How Grip Variation Effects Shoulder Complex Muscle Activation During the Pull-Up

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Abstract

Pull-ups are a common training exercise essential for strength gains in resistance-based training workouts and workout programs. The purpose of this study was to determine the impact of different pull-up grips on muscle activation in six college aged males. Participants were fitted with electrodes on the biceps brachii, middle deltoid, trapezius, and the latissimus dorsi. Maximum voluntary isometric contraction (MVIC) values were assessed for each muscle. Participants completed five trials of each pull up grip variation for sEMG assessment. Grip variations included pronated grip, neutral grip, and supinated grip. A two minute rest period was given between each grip variation. Mean EMG activation was normalized to MVIC values for each grip variation trial. Although it was evident that different grips did create varying levels of muscle activation, a series of one-way ANOVA revealed that these differences were not statistically significant.

Introduction

The pull up is a resistance exercise that is widely used in a variety of strength and conditioning settings to promote muscular endurance or strength adaptations.[1] The muscles utilized during the pull up include the middle and lower trapezius, rhomboids, pectoralis major and minor, posterior deltoid, infraspinatus, latissimus dorsi, teres major, biceps brachii, brachialis, brachioradialis, flexor carpi radialis and ulnaris, palmaris longus, flexor digitorum superficialis and profundus, and flexor pollicis longus.[2] A variety of grips can be used when performing a pull up, including pronated, supinated, or neutral grip. Past research indicates that peak activation of the shoulder muscles of pull up variants are similar despite varying hand orientation.[1] Research has also shown that the pronated grip is superior in recruiting the middle trapezius when compared to the neutral grip.[1] Studies also indicate that the biceps brachii and pectoralis major are more active during the chin-up (supinated grip) when compared to the pull-up (pronated grip).[3]Surface electromyography (sEMG) is a common technique used to investigate muscle activation and fatigue, is non-invasive and allows for continuous measurement.[4] sEMG testing allows researchers to quickly, efficiently, and reliably measure muscle activation.

Figure 1
Start Phase

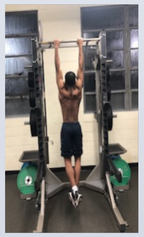


Figure 2
Concentric Phase

Figure 3
Eccentric Phase

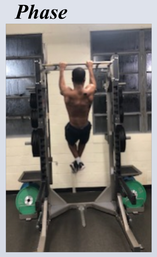
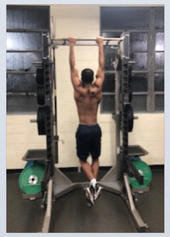


Figure 4
End Phase



Methods

Setting

- Small DI Midwestern University laboratory
- Spring 2020

Participants

- 6 college aged males

Procedures

- 5-minute dynamic upper body warmup.
- Skin surface of deltoids, trapezius, latissimus dorsi, and biceps brachii prepares and secured with electrode sensors.
- Maximal voluntary isometric contraction (MVIC) collected for each muscle.
- 5 repetitions of each variation of pull-up were performed and video recorded
- Subjects followed a cadence of 1 up, 1 second down, and a 1 second pause at the bottom of the movement
- Electrodes detecting muscle activity sent data via Bluetooth to computer program.
- Series of one-way ANOVA used to test statistical significance

Results

Table 1
Difference in mean percent MVIC muscle activity: Biceps

n	SUP	PRO	Δ	PRO	NEUT	Δ	SUP	NEUT	Δ
5	134.94	119.24	19.21	119.24	125.42	6.18	134.94	125.42	12.72

Table 2
Difference in mean percent MVIC muscle activity: Trapezius

n	SUP	PRO	Δ	PRO	NEUT	Δ	SUP	NEUT	Δ
5	143.97	123.3	20.67	123.3	127.61	47.88	143.97	127.61	44.62

Table 3
Difference in mean percent MVIC muscle activity: Latismus Dorsi

n	SUP	PRO	Δ	PRO	NEUT	Δ	SUP	NEUT	Δ
5	157.00	182.80	49.69	182.80	205.80	26.56	157.00	205.80	70.00

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Results cont.

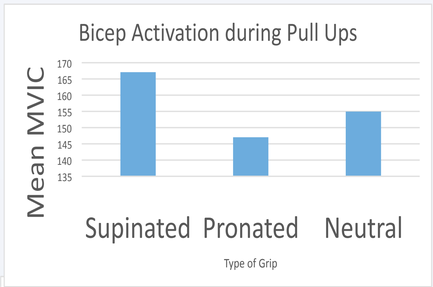

Figure 5
Comparison of bicep activation for three grips. Biceps: p = 0.91116

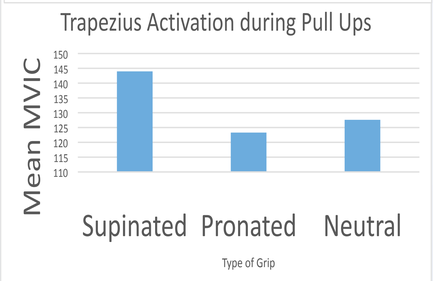

Figure 6
Comparison of trapezius activation for three grips. Trapezius: p = 0.8895

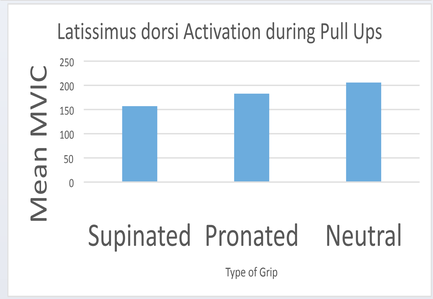

Figure 7
Comparison of latissimus dorsi activation for three grips. Latissimus dorsi: p= 0.93210

P-values for all muscles indicated a negligible difference between grips.

Conclusion

Overall this study displayed that varying pull-up grips do in fact cause variation in the levels of activation of the muscles found in the shoulder girdle the difference is not statistically significant. While the differences are not statistically significant, a small difference added up over and over again may equal a big difference in muscular strength gains. Therefore, this study showed that supinated pull-up grips elicit the greatest muscular activation in the biceps and trapezius, while the neutral and pronated grip pull-ups elicit a more significant muscular activation in the latissimus dorsi. People who wish to strengthen their shoulder girdle muscles overall but with an emphasis on bicep growth, should focus on incorporating more supinated grip pull-ups. Those who want to create more strength in their shoulder girdle with greater emphasis on the back muscles, should incorporate more pronated grip pull-ups in their workout routine.

References

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