

QUADRICEPS ELECTROMYOGRAPHIC ACTIVITY DURING TWO DIFFERENT SQUAT EXERCISES: FLYWHEEL MULTIGYM VS BARBELL HALF-SQUAT



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INTRODUCTION

The Flywheel Multigym device (www.yoyotechnology.com) allows for the performance of maximal concentric (CON) and eccentric (ECC) actions in a wide range of upper and lower body exercises. This exercise system uses the inertia of rotating flywheels to provide resistance and works independent of gravity¹. Though studies have reported positive effects of chronic resistance exercise using this device in confined² or bedridden individuals³, until now no study has compared muscle activity with this methodology and traditional free barbell exercise. The goal of this study was to compare the electromyographic (EMG) activity of knee extensor muscles during two squat exercises: Flywheel Multigym (FW) vs free barbell half-squat (SQ).



Figure 1. Subject performing the equivalent of squat exercises on the Flywheel Multigym. The subject is wearing an harness connected to the flywheel axle, which is put into rotation (CON action) when he is pushing with his legs against the foot rests, thus sliding backwards on the rails. The subsequent coupled ECC action consists of resisting to the pulling force of the flywheel after the strap has been unwound and starts to recoil.

METHODS

Five experienced male lifters (age 32.6 ± 1.8 yr; height 178.6 ± 104 cm; weight 88.2 ± 14.9 kg; SQ 10RM 146 ± 18 kg) volunteered. They were familiarized with the particular technique needed to perform the FW squat (**Figure 1**), and the 10RM in the half-squat exercise was determined using an Olympic barbell in two sessions that preceded the experiments. About one week later subjects performed three maximal voluntary contractions (MVC) at 90° knee angle and then five sets of 10 repetitions (3 min rest between sets) of either exercise. With use of bipolar surface electrodes, placed over mm. vastus medialis (VM), vastus lateralis (VL), and rectus femoris (RF), EMG activity was recorded (**Figure 2**). Root mean square of EMG signal amplitude (EMG RMS) data was calculated and normalized to maximal EMG for each individual. A two-way repeated measures ANOVA was performed to compare both exercises and the interaction between exercise x muscle, exercise x action type (CON and ECC), and exercise x muscle x action.

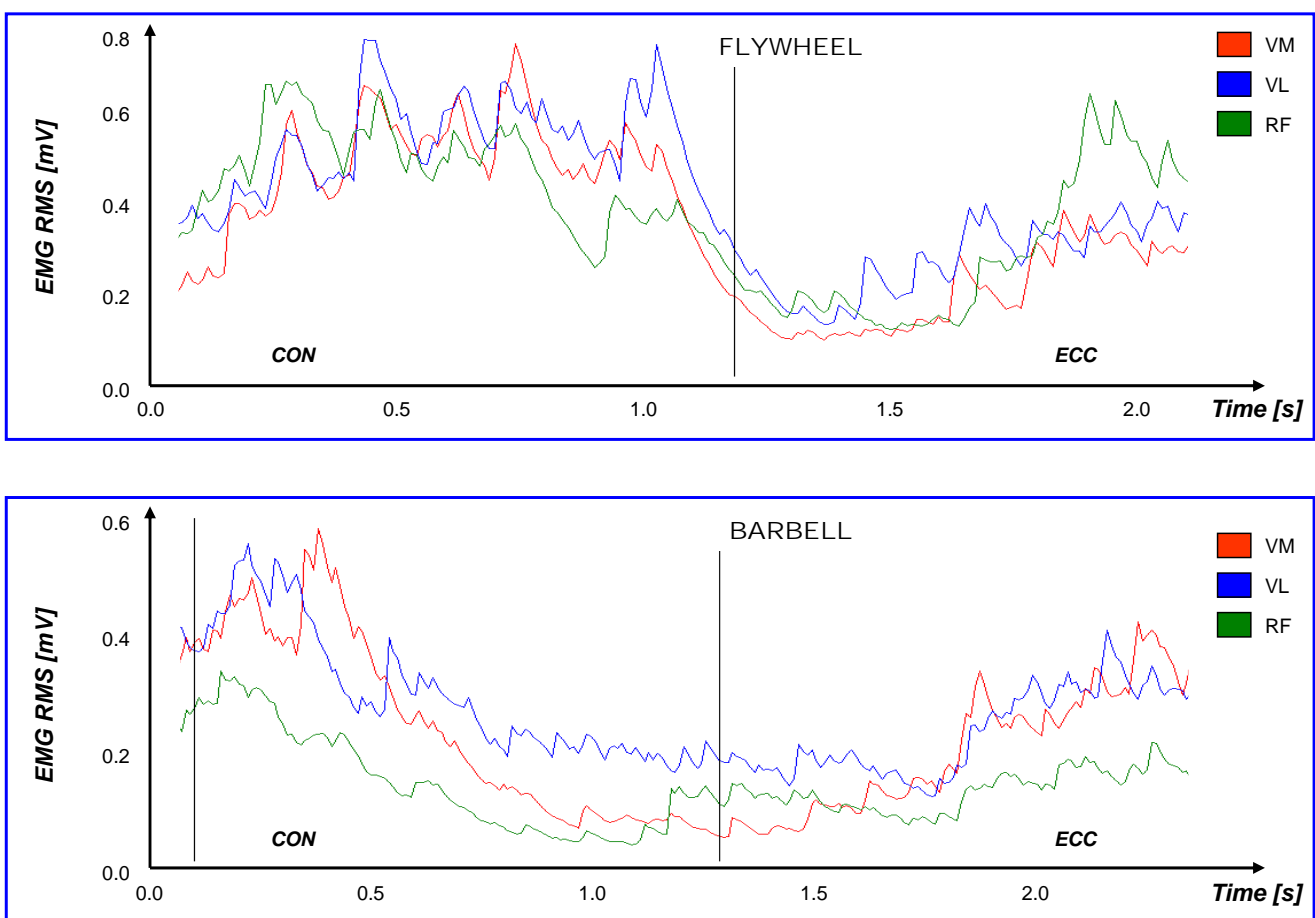


Figure 2. Time course of EMG RMS in the three muscles investigated during coupled CON/ECC action on the Flywheel Multigym (FW, above) and during conventional barbell squat (SQ, below). The vertical line in the middle of each graph separates the CON from the ECC action. EMG amplitude has higher values in FW than in SQ; furthermore, it is maintained maximal throughout all CON action, as opposed to conventional squat.

RESULTS

Overall quadriceps muscle EMG activity was greater for exercise with FW compared with SQ ($p < 0.0001$, **Figure 3**). While there was a trend for difference in the exercise x muscle portion interaction ($p = 0.087$), there was no difference for the exercise x muscle action (ECC/CON) or exercise x muscle x action interactions.

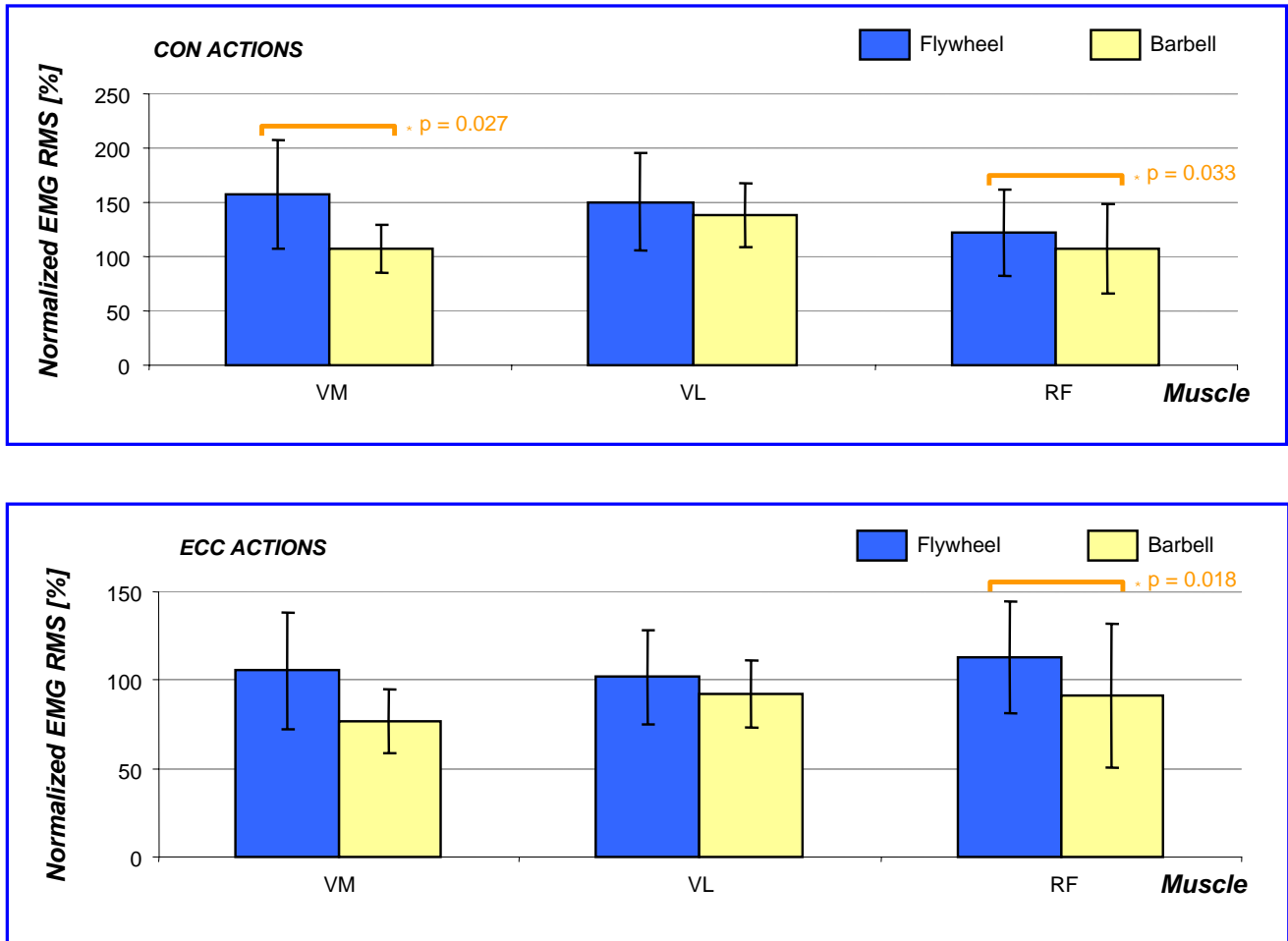


Figure 3. EMG amplitude (see text for details) of Flywheel vs barbell squat. The mean values of normalized EMG RMS values during each whole CON (top panel) and ECC (bottom panel) action, respectively were averaged over all reps and expressed as mean \pm SD. Significant difference for paired T-tests of muscles for the two exercise types is also indicated.

CONCLUSIONS

Performing squat exercise on the FW produces greater quadriceps muscle EMG activity than performing the traditional half-squat with an Olympic barbell.

As it emerged from this study, there are certainly other safe and functional yet effective alternatives to perform the barbell squat with heavy weights. Thus, the results reported here suggest that overall quadriceps muscle activity with FW is even greater than elicited with the barbell squat. This novel training approach may provide athletes, limited by weak trunk or upper-body strength or extraordinary body stature, e.g., basketball players, an alternative to carry out heavy squats.

REFERENCES

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