FORCE VELOCITY PROFILING

Informing the Prescription Process

Sam Portland - 5 March 2017
Introduction

Assessing maximal power output is common practice within human exercise performance (Smozino et-al 2008). Vertical Jumping has been found to be one of the most explosive assessments of lower limb power (Rahmani et-al, 2000). This is justified by vertical jumping being a simple, short in duration and extremely high intensity exercise (Smozino et-al 2008). Early research from Davies and Young (1984) confirmed that vertical jumping has a positive correlation to peak power output. It has been heavily established within the literature that the production of high mechanical power output across jumps is an essential performance determinant (Morin & Samzino, 2016). Subsequently to this it has been established that within sport athletes are required to express this mechanical power across a range of velocities (Kawamori, N and Haff, 2004). The work of Hill (1938) and later Thortensson and colleagues (1976) catalyzed current research in conducting work on force-velocity characteristics of isolated muscles assessing ‘explosiveness’. Through the evolution of sport science practitioners have aspired to be able to improve jump height through specific training (Newton et al.,2006). The specific direction of research regarding this point has now moved into the area of an optimal force-velocity (F-v) profile with the bulk of work being produced by the Samzino Group.

Samozino and colleagues (2012) established that whilst jumping is largely determined by maximal power output ($P_{max}$) it is also influenced by the individuals’ mechanical outputs of force and velocity, known as a F-v profile. F-v profiling is the measurement of the mechanical
capabilities of the neuromuscular system and is described as the parabolic relationship between power-velocity (de Lacey et al., 2014). F-v profiling has been developed to provide a higher level of accuracy to the training prescription process and been confirmed theoretically (Samozino et al, 2008) and practically (Samozino et al, 2014).

F-v profiles are conducted on force plates to obtain a more informative level of analysis of the stretch shortening cycle when compared to contact mats (Floría et al., 2016). Having this deeper level of analysis can increase the understanding of the qualities that contribute to performance (Hori et al., 2009). From this deeper analysis a practitioner can establish how an athlete produces ‘explosiveness’ (Samozino et al., 2013). This is expressed as a deficit and can interpreted relative to a spectrum as athletes will have a dominance towards one area either force or velocity (Jimenez-Reyes, 2017). From this process of analysis specific training programming can be implemented to improve the athletes’ performance (Floria et al., 2016, Samozino et al, 2012, Jiménez-Reyes et al, 2017).

To conduct an effective F-v profile, you need to include body mass, lower limb length in a fully extended position, starting height, and jumping height (Samozino et al, 2008). Morin & Samozino (2016) suggest that jump height should be measured with at least five additional loads ranging from 0 kgs to a load that decelerates an athlete to jump 10cm off the ground when performed maximally. From this you are able to establish a spectrum of F-v outputs relative to the load applied to the athlete (Samozino et al, 2008). After establishing this data this can then be plotted against an optimal F-v profile and specific training implemented (Samozino et al., 2012).

Samozino et al, (2013) provided further confirmation that ballistic performance is highly dependent on \( P_{\text{max}} \) and the F-v relationship. Subsequently a pilot study conducted by Broussal-Derval (2016) demonstrated the significance of force velocity relationships as F-v profiles differed between level of completion (young elite vs professional) in volleyball. This study highlighted the significant need for individualized training loads based on F-v profiling. The recent work of Jimenez-Reyes and colleagues (2017) have illustrated the effects of specific training derived from F-v profiling and its effect on ballistic performance. Splitting the 84 subjects in to four training groups (Force Deficit, Velocity Deficit, well balanced and Non optimized) individual training loads were prescribed. This study found that optimized individualized training load based on F-v
profiling beneficially increased jump height and created a reduction in the force-velocity imbalance. This study being the most recent in the literature provided a vehicle to confirm to the previous work of the Samozino group and the benefits of optimizing training through specific training loads derived from F-v profiling.

References:


Pablo Floría1, Luis A. Gómez-Landero1, Luis Suárez-Arrones1 and Andrew J. Harrison2 (2016). Kinetic and kinematic analysis for assessing the differences in counter movement jump performance in Rugby players. Journal of Strength and Conditioning Research Publish Ahead of Print


