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 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. [4] 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.

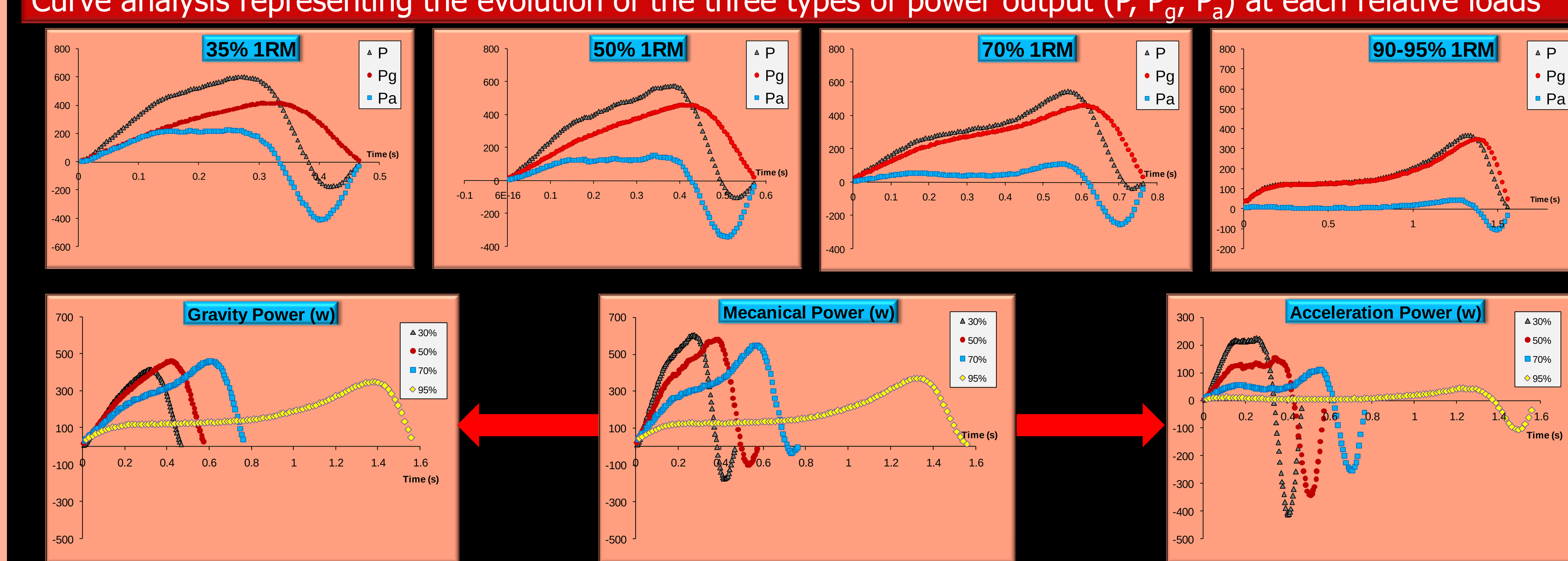
Méthodes

- 15 healthy males : 22±3yr, 1.76±0.12m, 72±13kg
- Concentric Bench Press exercise
- Inertial dynamometer [3]
  - Linear PositionTransducer
  - Accelerometer
  - Labview software
- Direct measurements and constants
  - Displacement (x),
  - Acceleration (a),
  - Gravity acceleration (g)
  - Time (t),
  - Mass (m)
- Calculated measurements
  - Velocity ($v = dx/dt$)
  - Net Force ($F_N = ma+mg$)
  - Mecanical power ($P_M = F_N V$)
- Acceleration and Gravity power concept
  - $P = (ma+mg)V = mav + mgv = P_a + P_g$
  - Acceleration power = P_a = mav
  - Gravity power = P_g = mgv

Load	Trials	Rest
35%	4	1’
50 %	3	1’
70 %	2	2’
90-95 %	2	3’

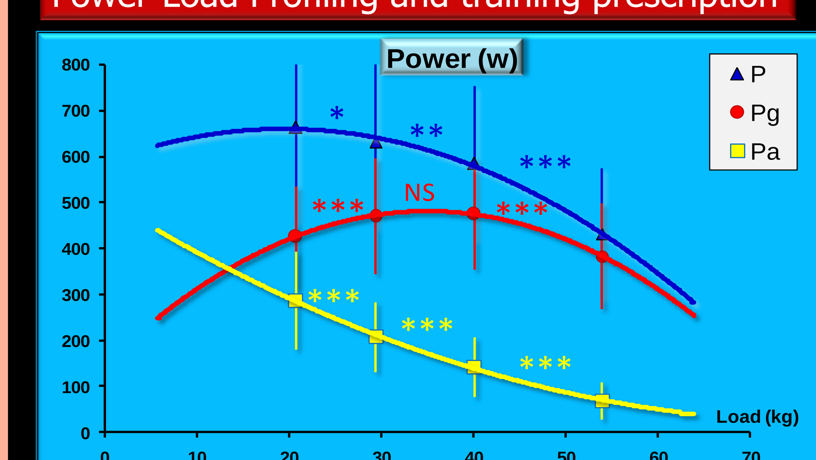
Results

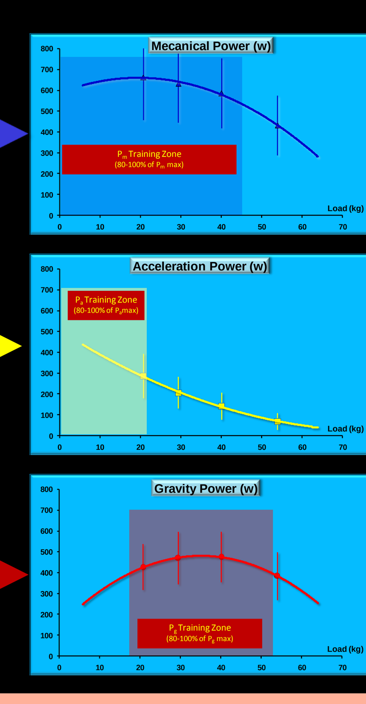
Curve analysis representing the evolution of the three types of power output (P, P_g, P_a) at each relative loads



The three different types of power outputs presented very different profiles revealed by curves analysis as well as by the power-load relationship. 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 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.

Power-Load Profiling and training prescription





Power training according to P-Load relationship => 0 to 45 kg

Power training according to P_a-Load relationship => 0 to 20 kg

Power training according to P_g-Load relationship => 17 to 54 kg

Discussion & Conclusions

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 [4]. 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.

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.

[1] Cormie et al., *J Strength Cond Res* **21,** 1042-1049, 2007. [2] Harris et al., *J Strength Con Res* **21,** 1260-1264, 2007. [3] Jidovtseff et al. *Isok Ex Sci* **14,** 53-62, 2006. [3] Quievre et al., *Comp Meth Biomech Biomed Eng* **S1**, 109-110, 2010.

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icst2010
28th - 30th October 2010, Bratislava, Slovakia