Short Communication

The 'Slingshot' can enhance volume-loads during performance of bench press using unaided maximal loads

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Objective: To examine whether using the Slingshot will enable participants to perform a greater volume-load during bench press repetitions with a maximal load and increase set volume-load compared to an unaided condition.

Summary of Background Data: Literature suggests that increased volume-loads during training may aid in improving strength, and further maximises mechanical tension and metabolic stress potentially leading to increased hypertrophy. It has been suggested that a new piece of equipment, called the Slingshot could be used in training to improve performance in the bench press by enabling individuals to increase their training volume whilst using maximal loads.

Method: Nine trained male participants volunteered to participate. Each participant performed a bench press one repetition maximum (1RM) test before completing repetitions to momentary failure using the Slingshot one week later. Volume-load for each condition was calculated as repetitions (n) × load (kg).

Results: A paired samples t-Test comparing between conditions revealed a significant difference ($p < 0.001$) between volume loads performed unaided (96.1 ± 14.6 kg) and with the Slingshot (350 ± 103.7 kg).

Conclusion: Using the slingshot in training does allow individuals to perform greater volume-loads with a maximal load; however longitudinal research must be conducted to ascertain the magnitude of any potential benefit from using it.

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Key words: Strength ■ hypertrophy ■ volume ■ load ■ slingshot

INTRODUCTION

Resistance training (RT) is argued to be beneficial for improving physical fitness and the bio motor qualities which underpin athletic performance.[1] The Bench press is one of the most commonly used compound exercises in athletic programs for developing upper body strength. Furthermore, it not only involves the chest and upper limbs but requires significant trunk and shoulder activation to perform effectively.[2] Improvements in strength and hypertrophy resulting from RT exercises such as the bench press are thought to be brought about by the manipulation and optimising of training volume and load and their interaction (repetitions [n] × load [kg] i.e. volume-load).[3] Furthermore, chronic exposure to high training volume-loads has been suggested to be a key factor in minimising the risk of injury in contact sport.[4] As such, strategies to bring about increased volume-loads in training might be of benefit.

Strength sport athletes have been known to use a variety of ergogenic training aids in order to achieve this goal through manipulation of volume and load such as bands and chains[1], lifting suits[5] and wraps to support joints.[6] A recent study by Ye et al.[7] reported that a device called the Slingshot can allow participants to utilise a supramaximal load during a one repetition maximum (1RM) attempt in the bench press compared to without the device. They reported that participants were able to use loads up to 10-15% higher with the Slingshot compared with their unaided 1RM. A recent study in powerlifters has also reported similar findings.[8]

Strength is thought to be highly specific and as such, if the goal is to improve strength as tested with a specific task, such as a 1RM, training with loads that are similar, if not the same, will optimise this outcome.[9,10] Indeed, success in the bench press is determined by optimising the kinematics of the lift where not only can the shortest bar path be achieved in order to be biomechanically efficient[11], but also economical in terms of neuromuscular effort[12]. Further, practising such a skill at high volumes may help to further facilitate adaptation[10,13].

It has been suggested that there are three primary mechanisms responsible for the stimulation of muscular hypertrophy (mechanical tension, metabolic stress, and muscle damage) and that optimising these may facilitate the greatest adaptations.[3] Though many studies show similar adaptations between heavier and lighter load RT[10], it is thought that different mechanisms may be responsible (i.e. mechanical tension under high load, and metabolic stress under low load).[14] However, again there is said to be a dose-response relationship between the volume of work completed per session and the potential for muscular hypertrophy.[15,16]

Normally, an increase in training volume or load requires a concomitant reduction in the other. Anecdotally, it has been suggested that the Slingshot device could also allow individuals to perform multiple repetitions (~3-5) using their unaided 1RM loads and that this increase in the volume-loads possible at higher loads may facilitate adaptation. Indeed, Dugdale et

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al.[8] reported a strong correlation between unaided bench press 1RM and the load participants could use in a predicted 3RM whilst employing the Slingshot. As noted, strength gains are highly specific and the increase in possible volume (3-5 repetitions) may not achieve traditional volumes associated with attainment of maximal hypertrophy. Thus whether the Slingshot has the potential to optimise desired chronic adaptations may be debatable. However, it is first necessary to examine whether the Slingshot can indeed produce increased volume loads when using loads matching that of unaided 1RM. Therefore, the aim of this study was to test the hypothesis that using the Slingshot would enable participants to complete multiple bench press repetitions with a maximal load and thus increase set volume load compared to an unaided condition.

METHODS

Research design

A repeated-measures experimental design was conducted with the Slingshot as the independent variable and bench press volume-load completed (repetitions [n] × load [kg]) as the dependant variable. The study was approved by the Centre for Health, Exercise and Sport Science ethics committee at Southampton Solent University. Upon recruitment each participant was provided with a Participant Information Sheet to ensure their understanding of the requirements of the study before signing an informed consent form. A Physical Activity Readiness Questionnaire was completed prior to each session to screen for any contraindications such as injury.

Participants

Nine male participants were recruited voluntarily using convenience sampling. Power analysis was conducted on another Slingshot study[7] to establish a sufficient sample size. An effect size of 0.94 based on the mean (132.1kg vs 114.6kg) and standard deviation (18.5 vs 18.6) was calculated using Cohen's d.[17] G*Power 3.1 was used to calculate the required sample for statistical power[18], alpha was set at 0.05 and power at 0.8 resulting in a sample size of 9 participants.[19] Inclusion criteria required that all participants had been performing RT for a minimum of twice a week for at least 12 months, were injury free, and had at least 6 months of previous bench press experience and a minimum bench press of 1 × bodyweight.[7] Exclusion criteria were the use of anabolic steroids and any shoulder injury within the last 6 months.[7]

Instrumentation

Stature was measured using a stadiometer (Veeder-Root, USA) and body mass was measured using scales (Seca, Germany). Maximum strength was measured using a bench press 1RM test having acceptable reliability ($r = 0.92$)[6] in comparison to predictive equations based on relative strength[20]. The 1RM test was conducted using an Olympic barbell (Elieko) and Ivanko weights (Ivanko Barbell Company). The repetition max test used all of the above with the inclusion of a classic Slingshot (Mark Bell's Slingshot, Woodland, CA), the size of which was determined by each participants natural grip width during the bench press. This meant that all participants used the extra-large Slingshot.

Procedures

Testing was conducted on three occasions, one week apart to control for fatigue. Each test was conducted under the supervision of a qualified first aider and NSCA Certified Strength and Conditioning Specialist. On the first and second weeks each participant completed a bench press 1RM test in order to ascertain the reliability of their 1RM, followed by three sub maximal familiarisation sets with the Slingshot in preparation for week three. In week three each participant completed as many repetitions as possible to momentary concentric failure[21] with their pre-determined 1RM whilst wearing the Slingshot. Each participant performed a standardised warm up of 5-10 repetitions using a light load with one minute rest, followed by two heavier warm-up sets of 2-5 reps, with a 2 minute rest between sets. Following a 4 minute rest, they then performed a 1RM attempt with proper technique. If the lift was successful, the participant rested for a further 4 minutes, increased the load by 5-10%, and attempt another lift. If the subject failed to perform the lift with correct technique, they rested for 4 minutes and attempt a weight 2.5-5% lower. Load was changed accordingly until a maximum lift was performed. The starting load was appropriately selected in order to complete the test within five attempts of the warm up in order to control for the effect of fatigue on performance. Repetitions were completed using each participants normal grip width, whilst lowering the bar to nipple level without bouncing it off the chest.[22] The researcher attempted to control for fatigue by asking that all participants be sufficiently rested prior to participation on each day, and to maintain their usual habits in terms of supplementation and caffeine consumption.

Statistical Analysis

Statistical analysis was completed using the Statistical Package for the Social Sciences 22.0 software (SPSS, Inc) with an alpha value of 0.05 as the level of significance. A Shapiro-Wilk test revealed that the data met assumptions of normality and could be analysed with a parametric test for significance.[23] A paired samples t-test was used to compare the volume load completed between conditions.

RESULTS

Descriptive statistics

Descriptive statistics for participant data are shown in table 1.

Volume-load

Participants completed 3.7 ± 1.00 (mean ± SD) repetitions with the aid of the Slingshot using their unaided bench press 1RM load. Paired t-test ($t_{(8)} = -7.202$, $p < 0.001$) revealed a significantly greater volume load for the Slingshot condition (350.00 ± 109.99 kg) compared with the unaided condition (96.11 ± 15.52 kg). Figure 1 shows the individual responses for volume-load between the two conditions.

Table 1 Participant (n = 9) Descriptive Statistics

Variable	Mean ±SD	Shapiro-Wilk test (p)
Age (years)	22 ±3	0.737
Stature (cm)	177.8 ±5.0	0.319
Body mass (kg)	79.7 ±11.0	0.251
Bench Press 1RM (kg)	96.1 ±15.5	0.563

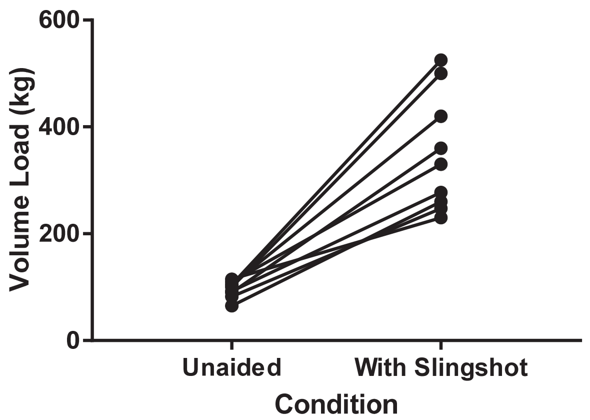

Figure 1 Participant (n = 9) Individual Volume Load Response

DISCUSSION

The aim of this study was to test the claims that the Slingshot could be used in training to enable individuals to perform multiple repetitions with a 1RM load, thus resulting in a greater volume-load during bench press training. The results demonstrated that when compared to an unaided control condition, participants were able to complete multiple repetitions (ranging from 2 to 5 additional repetitions). Thus, the Slingshot might be considered as a useful tool to allow persons to accrue a greater volume-load during bench press training with heavy or maximal loads potentially influencing training induced adaptations.

Other studies have identified that ergogenic aids can be utilised in training to elicit a variety of adaptations. Bands and chains are commonly used by powerlifters and athletes from throwing events to alter the force velocity profile of the bench press and other exercises.[1] In an analysis of the effect of a bench press shirt on joint kinematics, it was suggested that there was no correlation between bar velocity with and without the bench shirt.[5] Though this lead to greater time under tension and volume-load, the authors made no suggestion about the potential benefits beyond competition specific training due to the acute study design and Powerlifting specific population. Unlike the deadlift which has a descending strength curve,[24] the bench press' ascending strength curve means that muscular tension is at its lowest when the leverage is greatest.[11] While the sticking point is the moment where velocity decreases as a result of inefficient leverage and variable resistance,[22] more recent literature has suggested that there is a sticking region where acceleration of the bar decreases[20].

The increase in volume-load with the Slingshot reported in the present study whilst using the same load achieved with an unaided bench press 1RM might be useful for enhancing strength and hypertrophic adaptations. Typically, maximisation of both strength and hypertrophy outcomes requires the use of both maximal (or near maximal) load lifts in addition to the attainment of some minimal volume.[25] While the findings of this study suggest sets of 2-5 repetitions using and unaided 1RM load are possible with the Slingshot, sets utilising this repetition range are more commonly associated with strength development.[3] The performance of increased total training session volume-loads during heavy load bench press training has been reported as significantly associated with greater improvements in bench press 1RM in adolescents.[12] Hypertrophy is also thought to be related to volume-loads with some suggesting there is a dose-response relationship between two.[15,16] Indeed, Schoenfeld et al.[3] have shown that, when volume-load equated, multiple sets of 3RM loads produce similar hypertrophy to traditional 'hypertrophy' loads (10RM), yet with greater 1RM improvements. Thus high volume-loads performed using high loads may maximise both outcomes. Chronic exposure to high training volume has also been shown to have an impact on reducing the likelihood of injury by making athletes more robust and tolerant to acute spikes in load.[4] Therefore, the findings of this study suggest that the use of the Slingshot in bench press resistance training across multiple sets might permit greater total session volume-load and thus might be of use to trainees to enhance these outcomes.

It is however worth considering that the results of prior work has suggested that there may in fact be decreased activation of both the pectorals and triceps whilst using the Slingshot.[7,8] Further, when using the Slingshot to lift the loads attained during an unaided bench press 1RM there is an increased bar velocity, even during predicted 3RM attempts, further suggesting that fatigue is reduced.[8] This suggests that the Slingshot may in fact be resulting in a lower relative demand during the bench press exercise and that this is one of the reasons for the enhanced performance in terms of both the ability to use 'supramaximal' loads and to attain higher volume-loads with unaided 1RM loads. Increased volume-load has been argued to be important in enhancing both strength through practice as well as hypertrophy by maximising mechanisms involved with such adaptation. However, if this increased volume-load is occurring at the cost of a reduced demand it might conversely be argued that the Slingshot might result in diminished adaptation due to a diminished physiological stimulation. Indeed, this might be further compromised for larger individuals as bench press 1RM with the Slingshot is closely related to body mass possibly due to the greater stretch and stored elastic energy that can be utilised in the Slingshot ($R^2 = 0.334$).[8] In fact, in retrospective analysis of our results in light of this we also found that body mass was closely related to the increase in volume-load performed with the Slingshot whilst using an unaided 1RM load ($R^2 = 0.518$).

However, there may still be benefits to utilising the Slingshot in terms of enhancing skill development and bench press kinematics. Previous literature which analysed the kinematic variance in the bench press technique of skilled and unskilled powerlifters consistently observed that the key difference between the two groups was the increased moment arm of the unskilled participants.[22] Previous literature that observed the effect of grip width on muscular activation during the bench press reported that the greatest effort was applied where trained participants used the grip width which was most comfortable for them.[26] Van Den Tillaar et al.[27] also suggest that the sticking point in the bench press occurs partly due to the elbows manoeuvring into a mechanically less advantageous position. Indeed it may be that the use of the Slingshot forces the user to adopt a more advantageous position for both grip width and elbow position to reduce the influence of the typical sticking point which occurs during the bench press. Indeed, Dugdale et al.[8] corroborate this suggesting that the sticking point position was shifted subtly when using the Slingshot compared to when not. Thus, the greater volume-load that can be achieved during use of the Slingshot with unaided maximal loads might permit greater practice of the correct kinematics involved with successful bench pressing.

This being said, there is currently a lack of research examining the use of the Slingshot in a chronic training intervention. The increased volume-loads permitted may or may not be sufficient to influence hypertrophic adaptation over the course of a training intervention. Further, as strength is highly specific, although the Slingshot might permit practice at greater volume-loads of the kinematics involved with successful bench pressing, training with it may primarily influence the ability to lift loads whist equipped with the Slingshot and not necessarily transfer to unaided bench press. Future research should consider the use of the Slingshot, both in combination with traditional training and in isolation, across a training intervention to understand whether these acute changes might impact upon chronic adaptations.

It should also be noted that there were some adverse responses whilst using the Slingshot which should be considered in its employment as a training tool. Typically ideal bench press form requires that the wrist should be "cocked" with knuckles pointed towards the ceiling to minimise strain on the passive structures of the joint.[28] Many participants reported discomfort in the wrists following testing whilst using the Slingshot. A similar phenomenon was reported in a study which analysed the kinematics of successful and unsuccessful bench press attempts with supramaximal loads[20] where researchers also observed a marked change in wrist position between efforts. Supramaximal loading appears to accentuate this sub optimal wrist position, and while it may have no bearing on work output initially, individuals should be conscious of this change to avoid injury. However, wrist position changes and subsequent discomfort may also stem from other joint kinematic changes that occur from the use of the Slingshot. Surprisingly there is a lack of research examining elbow and shoulder joint kinematics in equipped lifting (i.e. to our knowledge bench shirts have been examined only upon bar path kinematics)[5,29] and thus future work should examine the effects of the Slingshot upon joint kinematics during bench press.

CONCLUSION

The aim of this study was to test the Slingshot's ability to allow individuals to perform an increased volume-load during the bench press whilst using a maximal load obtained during an unaided bench press 1RM. The results revealed a significant increase in volume load whilst using the Slingshot in line with prior research similarly suggesting that it can enable 'supramaximal' loads to be utilised. The Slingshot therefore might facilitate enhanced practice of lifting maximal or near maximal loads through an increased volume-load. However, future research should implement an intervention to measure the potential strength and hypertrophy outcomes of using the Slingshot.

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