Comparison Of Muscle Activity Between The Tsunami Barbell™ And An Olympic Barbell

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Abstract
Variations on a standard Olympic barbell (chains, resistance bands, board presses) have been used as alternative methods for power development. A new product, the Tsunami Barbell™ (TSB), claims to incite increased muscle activity due to its flexible nature when compared to performing similar lifts on an Olympic barbell (OB). **PURPOSE**: The study sought to determine whether there is a difference in muscle activity and force production when performing a bench press with a flexible barbell (Tsunami Barbell™) versus with a standard Olympic barbell. **METHODS**: Male varsity athletes (n=13, age=19.5±1.4) from Furman University who had been previously trained with the TSB volunteered to participate. After a familiarization trial, surface electrodes were placed on five major muscles: anterior deltoid (AD), lateral deltoid (LD), posterior deltoid (PD), pectoralis major (PM), and triceps brachii (TB), to monitor muscle activity via EMG. Using an estimate of their 1RM for bench press, subjects were asked to perform three sets; the estimated 1RM with the OB to find maximal voluntary contraction (MVC), 40% of 1RM with the TB, and 40% of 1RM with the OB. For the 40% lifts, subjects performed 7-10 repetitions in sync with a metronome set at 50Hz. The TSB and OB sets were normalized to the 1RM voltage. Two measures were analyzed: the normalized max (NM) and the mean of the integrated signals (MI) for 4 reps in the middle of each set. **RESULTS**: The TSB showed significantly higher muscle activity for all five muscles groups in both analyzed measures (Table 1). **CONCLUSIONS**: The results of this study suggest that muscle activity in the muscle groups studied may be greater when performing a bench press with the Tsunami Barbell™ than with an Olympic barbell at the same weight.

Introduction
The bench press exercise has always been a popular form of upper body resistance training. It is primarily used to develop the pectoral muscles (pectoralis major, pectoralis minor), the shoulder muscles (the anterior, lateral, posterior heads of the deltoid), and the muscles of the upper arm (namely the biceps brachii and triceps brachii). As athletes seek to develop strength and power, they require different lifts to maintain variety in their training sessions. Chains, resistance bands, and board presses have all been used as a form of power development. Despite the popularity of the bench press, alternative forms of upper body strength training have been sought out. A new product, the Tsunami Barbell™ (TSB), claims to incite increased muscle activity due to its flexible nature when compared to performing similar lifts on an Olympic barbell (OB). Previous studies have looked at form (hand position) and technique (speed differences, explosive bench throws) variations to the bench press and have found that these methods do incite greater muscle activity. Studies have varied on the advantages to use of dumbbells and bench press machines, with mixed significance seen for both alternative forms of upper body lifts.

Purpose
The purpose of this study was to determine whether there is a difference in muscle activity when performing a bench press with a flexible barbell (Tsunami Barbell™) versus with a standard Olympic barbell. Specifically, this study compared muscle activation for the three heads of the deltoid (anterior, lateral, posterior), the pectoralis major, and the long head of the triceps brachii while performing the lift at 40% of the subject's one rep maximum. This study was conducted under the null hypothesis that no difference would be observed in muscle activity between the TSB and OB.

Methods
Participants
Thirteen male varsity athletes (age=19.5±1.4) from Furman University volunteered to participate. Each subject had substantial prior training with the TSB through the Furman University Strength and Conditioning Program.

Testing Protocol
A familiarization trial was held for each subject in order for them to become proficient at moving both the TSB and OB (loaded with 40% of their estimated 1RM) in sync with a metronome set at 50Hz. Once the subject was comfortable with moving the barbells at that pace, surface electrodes were placed on five upper body muscle groups: anterior deltoid (AD), lateral deltoid (LD), posterior deltoid (PD), pectoralis major (PM), and triceps brachii (TB). Grounds for the surface electrodes were placed on a bony surface such as the olecranon, acromion, manubrium, and clavicle. The surface electrodes were connected to BIOPAC Systems, Inc. BioNomadix EMG transmitters, whose signal was sent to the BIOPAC Systems, Inc. MP150 Receiver and recorded in AcqKnowledge software. With the systems running, the subject's estimated 1RM was loaded onto an OB and they were asked to perform the lift so maximal voluntary contraction (MVC) could be obtained. If the subject could not perform the 1RM, forced repetition procedure was used where a spotter would provide just enough assistance for the subject to complete the lift. After adequate rest, 40% of the subject's 1RM was loaded onto either the TSB or OB (randomly determined), and they performed seven to ten repetitions in sync with the metronome. Once they completed that set and adequate rest was once again provided, the subject performed another set of seven to ten repetitions on whichever barbell they had not previously used.

Figure 1

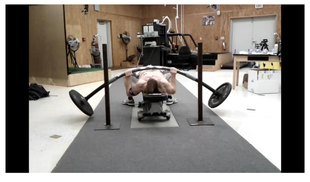


Figure 1 shows the Tsunami Barbell at its lowest point during a standard bench press repetition.

Data Analysis
The EMG data for the TSB and OB sets were normalized based on the 1RM voltage so that values for each contraction were represented as %MVC. The first measure was the normalized maximum value (NM) for %MVC of each analyzed contraction. This measure was simply the highest peak in each contraction wave. The second measure was the mean of the integrated signals (MI) for %MVC of each analyzed contraction. For this measure, the entire contraction wave was integrated and the mean wave obtained.

Figure 2

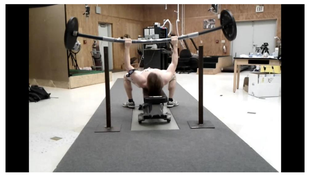


Figure 2 shows the Tsunami Barbell at its highest point during a standard bench press repetition.

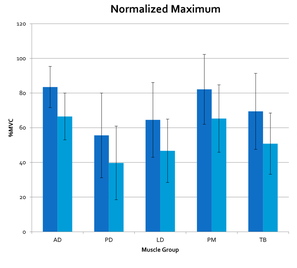
Results
The data was analyzed using a paired samples T-test in SPSS statistical software with a P<0.05 for level of significance. Table 1 contains the descriptive statistics to which the T-test were applied. Significant differences between means have been bolded and identified with an asterisk.

Table 1: Descriptive Statistics in %MVC

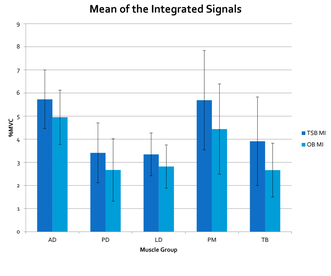
	Tsunami Barbell	Olympic Barbell
Anterior Deltoid	**NM: 83.5±11.7*** **MI: 5.7±1.3***	NM: 66.5±13.5 MI: 5.0±1.2
Lateral Deltoid	**NM: 64.5±21.2*** **MI: 3.4±0.9***	NM: 46.7±18.3 MI: 2.8±1.0
Posterior Deltoid	**NM: 55.6±24.4*** **MI: 3.3±1.3***	NM: 39.7±21.2 MI: 2.5±1.2
Pectoralis Major	**NM: 80.8±20.0*** **MI: 5.7±2.1***	NM: 62.1±16.4 MI: 4.4±2.0
Triceps Brachii	**NM: 68.8±19.8*** **MI: 3.7±1.8***	NM: 50.5±18.3 MI: 2.7±1.2

* P < 0.05, P<4E-4

EMG Analysis
Results of the paired samples T-test show that, for each of the muscle groups tested, the NM %MVC (AD, t = 9.647, P = .000; LD, t = 9.271, P = .000; PD, t = 5.380, P = .000; PM, t = 9.261, P = .000; TB, t = 6.497, P = .000) and MI %MVC (AD, t = 5.479, P = .000; LD, t = 5.798, P = .000; PD, t = 6.373, P = .000; PM, t = 11.908, P = .000; TB, t = 4.501, P = .000) for the TSB were found to be significantly higher than the NM and MI for the OB (Table 1). Basic descriptive statistics for each muscle group comparison indicate that muscle activity, in the form of %MVC, was greater for the TSB than for the OB.



Graph 1 (*left)* shows the normalized max for %MVC, with the TSB having great %MVC for all muscle groups



Graph 2 (*right)* shows the mean of the integrated signals for %MVC, with the TSB having great %MVC for all muscle groups

Figure 3

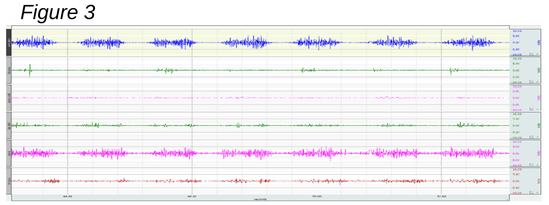


Figure 3 shows an EMG with each wave representing a muscle contraction for each muscle during the repetition.

Conclusion
The results of the study suggest that muscle activity and force production may be greater when using the TSB compared to using a standard OB at the same weight. For both the maximum electrical signal (NM) and the average of the electrical signal during the entire contraction (MI) for each muscle group tested, the TSB was significantly higher than the OB. Each muscle group displayed at least a 15.9% higher NM MVC for the TSB than they did for the OB, with the PM having the greatest difference in %MVC at 18.7% and the PD having the smallest difference. The MI %MVC was also higher for the TSB by at least 0.6%, with the PM once again having the greatest difference and LD having the smallest. There are two possible reasons for the increased amount of muscle activity seen with the TSB when compared to the OB. First, the TSB was designed to provide the ability to lift while simulating an unstable environment. Because the deltoid muscles serve not only to move the shoulder joint, but also to stabilize it, it is logical that a barbell that is meant to develop the stabilizer muscles would have a greater amount of muscle activity and force produced by those muscles. Secondly, the movement of the barbell through its oscillation created peaks of large force production at the highest and lowest points of a repetition, which would also explain why more muscle activity was required to move the TSB.
In displaying greater significance in muscle activity and force production, the TSB can seemingly become an alternative to the standard bench press using the OB. It can add variation to any upper body resistance training and can be considered beneficial to the development of upper body strength and power. The TSB also serves to simulate some forms of in-competition movements as it provides an unstable resistance in a strength training setting and exercise. Bench press with the TSB can supplement standard bench press exercises, as there are benefits to the OB.

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