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MECHANICAL COMPARISON OF A ROTATIONAL INERTIAL RESISTANCE DEVICE AND FREE WEIGHTS

Rotational inertial resistance (RIR) devices have recently been marketed as viable resistance training modalities. However, there exist only limited data comparing such devices with traditional resistance training tools.

PURPOSE: To compare kinetic and kinematic performance outcomes between a RIR device and free weights.

METHODS: Eleven resistance-trained males (X±SE, 24.7±0.94 yrs; 174.0±1.4cm, 79.8±2.4kg) participated in this investigation. The RIR device features a tether wrapped around a vertical cone-shaped shaft. The cone's moment of inertia can be altered by changing counterweights (CW) located on the bottom. An adjustable pulley on the side 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 the front of a shoulder harness thus resembling a front squat position. The sessions consisted of dynamic performance tests using free weights (FW) and the RIR device. Eight sets of three RIR front squats and six sets of three FW front squats were performed on separate days. The RIR front squats were performed in duplicate with 2kg CW/high velocity pulley (2H), 2kg CW/low velocity pulley (2L), 8kg CW/high velocity pulley (8H), and 8kg CW/low velocity pulley (8L). Force data were collected using a strain gauge connected in line with the tether. A velocity transducer was used to directly measure linear vertical velocity. The FW front squats were performed in duplicate sets of three repetitions with 45, 65, and 85% 1 RM. A force platform measured vertical ground reaction force while a velocity transducer attached to the bar measured linear velocity. The strain gauge, force platform and linear velocity transducer were interfaced to a PC. Data were sampled at 1000 Hz and filtered using a low-pass, 4^{th} order Butterworth filter with a cutoff frequency of 30Hz. Data analysis was conducted with Datapac 2K2 (v3.18; Runtech, Mission Viejo, CA). The order of sets was counterbalanced and sessions were repeated at least 48 hours later to determine stability reliability using intraclass correlation coefficients with r-values ≥ 0.70 considered reliable. Coefficient of variation values ≤ 15% were considered precise and used for further analysis.

RESULTS: Concentric measures of peak force (PF), mean force (XF), peak velocity (PV), mean velocity (XV), and mean power (XP) were reliable. Mean and peak data followed similar trends. FW 45% 1 RM produced higher XF force than 2L, 2H, and 8H ($p<0.05$). FW 65 and 85% 1 RM produced XF greater than all RIR conditions ($p<0.05$). XV for 45% 1 RM was lower than 2H and higher than 8L. XV for 65 and 85% 1 RM was lower than 2H, 2L, and 8H. XP was equal across all VC conditions ($p>0.05$).

CONCLUSIONS:
This RIR device does not produce as much force during lower body exercise as traditional free weights but does appear to produce velocity and power outcomes similar to traditional free weight exercise at relatively light loads.

PRACTICAL APPLICATIONS:
This RIR device appears may provide adequate loading for typical assistance and rotational resistance exercises that do not require high levels of loading. Although power output remains consistent, a large variation in force and velocity outcomes existed across the various RIR device settings. This project was sponsored in part by Heart Rate Inc.