



Electromyographical Comparison Between a Digital Weight and Traditional Free Weights

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Background

- Various digital weight systems (DWS) have been designed for at-home use. These DWS include various exercise modes, some of which result in variable resistance during exercise.
- These variable resistance modes utilize the DWS to intelligently match the resistance to the exerciser by continuously adding or subtracting weight depending on when their muscles are at their strongest and weakest during an exercise.
- Variable resistance training methods have been shown to improve the rate of force development, coordination between antagonist and synergist muscles, the recruitment of motor units, and reduce the drop in force produced in the sticking region of lifts (1).
- It is essential that strength and conditioning professionals understand the effects that diverse resistance exercise modes have on the exercising muscles in order to design effective resistance training programs
- Muscular activation is important during an exercise program as it has been shown to be an important stimulus for the development of muscle strength and mass (2).
 - Surface electromyography (sEMG) can be used to noninvasively assess muscle activation during dynamic exercise.

Purpose and Hypothesis

The purpose of this study was to compare muscle activation during various exercises performed using a digital weight system and traditional free weights.

We hypothesized that we would observe a difference in muscle activation between the two exercise modes due to the variable nature of the digital weight system.

Methods

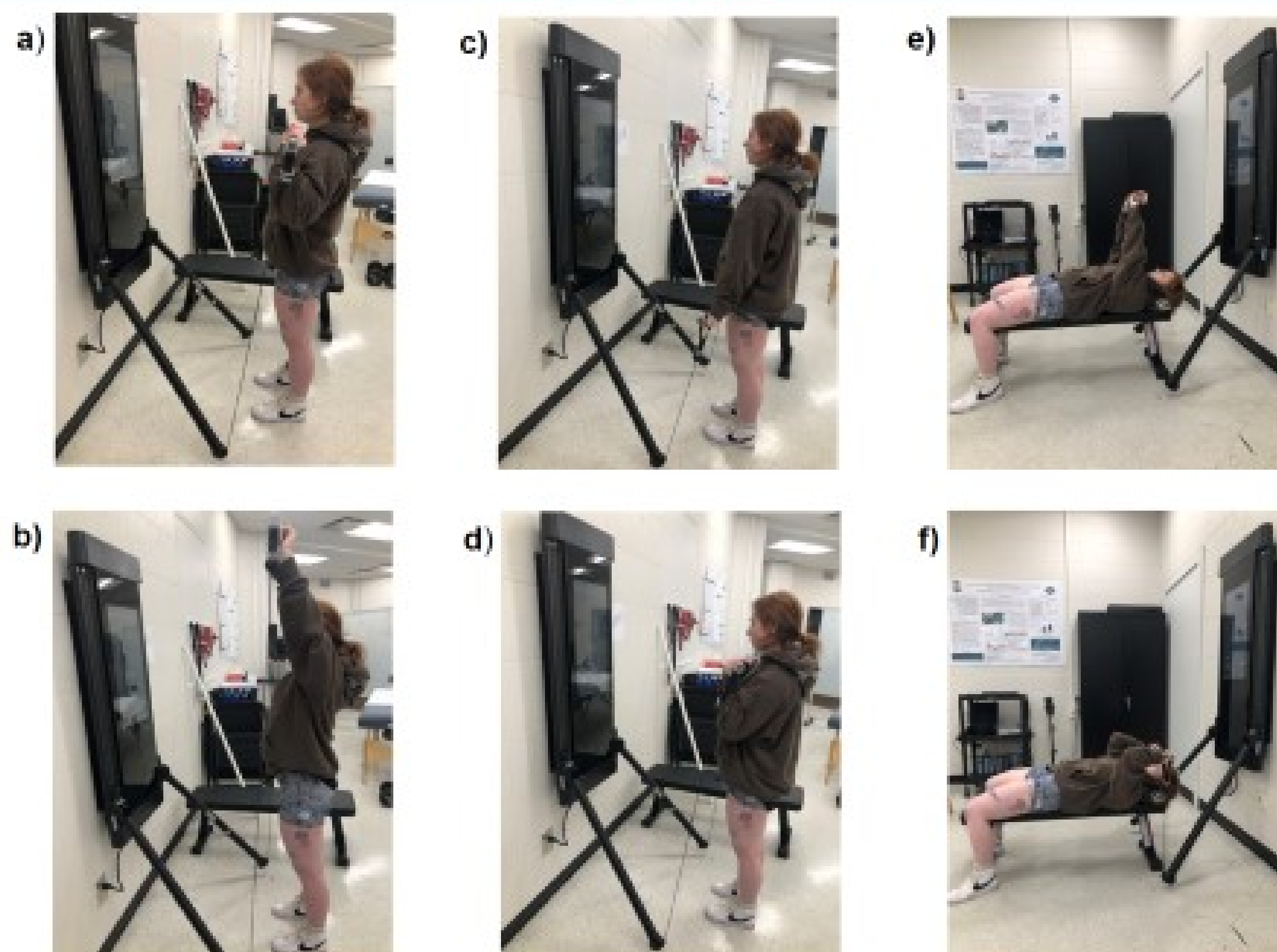


Figure 1. Representation of DWS exercises: a) starting position for standing overhead press, b) ending position for standing overhead press, c) starting position for bicep curl, d) ending position for bicep curl, e) starting position for skull crushers, f) ending position for skull crushers

Methods

Participants

- Eight healthy adults (26 ± 7 yrs.) participated in this study. All participants completed three separate visits

Visit 1

- Participants first completed an informed consent and medical history questionnaire
- Next participants completed a one-repetition maximum (1RM) for the three exercises that were performed. Skull crushers were performed to target the triceps, standing overhead press targets the anterior deltoids, and bicep curls were performed to target the biceps.
 - 65% of their 1RM's were used during each condition (DWS or free weight)
 - A Tonal© system was used for the DWS, utilizing the Smartflex© exercise mode

Visit 2 and 3

- Participants completed conditions (DWS, free weight) in a randomized order.
- Participants were first outfitted with sEMG on the anterior deltoid, biceps brachii, and triceps
- During each condition participants begin their exercise trials by completing maximal voluntary isometric contractions (MVICs) for each muscle under investigation. This was done in order to normalize the sEMG data.
- Next, in random order participants completed 9 repetitions of each exercise.
- In between each exercise, participants rested for 5 minutes to minimize the effect of fatigue on performance.

Data Analysis

- The EMG signal was collected at a frequency of 2000 Hz, bandpass filtered at 10-500 Hz, smoothed via root mean square (RMS), then normalized to MVICs.
- Repetitions 4, 5, and 6 were analyzed and used for comparisons between conditions.
- T-test was utilized to assess differences

Practical Application

The DWS may be an effective home-based exercise modality, however, future research is needed to determine long-term training adaptations.

References

1. Soria-Gila, Miguel A.; Chiroso, Ignacio J.; Bautista, Iker J.; Baena, Salvador; Chiroso, Luis J. Effects of Variable Resistance Training on Maximal Strength: A Meta-Analysis. *Journal of Strength and Conditioning Research* 29(11):p 3260-3270, November 2015.
2. Trebs AA, Brandenburg JP, Pitney WA. An electromyography analysis of 3 muscles surrounding the shoulder joint during the performance of a chest press exercise at several angles. *J Strength Cond Res.* 2010 Jul;24(7):1925-30.

RESULTS

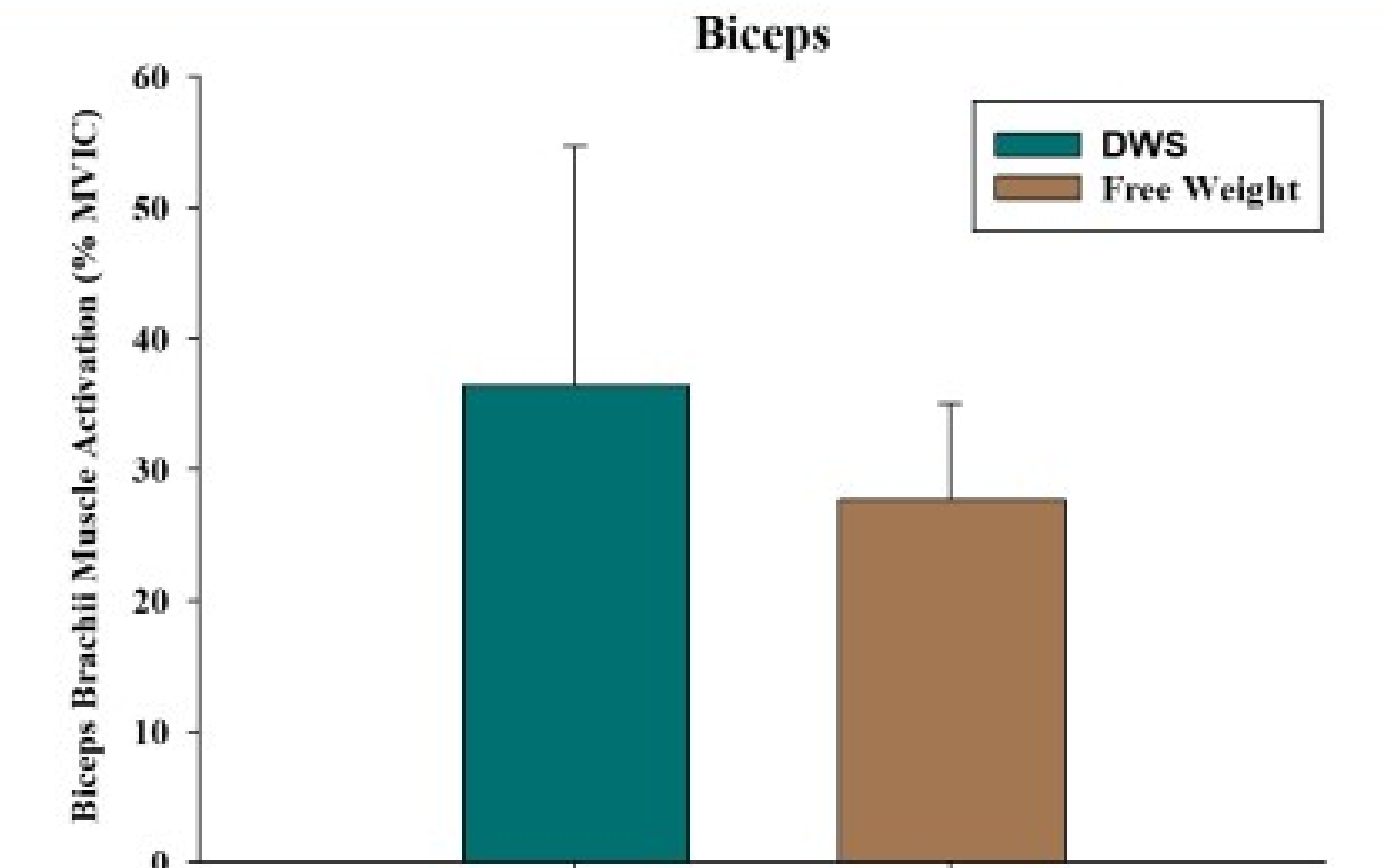


Figure 2. No difference in muscle activation of the biceps brachii during bicep curl

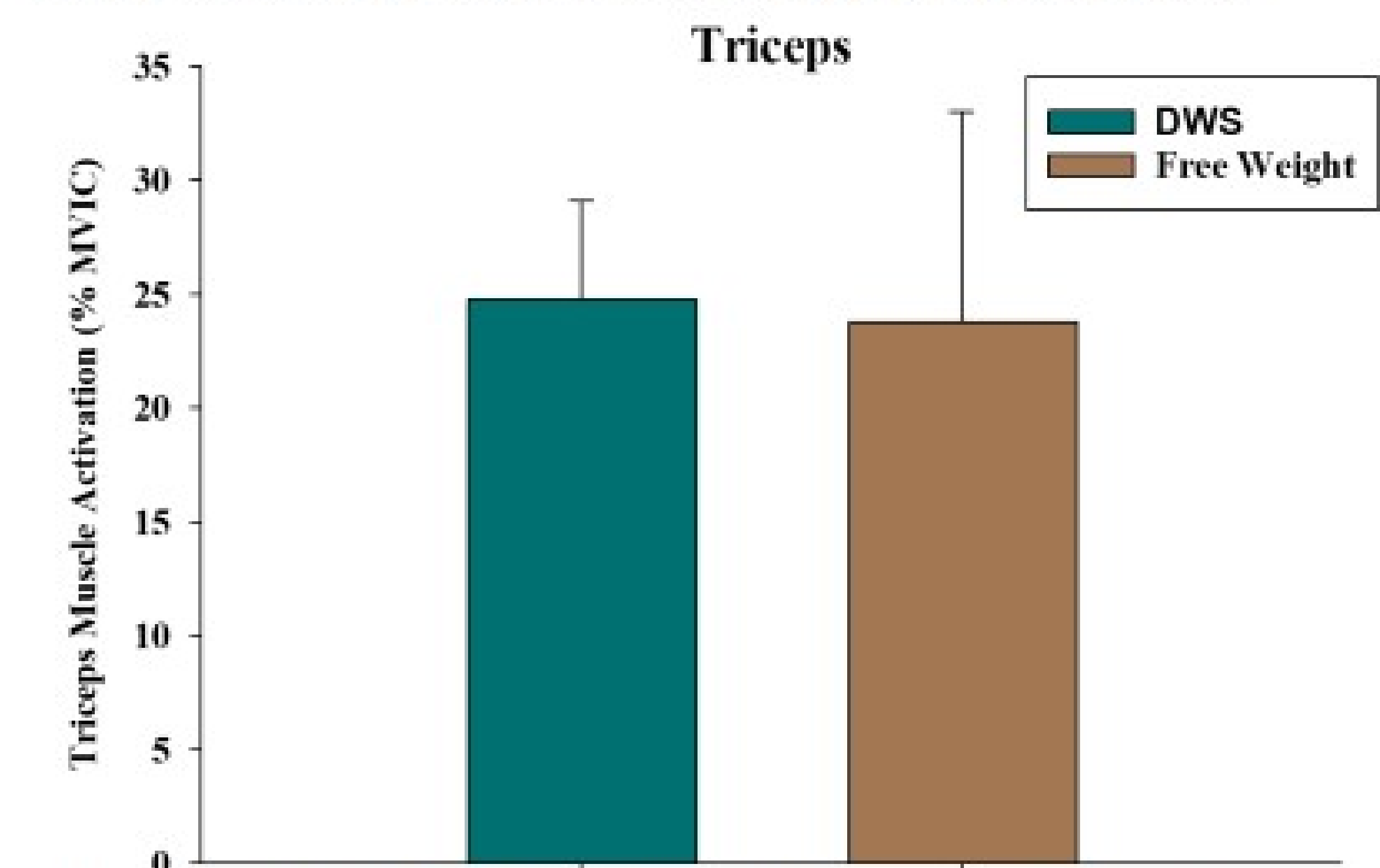


Figure 3. No difference in muscle activation of the triceps during skull crushers

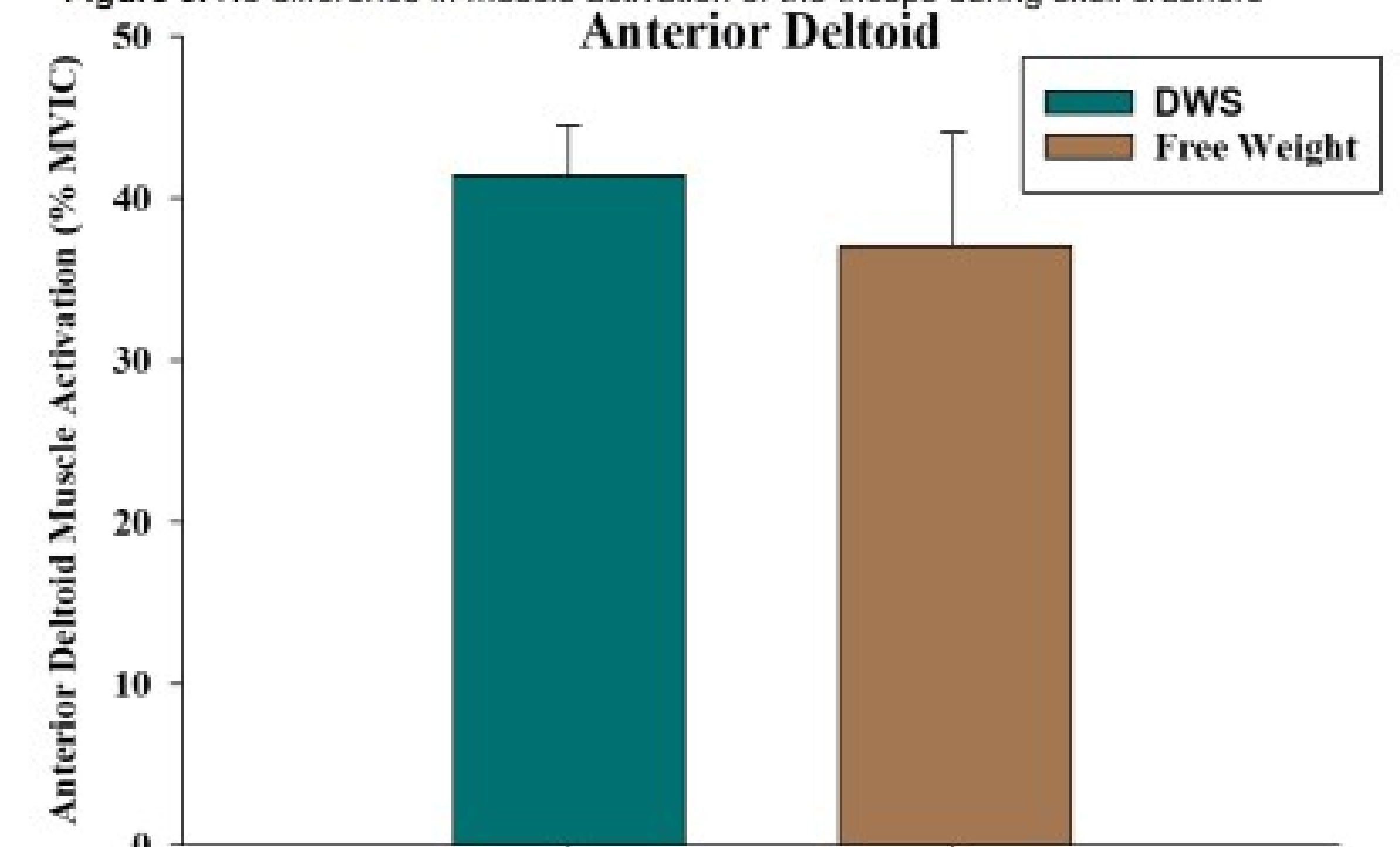


Figure 4. No difference in muscle activation of the anterior deltoid during the overhead press

Conclusion

In the current investigation, no differences in muscle activation were observed between free weight exercise and DWS in the primary movers during the investigated exercises.