Which Hip Extension Exercises Reflect the Specific Nature of Sprint Performance?

Conor Wilson, Dr. Ciarán Ó Catháin, Dr. David Kelly
Department of Sport & Health Science, Athlone Institute of Technology

Introduction:
Sprinting is a performance determining factor across a wide range of sports, (Barr et al., 2014; Kratrup et al., 2005; Biszczewich & Jenkins, 1998). There are a number of factors that can influence sprinting such as; training, biomechanics, technique, physiology, nutrition, genetics and climate (Kennedy et al., 2017; Girard et al., 2015; Eynon et al., 2013; Tipton et al., 2007; Lee, 2005). Although the latter two cannot be changed or controlled, through training the others can.

The training an athlete does should be specific to the event they are training for to yield the best results (Reilly et al., 2009). Resistance training is a way of improving muscular power (Young, 2006). By using resistance exercises that have similar kinetics and kinematics to sprinting the transfer of power from training to performance would be optimised. Given the importance of hip extension in the action of sprinting (Belli et al., 2002), hip extension exercises should produce the best results for performance improvement.

Background:
Training specificity is key to performance. Dynamic correspondence states a number of aspects be considered when selecting resistance exercises to improve transfer from gym to field performance. These include, movement similarity, accentuated region of force production, rate and time of maximum force production and regime of muscular work (Siff & Verkhoshansky, 1999). So, although a resistance exercise such as weighted sled runs might have similar movement patterns to sprinting it may not have the best transfer over to sprint performance. Therefore it’s necessary to consider other aspects when choosing exercises for a sprinting programme.

Sprint performance is largely determined by the muscular strength of the lower body (McBride et al., 2009), specifically an athlete’s ability to generate power through hip extension (Biszczewich & Jenkins, 1998b). The muscles about the hip, particularly hip extensors are the prime muscles generating power causing forward momentum, with ≥60% of net power provided by the hip extensors at max velocity (Belli et al., 2002).

There are many different resistance exercises that can improve power. However, not all have the best transfer over from training to performance. Each exercise has differing characteristics that make them unique. Given the many differences between all of the exercises it is necessary to analyse them and attempt to explain their biomechanical features.

Aims:
1. Examine kinetics & kinematics of resistance exercises
2. Identify levels of specificity for sprinting

Hypothesis:
1. Not all hip extension exercises display similar kinetics & kinematics
2. Different exercises reflect different aspects of sprinting

Methodology:
20 resistance trained male sprinters (age = 22.6 ± 3.2 yrs, height = 177.97 ± 7.1 cm, weight = 74.44 ± 50.1 kg) were recruited for the study. Participants were sprinters free from injury ranging from 100m to 400m (including hurdles) in discipline with a minimum of 18 months resistance training experience. Convenience sampling was used in order to obtain participants.

Testing consisted of 3 countermovement jumps (CMJ) and 3 double leg drop jumps (DLDJ) followed by 3 sets of 5 reps of each of the five exercises. The 45° back extension was a new exercise to be collected. 28 reflective markers were attached on one occasion for kinetic and kinematic information on the exercises.

Participants visited the Biomechanics Lab in Dublin City University on one occasion for kinetic and kinematic information on the exercises to be collected. 28 reflective markers were attached using double sided tape to specific landmarks on the body. This allowed for a 3D model to be made of the participant (Figure 2). A Vicon Motion Capture System was used to collect the data. This comprised of 17 ME high speed infra-red cameras coupled with an AMTI force plate.

Testing consisted of 3 countermovement jumps (CMJ) and 3 double leg drop jumps (DLDJ) followed by 3 sets of 5 reps of each of the five resistance exercises.

Discussion:
Research suggests that peak power is seen between 70-85% of 1RM (Fleck & Kraemer, 2014). The results of this study will provide key data and findings comparing resistance exercises that accurately reflect the kinetic and kinematic characteristics associated with sprinting.

Based on points of specificity exercises will match up with the sprint phases.

Specificity Points:
- Region of accentuated force production
- Rate and time of max force
- Muscle length at max force

From this study exercises may be categorised to match the phases of sprinting allowing for a greater transference of power from training → performance.

Results:
Currently in the process of data analysis. Descriptive statistics will be run to explore relationships between variables and exercises. Early results indicate that there is differences in kinetics and kinematics between the exercises. This may have implications for their transfer over to sprint performance. However these are just preliminary quick report findings (see Figure 4).