

COMPARING MUSCLE ACTIVITY DURING FORWARD AND BACKWARD STRIDING ON AN ELLIPTICAL TRAINER

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INTRODUCTION

The elliptical trainer is a fairly new piece of exercise equipment, and despite its growing popularity, there is limited research on this training modality. Studies have examined cardiovascular responses and impact forces (Mercer, et al. 2001; Porcari, et al. 2000); however, to date there is no literature available on relative muscle activity at different grades and direction while using the elliptical trainer. Similar research on forward and backward running has shown muscle activity differences (Flynn, 1993). The purpose of this study was to determine the differences in muscle activity, as measured through electromyography (EMG), between forward and backward striding at three grades on an elliptical trainer.

Knowledge of relative muscle activity at different grades and direction would be beneficial in designing training and rehabilitation programs that incorporate the elliptical trainer. This would enable targeting specific muscle groups or avoiding re-injury, especially for athletes with muscle strains.

METHODS

Moderately active females (N = 10; age: 20.2 ± 1.0 years; mass: 66.8 ± 9.1 kg; height: 169.5 ± 7.1 cm) with previous experience using the elliptical trainer

(Precor EFX546) were asked to stride both forward and backward at low, intermediate, and high grades, with the resistance and stride rate held constant. University IRB approval was obtained and all subjects signed informed consents.

Participants were asked to perform all conditions in a random order, striding for five minutes in each grade and direction setting. Surface EMG was used to determine the total integrated muscle activity averaged over two 5-second trials for four major muscle groups (gluteus maximus, rectus femoris, biceps femoris, and gastrocnemius). Recordings were taken at times during each condition without the subjects' knowledge of when the data collection actually occurred.

EMG activity was recorded using a Bortec AMT-8 Octopus cabled system, collected by Run Technologies DataPac software. EMG signals were rectified, low passed filtered (Butterworth 15 Hz, cutoff 7) and integrated. The resulting signals were normalized to the percent of signal time, and averaged per condition.

Maximum IEMG values were compared within each muscle group, between each grade x direction condition, using a repeated measures 2 x 3 ANOVA. Alpha was set at .05 level of significance.

RESULTS AND DISCUSSION

Each subject demonstrated unique patterns in muscle activity between conditions, but several trends were noted across subjects (see Figure 1). Within each muscle group, EMG activity was statistically significantly higher for the rectus femoris in backward striding when compared to forward striding ($F=5.65$, $df=1$, $p=.04$).

No other statistically significant differences for the main effects of grade or direction, nor for any interactions, were noted within the muscle groups. However, somewhat greater bicep femoris activity was observed in forward striding when compared to backward striding. The gluteus maximus was the only muscle that appeared to have increased EMG activity with increasing grade. The lateral gastrocnemius showed little variation with respect to either direction or grade.

SUMMARY

There is limited research on the elliptical trainer, particularly with regards to muscle activity. This information would help to design training and rehabilitation programs that either target or avoid specific muscle groups. This study found that the biceps femoris and rectus femoris were most active during forward and backward striding, respectively, while muscle activity for the gluteus maximus increased with grade, and the gastrocnemius did not demonstrate any trends. Overall, direction appears to have a greater influence on muscle activity than the grade, at least for this elliptical machine.

REFERENCES

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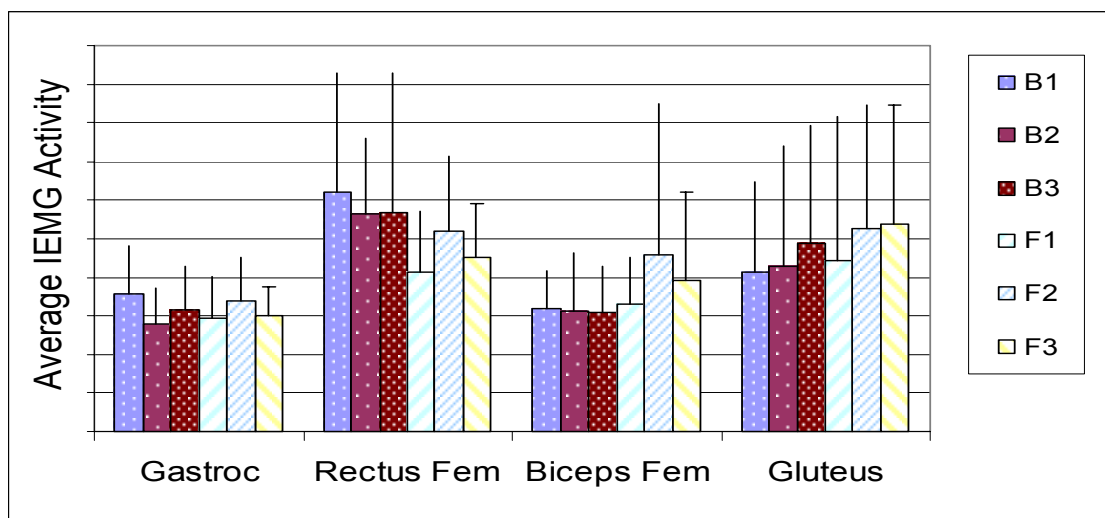


Figure 1: Average IEMG activity for each muscle group during forward (stripes) and backward (dots) striding at low (1), intermediate (2), and high (3) grades.