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ELECTROMYOGRAPHICAL COMPARISON BETWEEN A ROTATIONAL INERTIAL RESISTANCE DEVICE AND FREE WEIGHTS: A CASE STUDY

In order to be a viable training tool, rotational inertial resistance (RIR) devices should produce a stimulus equivalent to, if not better than, traditional free weights. To date, there is a lack of data comparing RIR and free weight exercise in regards to muscle activation.

PURPOSE:

To compare muscle activation via electromyography (EMG) between a rotational inertial resistance (RIR) device and free weights (FW) during front squats.

METHODS:

The subject was a 31-year-old resistance trained male (170 cm, 83 kg) with 9 years of weightlifting experience (front squat 1RM = 150 kg). The RIR device features a tether wrapped around a vertical cone-shaped shaft. The cone's moment of inertia can be altered by changing weights located on the bottom. An adjustable pulley on the side of the device alters the torque applied to the cone and thus alters movement velocity. The RIR device was configured with the tether threaded through a pulley attached to the floor platform and connected to a shoulder harness. The session consisted of dynamic performance tests using free weights (FW) and the RIR device. After the skin was prepped by shaving and vigorous abrasion with fine sand paper and alcohol swabs differential electrodes were placed bilaterally on the vastus lateralis (VL), rectus femoris (RF), vastus medialis (VM), and biceps femoris (BF) muscles. Eight sets of three RIR front squats and six sets of three FW front squats were performed. The RIR front squats were performed in duplicate with 2kg counterweights/high velocity pulley (2H), 2kg counterweights/low velocity pulley (2L), 8kg counterweights/high velocity pulley (8H), and 8kg counterweights/low velocity pulley (8L). Following the RIR sets, three duplicate sets of FW front squats with 45, 65, and 85% 1 RM were performed. Muscle activity data was collected simultaneously with force and velocity data at 1000 Hz with an 8-channel EMG system (Runtech, Mission Viejo, CA). Signals were band-pass filtered with cutoff frequencies of 10 and 400 Hz. A 4^{th} order recursive Butterworth filter with a low-pass cut-off frequency of 30 Hz was used for force and velocity signal smoothing. An average of the best repetition from each set based on peak power was used for analysis. EMG data was averaged across all muscles.

RESULTS:

Median EMG (mEMG) frequency was similar for all conditions (mEMG range = 90.0Hz - 99.4Hz). All FW root mean square EMG (rmsEMG; 50ms) (rmsEMG) values were greater than 2L and 2H. 8H and 8L rmsEMG was greater than 45% 1RM but lower 85% 1RM FW. 8H and 8L rmsEMG was similar to 65% 1RM. All FW integrated EMG (iEMG) values were greater than 2L and 2H. 8L produced greater iEMG than 45 and 65% 1RM but less than 85% 1RM. 8H iEMG was greater than 45%1RM but less than 65 and 85% 1RM.

CONCLUSIONS:
In general, free weight front squats produced greater muscle activation than the RIR front squats. However, using the large counterweights, the RIR device was capable of eliciting higher muscle activation than 45 and 65% 1RM FW front squats. Previous data from our lab shows that the RIR device produces similar force to 45% 1RM FW front squats. **PRACTICAL APPLICATIONS:** This RIR device may allow users to achieve muscle activation comparable to that achieved during conventional free weight exercise at low to moderate intensities. This project was sponsored in part by Heart Rate Inc.