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

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Introduction:

Sprinting is a performance determining factor across a wide range of sports, (Barr et al, 2014; Krustrup et al, 2005; Blazevich & 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 must 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 athletes' ability to generate power through hip extension (Blazevich & 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.

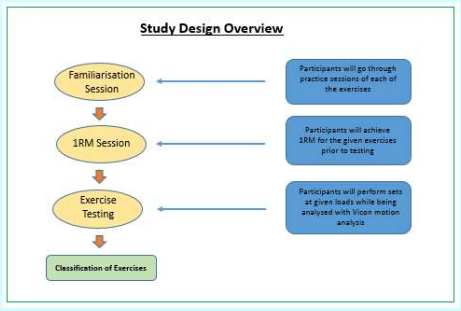

Figure 1. Overview of Study Design

Exercises

Exercises were selected on the basis that the movement included hip extension. Included exercises; squat, Romanian deadlift (RDL), hip thrust, 45° back extension and good morning.

Testing

One repetition maximum (1RM) testing was carried out over two days with an interval of 24-48 hours. The purpose of this was to achieve a true 1RM for four of the five exercises (squat, RDL, hip thrust and good morning). The 45° back extension was a new exercise to the majority of the participants and given its unique nature a 5RM was used instead. Protocol for the 1RM was taken from Haff & Triplett (2016) *Essentials of Strength and Conditioning*, NSCA as well as Earle, (2006).

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. The system comprises 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.

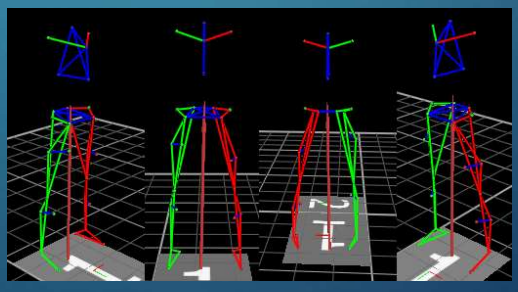

Figure 2. 3D Biomechanical Model

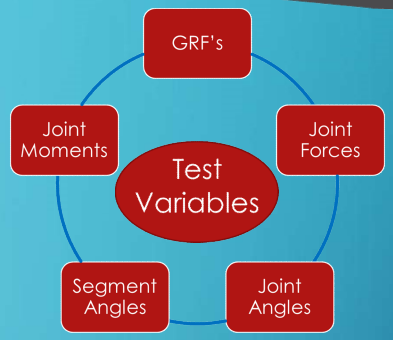

Figure 3. Variables being examined in the study.

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).

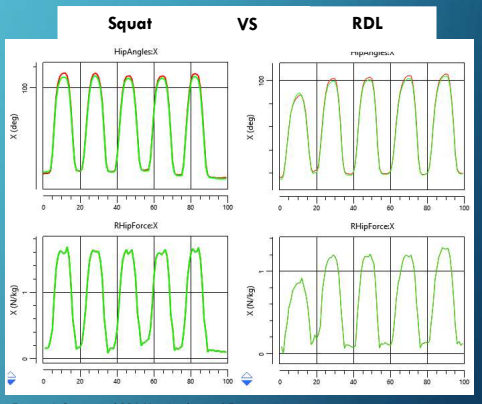

Figure 4. Squat and RDL Hip Angles and Forces

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

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