RELEVANCE OF ACCELERATION AND GRAVITY POWER PROFILING FOR TRAINING PRESCRIPTION

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INTRODUCTION

Determining the load-power relationship for given resistance exercises could be useful for quantifying performance changes after training and to identify the training load to maximize power output. It is has been recommended that to improve power, athletes should use this load that maximizes power output. However, it has been recently demonstrated that for some exercises, the power profile was relatively similar across a wide range of loads. As a consequence, near maximal power output could be produced at very different loads (1, 2). However, performing a squat at 20% or 80% of the 1RM, despite producing the same power output, results in very different neuromuscular activity and according to training specificity theory, working with 20% or 80% 1RM loads will result in differential training objectives as well as neuromuscular adaptations.

Recently, Quievre et al. (3) have suggested splitting total power output into two components: one linked to the force of gravity (gravity power, P_g) and one linked to the system mass resulting acceleration (acceleration power, P_a). It may be that differentiating total power output into these P_a and P_g and noting their effects, results in a different interpretation of the load-power relationship and therefore the loading and adaptational effects to muscle. We have hypothesised that profiling P_a-load and P_g-load relationships could inform programme design to better effect as to the loads to use for specific power training objectives.

METHODS

Fifteen healthy subjects (22±3yr, 1.76±0.12m, 72±13kg) participated in this study and were tested following the same modalities. A concentric bench press (BP) exercise was performed with a standardized position on a Smith machine. Subjects were tested at four increasing loads: 35, 50, 70 and 95% of the 1RM. Number of trials and recovery was adapted to the load. Subjects were instructed to lift the barbell as fast as possible.

The inertial dynamometer used in this study combined a linear position transducer and an accelerometer in order to record barbell's vertical movement. A specific Labview programme was designed in order to measure different mechanical parameters during the movement. Total power (P) acceleration power (P_a) and gravity power (P_g) were used in the present study and were calculated according to following equations:

$$P = (ma+mg)V = mav + mgv = P_a + P_g$$

$$P_a = mav$$

$$P_g = mgv$$

For descriptive data, ordinary statistical methods were employed, including means (x) and standard deviation (SD). A paired t-test was used to determine significant ($p<0.05$) differences between relative charges.

RESULTS

Figure 1 shows that the three different types of power outputs presented very different profiles. P as well as P_a significantly decreased from 35 to 95% of 1RM, but not in the same way: the reduction in power increased with load for P while it was almost constant for P_a. P_g significantly increased from 35 to 50% and decreased from 70 to 95% of 1RM. There was no significant difference between 50 and 70% of the 1RM. It can be observed from the curves (see Figure 2) that P_a has a substantial influence on P at 35% of the 1RM but not at 95% where P is almost totally influenced by P_g.

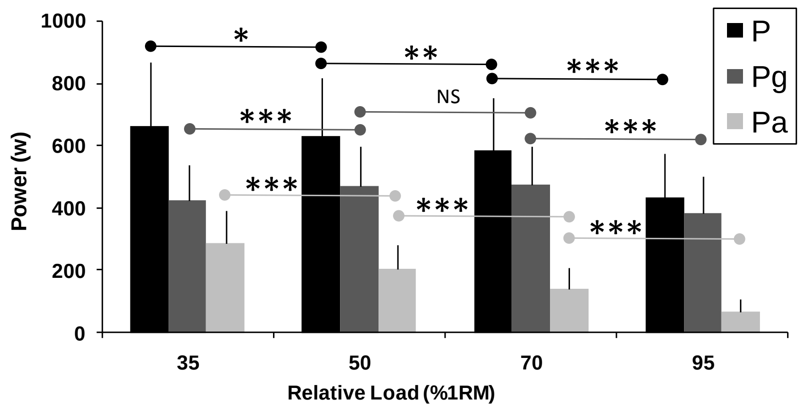

Fig.1 Means and standard deviations of each power (P, P_g, P_a) accordingly to the load. Significant differences between loads are represented by *(p<0.05), ** (p<0.01) and *** (p<0.001).

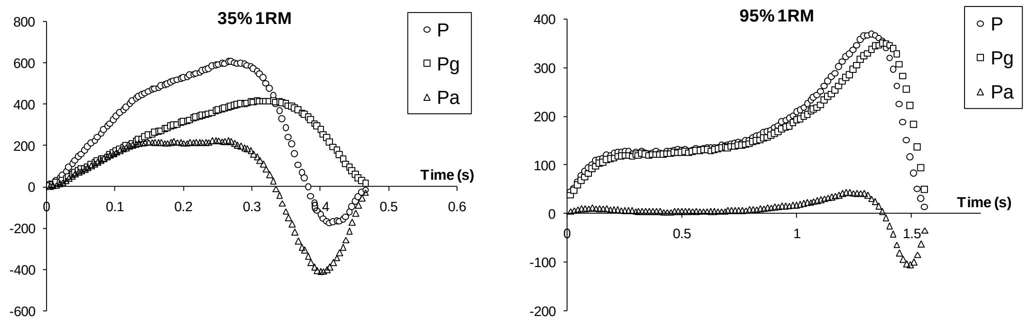

Fig.2 Curve analysis representing the evolution of the three types of power output (P, P_g, P_a) during 35 end 95% 1RM loading

DISCUSSION

The results indicate that P, P_a and P_g are not affected in the same way when load was increased, confirming the previous study of Quievre et al (3). These findings question the value of traditional power-load profiling and the use of these profiles in training load selection. Researchers have highlighted that in the squat jump and power clean, P presented little change over a wide range of loads (1,2). According to Harris et al (2), in these specific cases, profiling the P-load relationship may not be that important. With the introduction of P_a and P_g concept, it appears that using a light or heavy load should result in different training outcomes. For coaches, profiling P_a-load and P_g-load relationships could be more relevant than the classical P-load relationship in order to determine which amount of load they have to use in their power training programme. Obviously, load selection should depend on sport characteristics and the relative importance of P_a and P_g during decisive actions.

CONCLUSION

The introduction of the P_a and P_g concept should lead to new considerations regarding power output and the load to be selected to maximize muscle performance.

REFERENCES

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