Reliability and Validity of Using TENDO Fitrodyne Sports Powerlyzer and TENDO Weightlifting Analyzer for Measurement During Weight Training.

Introduction

Resistance training programs have involved the monitoring of weight lifted. The maximal power performance, the velocity of movement and power output are important factors which influence the resulting training adaptations. (Kreamer, Hakkinen, Hamar) Therefore, the measurement of velocity and power of the load moved during resistance training would provide further valuable information for strength and conditioning coaches and athletes.

TENDO Fitrodyne Sports Powerlyzer and TENDO Weightlifting Analyzer are microcomputers systems for measurement of power and velocity. Each system consist of 2 functional components, a velocity sensor unit and a microcomputer. The velocity sensor unit consists of an optical sensor with light source with slotted disk for displacement and time measurement and DC motor for movement orientation. As the disk rotates, electrical pulses are generated with each pulse corresponding to a given angular displacement. Slotted disk is attached to a pulley with cable for linear displacement measurement.
Velocity sensor unit is connected to the lifting weight by means of cable with velcro strap.

In weight exercise, the muscles lift a mass m by applying a force F (equal to m . g …g-gravity acceleration) at velocity v producing power (equal to F .v).
The system measures upward vertical average velocity of the weight lifted. Using known mass, the system calculates average power in concentric phase of weight exercise.

The purpose of this study was to determine the reliability and precision of velocity sensor unit for measurement of average velocity.

Methods

Lat pull down machine with weight stack was using to test velocity sensor units (VSU). The machine allows vertical movement of the weight, only. Also metal stops for adjustment of upper displacement limit was used.
The TENDO Speed timer device was used for measurement of time for moving weight.
Contact mat of timer device was positioned under central rod of weight stack system and photo cell was positioned on metal stop.
When the weight starts to move, timer device starts to measure the time. Timer device stops to measure the time if the weight reaches set distance and stops the movement by hit the metal stops.

Testing Procedure

During the experiment, the weight was moved up and down manually through a set of distance. Steel stoppers attached above weight stack ensured that the distance traveled was limited to the measured distance 0.895 meters.

The distance between lower position of the weight and the stopper was measured using a steel tape measure. During each repetition the time was measured for set distance. Two trials of 10 repetitions were completed.
From measured time and known distance were calculated average velocity and compared to microcomputer measurements.

Results

Time and calculated velocity from trials are presented in Table 1.

Trial 1

Repetition Number	Measured Time (second)	Calculated Velocity (m/s)	Measured Velocity Fitrodyne	Error (%)	Measured Velocity TWA	Error (%)
1	1.10	0.81	0.82 m/s	1.23%	0.80 m/s	-1.23%
2	0.81	1.10	1.10 m/s	0	1.09 m/s	-0.90%
3	0.92	0.97	0.98 m/s	1.03%	0.96 m/s	-1.03%
4	0.80	1.11	1.10 m/s	-0.90%	1.11 m/s	0.00%
5	0.89	1.00	1.02m/s	2.00%	1.00 m/s	0.00%
6	0.87	1.02	1.02 m/s	0	1.01 m/s	-0.98%
7	0.76	1.17	1.16 m/s	-0.85%	1.14 m/s	-2.56%
8	0.87	1.02	1.06 m/s	3.92%	1.01 m/s	-0.98%
9	0.68	1.31	1.30 m/s	-0.76%	1.31 m/s	0.00%
10	0.88	1.01	1.02 m/s	0.99%	1.02 m/s	0.99%

Trial 2

Repetition Number	Measured Time (second)	Calculated Velocity (m/s)	Measured Velocity Fitrodyne	Error (%)	Measured Velocity TWA	Error (%)
1	0.97	0.92	0.92	0	0.91	-1.08%
2	0.81	1.10	1.10	0	1.08	-1.81%
3	1.14	0.78	0.80	2.56%	0.79	1.28%
4	0.86	1.04	1.02	-1.92%	1.04	0.00%
5	0.88	1.01	1.02	0.99%	1.00	-0.99%
6	0.88	1.01	1.04	2.97%	1.00	-0.99%
7	0.89	1.00	1.02	2.00%	1.00	0.00%
8	1.15	0.77	0.78	1.29%	0.78	1.29%
9	0.91	0.98	1.00	2.04%	0.98	0
10	0.89	1.00	1.02	2.00%	1.02	2.00%

Fitrodyne…….TENDO Fitrodyne Sports Powerlyzer
TWA……TENDO Weightlifting Analyzer
Calculated Velocity……..v = distance / time

TENDO Fitrodyne and TENDO Weightlifting Analyzer as used in this study are training pieces of equipment to give coaches and athletes instant feedback on power and velocity while weight training. The data produced from such a system enhance effectiveness of weight training.
The results of this study showed, that both microcomputer systems work with an error less then 3%, which is sufficient precision for training equipment. The exercise error is much higher, especially for free weight exercises, where it is difficult to keep identical trajectory of the cable or movement for each repetition, while doing the exercise set.