSS, version 26 (IBM, Chicago, IL).

RESULTS

The final three repetitions of the BOMB throw (Figure 1) and final two repetitions of the PST throws were not significantly different ($p > 0.05$) (Figure 2) and had high intraclass correlation coefficients ($ICC_{3,1}$ = 0.961 and 0.970, respectively). Typical error of measurement was 0.33 m (CV% = 3.2%) for BOMB distance and 163 W (CV% = 13%) for PST peak power. Smallest worthwhile change (SWC) for BOMB distance was 0.94 m (SWC% = 6.0%) and 111 W (SWC% = 5.6%) for PST peak power.

Data for BOMB throw distance and PST peak force, maximal bar velocity, and peak power are shown in Table 1. The significant correlation between peak PST power and best BOMB throw allowed production of an acceptable prediction equation to estimate peak power [PST peak power

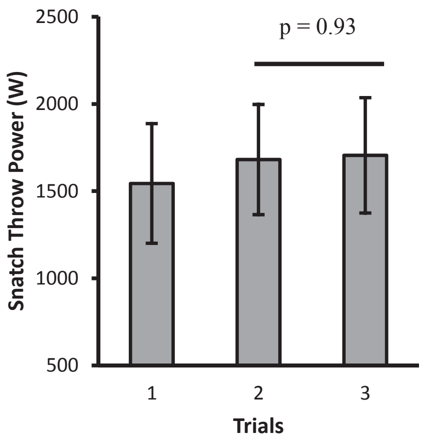

Figure 1 Reliability of snatch throw power.

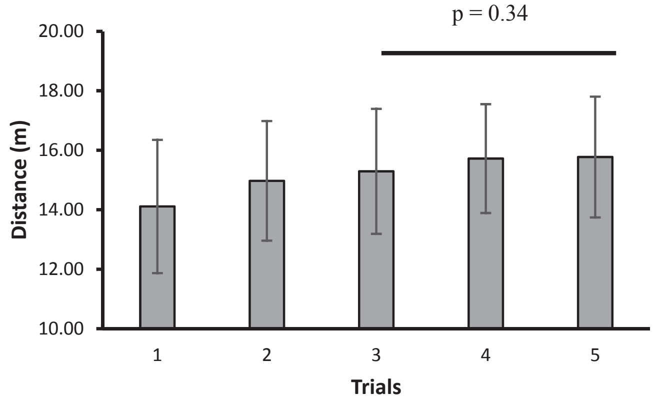

Figure 2 Reliability of backward medicine ball throw.

Table 1 Descriptive characteristics of the participants (n = 23).

	Mean ± SD	Range
Age (y)	21.0 ± 1.4	19.0 – 23.4
Height (cm)	184.6 ± 6.0	173.5 – 196.9
Weight (kg)	105.4 ± 19.0	79.5 – 141.4
BMI (kg/m^2)	30.8 ± 4.7	23.8 – 39.0
PST velocity (m/s)	2.12 ± 0.25	1.64 – 2.56
PST force (N)	1,129 ± 87	959 – 1,270
PST power (W)	1737 ± 337	1,170 – 2,440
BOMB throw (m)	16.15 ± 1.81	13.26 – 20.19

(W) = 134.9 BOMB (m) – 442 (r = 0.73, SEE = 237 W, and CV% = 13.6%] (Figure 3). Body mass was significantly related to best BOMB distance (r = 0.42, p = 0.05) and PST peak power (r = 0.43, p = 0.05). Removing the effect of body mass by partial correlation nonsignificantly reduced the correlation between BOMB and PST ($r_{12.3}$ = 0.67, p < 0.001). Maximal bar velocity of PST (2.12 ± 0.25 m/s) had a significant relationship with BOMB (r = 0.58, p < 0.005) (Figure 4).

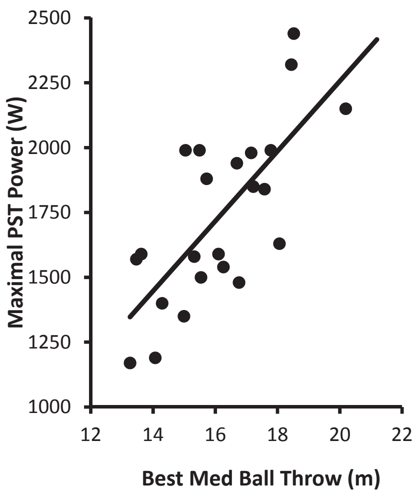

Figure 3 Relationship between BOMB throw and pull snatch throw.

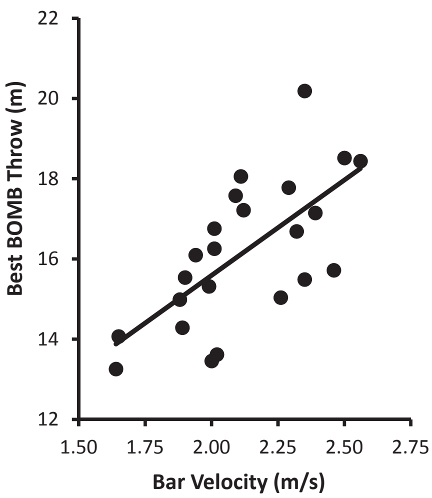

Figure 4 Relationship between bar velocity and BOMB throw.

DISCUSSION

The current findings support the BOMB throw as a good reflection of total body explosive power in college football players when benchmarked against the PST, a test with similar compound movement pattern and skill complexity. The correlation between the two tests of power in the present study (r = 0.73) was higher than previously noted when comparing BOMB to vertical jump power determined on a force plate (r=0.59).[7] This is most likely related to the similarity of movement pattern between the two throw tests. Peak power previously reported for vertical jump (4,343 W)[7] was significantly greater than the present PST test (Table 1), which could be due to the external load relative to body weight for each player.

Studies have indicated that the optimal load for expression of peak power in the clean exercise is between 70% and 90% of 1RM,[4,10,11] while peak power from a vertical jump occurs at body mass.[5] Peak power has been observed using external loads between 40% and 90% for a power clean performed from knee level,[12,13] which approximates the staring position of the present PST test. Ultimately, a relative load of 60% (±10.6%) was used during testing in the present study based on past team power clean performances. In contrast, the BOMB throw utilized an 8 kg medicine ball which represented an external load of approximately 7% of body weight. PST maximal bar velocity was positively correlated with BOMB throw while load expressed relative to body weight correlation was significantly lower and negative. It is possible the PST load used in this study may have been greater than optimum for expressing peak velocity and power in this maneuver. Previous work has shown that peak velocity and peak power occurred at 30% of maximum loads in the jump shrug.[14] It is possible that the relationship between the BOMB and PST tests might be improved if the PST load were decreased to less than 60% of body weight to more closely match the maximal bar velocity associated with BOMB throw. However, pilot testing with several larger players indicated that light loads (< 45 kg) resulted in throw distance that exceeded the limits of the device. Further investigation of optimal loading of the PST to achieve maximal bar velocity and optimal peak power expression appears warranted.

An interesting finding in the present study relates to the novelty of the PST task and BOMB throw as indicated by a significant learning curve (Figure 1). Due to the novelty of the PST, it is possible that expression of power and performance in the present testing scenario could be limited by skill, and improvements may only indicate lifting technique and enhanced skill acquisition.[15-17] The PST test required players to release (throw) the bar overhead at the top of the snatch movement, a procedure with which they were not familiar. The high reliability for both tests (ICC > 0.961), however, does suggest a relatively rapid learning curve requiring only a single exposure with less than 5 attempts to acquire stable scores: BOMB throw by the third repetition and PST by the second repetition. The high ICC for PST power and small effect size (ES = 0.07) between trials 1 and 2 supports a fast learning curve despite the complex movement pattern. Similarly with the BOMB, the high ICC and small TEM with the current group of football players is in close agreement with previous work showing a TEM of 0.1m.[18] Based on the current analysis, a change of approximately 5% in either the BOMB throw or PST would be considered a meaningful improvement in performance. This allows strength and conditioning professionals to have a standard by which to evaluate whether players are making meaningful progress in training.

CONCLUSION

Based on the present observations, it appears that the BOMB throw is a valid and reliable field test for assessing explosive power in college football players. The minimal learning curve for the BOMB throw lends itself to all sports and levels of athlete experience, both for assessment and training. Since movement velocity is the key determinant of explosive power, maximal BOMB throws with different loads may enhance movement velocity in various athletic movements. The relationship between BOMB throw and peak power suggests greater involvement of the arms and back during the BOMB throw. One caveat of the present study might be the small sample upon which our prediction equation was based. Further investigations to evaluate the validity of the current equation and assess the transfer of BOMB throw training to specific sports movement improvements are warranted.

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